Five Year Strategic Research Plan
2001-2006

Prepared by AFMA in conjunction with the Southern Squid Jig Fishery Fisheries Assessment Group
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Introduction

The Australian Fisheries Management Authority’s (AFMA’s) partnership approach to research involves close consultation with managers, fishers, researchers and others. This approach provides opportunities for stakeholders to have input into the research priority-setting process through the Management Advisory Committees (MACs) and FAGs? The AFMA Board establishes MACs for each major AFMA managed fishery and often rely on advice from its Fishery Assessment Group (FAG) to identify the key research needs for the Fishery. The FAG prepares annual five-year rolling research plans in addition to providing information required to improve the confidence in stock assessments.

The Southern Squid Jig Fishery Five Year Strategic Research Plan has been compiled by the Southern Squid Jig Fishery Assessment Group (SquidFAG), which consists of the Fishery manager, industry members and scientific members. The Plan has been ratified by the Southern Squid Jig Management Advisory Committee (SquidMAC).

The Plan has been developed within a five-year framework, identifies issues currently facing the industry and outlines approaches to address these issues. However, the Plan is regularly reviewed by the SquidFAG, and may be amended from time to time as issues currently facing the Fishery are addressed or as new ones arise.

Objectives of the Five Year Strategic Research Plan

The main objective of the Plan is to provide a comprehensive guide to current and future research needs for the Fishery. The Plan outlines those areas of research currently seen as most relevant to industry, although research in other areas may be funded if its relevance to industry can be clearly demonstrated.

It is intended that the SquidMAC will use this document in its consideration of future research projects and that AFMA will consider this Plan when developing its corporate 5 year research plan. The Plan also establishes processes by which research agencies can put forward submissions for funding for research projects which address the identified research priorities.
This Plan was developed to effectively target the research relevant to the Southern Squid Jig Fishery (SSJF). The Plan's objectives are:

- identifying the major issues likely to affect the management of the Fishery now or within the next 5 years
- developing a research program to provide management with the information to overcome these issues
- prioritising the different research projects

SquidMAC reviews this Strategic Plan and the priority list annually to ensure that research undertaken in the Fishery is relevant to the sustainable management of squid. This process ensures that research for the SSJF is focused on key issues relating to stock assessment, principally aimed at reducing uncertainties in understanding squid stocks, the management of squid and ecologically related species. These priorities were established in line with AFMA's corporate objectives.

**Background**

**Squid stock structure and life history**

In southern Australian waters the main squid species of commercial value is the arrow squid (*Nototodarus gouldi*), also known as Gould's, flying or torpedo squid. Other squid of commercial potential in the area are the inshore Southern Calamari (*Sepioteuthis australis*), the Offshore Red Ocean Squid (*Ommastrephes bartrami*) and the Southern Ocean Arrow Squid (*Todarodes filippovae*).

Arrow squid are distributed throughout southern Australian waters as well as the northern waters of New Zealand (Kailoia *et al.* 1993). To date there has been very little research into the squid stocks of the Southern Squid Jig Fishery. Little is known about the biology and life cycle of arrow squid although some research was undertaken in conjunction with feasibility fishing by foreign vessels in the 1970s and 1980s. Arrow squid are known to spawn throughout their Australian distribution (Dunning 1988 and Machida 1983). In southeastern Australian waters, spawning occurs in all months, although studies indicate that there may be 2 or 3 peaks in spawning activity. It is thought that squid die shortly after spawning (Winstanley *et al.* 1983).

Arrow squid are relatively short-lived, probably reaching a maximum age of around only 12 months (Winstanley *et al.* 19983 and Molloy 1988). They are fast growing animals with growth rates being estimated by Statolith ageing analysis at up to 4 cm per month in southeastern Australia. Females grow faster than males and can reach a mantle length of 40 cm while males grow to about 35 cm (Winstanley *et al.* 1983). They are also strong and powerful swimmers. Limited tagging studies of arrow squid in Bass Strait showed that their movement may be quite substantial, however no significant migratory pattern has been revealed so far.
Arrow squid are schooling animals that tend to aggregate near the seabed during the day and disperse throughout the water column at night to feed. They are voracious feeders and will often aggregate near the thermocline or migrate to the surface to feed. They eat pelagic crustaceans, fish and other squid. Catch rates usually decrease at the surface during the full moon period. In southeastern Australian waters arrow squid are eaten by a number of fish species including school, gummy and whiskery sharks, tunas and John Dory, as well as whales, seals and birds. (O’Sullivan and Cullen, 1983 and Winstanley et al., 1983 in Kailola et al., 1993)

The importance of squid in the food chain was queried following exploratory squid fishing to assess the feasibility of an arrow squid fishery that was undertaken off southeastern Australia in the 1980s. At the time, Victorian fishers raised concerns that increased squid jigging resulting from the establishment of squid fishery might lead to the depletion of commercial fish stocks which depend on squid for food. In response to these concerns, a study of the diets of 52 commercial fish species from Bass Strait and adjacent Victorian waters was undertaken by Coleman and Hobday between August 1980 and December 1981. The study concluded that, although arrow squid was identified in the diets of several species, in no cases was there evidence that it consistently formed a major part of the diet. It was concluded that fears that increased squid jigging would deplete fish stocks through the removal of an essential food source had little basis.

In Australian waters, arrow squid are wide ranging in distribution and are found in waters with sea surface temperatures from 11°C to 22°C, from Western Australia to southern Queensland (Dunning 1988). Figure 1 illustrates the sea surface temperatures in which squid were taken over the past three seasons. The most productive temperatures ranged between 12 and 18°C, with the best catches at 17°C. Sea surface temperatures greater than 18°C were unproductive, with a dramatic decline in catch when water temperature rose from 17°C to 18°C. Although its distribution varies, arrow squid are most abundant over the continental shelf from 50m to 200m. However, commercial quantities on any scale have only been identified in Bass Strait and off western Victoria.

Figure 1: Arrow squid catch in the Southern Jig Fishery by sea surface temperature
Little is known about the stock structure of arrow squid although a limited genetic study undertaken in the early 1980s was unable to distinguish differences in stock structure between samples collected in Bass Strait and off South Australia and south-eastern Tasmania. It is anticipated that current research by Dr George Jackson of the University of Tasmania will shed light on the understanding of squid stock structure.

**Stock status**

The stock status is uncertain in western Bass Strait and probably underfished in other areas.

Prior to 1972, annual arrow squid landings totalled less than 100 t and were taken mainly as byproduct of demersal trawling and trolling off south-eastern Australia. In December 1972, large numbers of arrow squid were found in the Derwent estuary near Hobart during squid jigging trials and up to 30 domestic commercial vessels fished the schools over the following two months using improvised fishing gear. A total of 154 t were caught during this period. Feasibility studies were conducted in Tasmanian waters in 1972-73 and off Victoria in 1973-74 but with no subsequent development of the jig fishery.
In the late 1970s, resource surveys of arrow squid stocks in Bass Strait and Tasmanian waters were carried out by the Japan Marine Resources Research vessel. In 1980-81 this vessel also fished off South Australia, Victoria and southern Queensland. Feasibility fishing was also conducted in south-eastern waters by Japanese commercial squid jig vessels in the 1978-79 and 1979-80 seasons. In 1978-79, 19 vessels caught 3387 t and in 1979-80, 64 vessels caught 7914 t. Taiwanese and Korean vessels subsequently fished Bass Strait waters each season from 1983-84 to 1987-88, with annual catches ranging from a low of 13 to a high of 2309 t. Vessels frequently left Bass Strait to fish the waters off New Zealand. The most productive domestic waters fished during this period of foreign fishing were off northern Tasmania and in western Bass Strait.

Due to the nature of the Fishery and the unique biology of the squid, traditional stock assessment methods used for assessing fish stocks is unlikely to determine the status of squid stocks. The current level of knowledge of the arrow squid in the SSJF has hindered the production of a stock assessment and as yet no reliable, quantitative stock assessment has been produced. Significant uncertainty exists in the understanding of the population biology, age structure and recruitment relationships of the arrow squid. As such, reliable estimates of potential stock production and sustainable yields have not been able to be produced. Within the next five years, any assessment of the size and extent, geographically or seasonally, of the exploitable resource of squid in any region would only be preliminary.

**The Fishery**

Renewed domestic interest in the SSJF saw the start of the domestic squid jig fishery for arrow squid in the 1986-87 fishing season with a single vessel and has developed into a fishery of up to 41 active vessels in recent years. There is still the possibility of further development in the Fishery as 84 Commonwealth Southern Squid Jig entitlements exist. Many of the squid jiggers also hold Fishing Permits for other fisheries such as Southern Shark and Bass Strait Central Zone Scallop fisheries, in which they work outside the peak squid jigging season or when economic returns dictate.

The catch by domestic jig and trawl vessels (see Figure 2) is chilled on board and returned to port for processing and freezing within 24 hours of landing. Most of the Australian catch of arrow squid is sold on the domestic market through the Sydney Fish Market, the Melbourne Wholesale Fish Market or directly to processors. Despite this, the majority of the squid consumed in Australia is imported, with approximately 5000 tonnes of squid products being imported annually at a cost of around $17 million.
Management of the Fishery

To date, management arrangements for fishing of squid in Commonwealth waters have focused on the jigging sector, with trawl catches falling under existing but separate management arrangements for the South East Trawl and Great Australian Bight Trawl Fisheries.

Although no foreign squid jigging vessels have sought to operate in the squid Fishery since foreign fishing ceased in 1988, the Commonwealth is obliged, under the United Nations Convention on the Law of the Sea, to give foreign fishers access to resources which are not being fully utilised by Australia. Although knowledge about the Squid Fishery is limited, the present scientific opinion is that the squid resource is probably not fully utilised by domestic jiggers and trawlers. However, the capacity of the existing domestic fleet that has access to the Fishery is far larger than current catch levels would indicate.

Operators in the SSJF must hold a Fishing Permit authorising the taking of squid by the jigging method. Fishing Permits are currently granted for one year only but may be regranted upon application. Under the current arrangements, access to the squid jig Fishery is limited to the existing 84 permit holders. This acknowledges the fact that the Fishery has been established for some time, if only on a seasonal basis, and that there are already substantial numbers of operators (including a large latent effort component) permitted to take squid in Commonwealth waters. Despite this, it is recognised that parts of the Fishery may not be fully utilised and that there may be scope for further development in these areas.
Operators taking squid by trawling (usually as byproduct only) must hold a Fishing Concession authorising the use of trawl gear in the area in which they are operating. Squid is a non-quota species in the South East Trawl Fishery and, as such, are not subject to a total allowable catch or individual transferable quotas. There are no specific Permit conditions relating to this species on demersal trawl Permits in the South East Trawl Fishery and Great Australian Bight Trawl Fishery. The only restriction on access is that there is an upper limit on the number of boats in the South East Trawl Fishery (118) and in the Great Australian Bight Trawl Fishery (10), and no additional entitlements will be granted.

Ideally, management arrangements for the Fishery would be underpinned by a robust fishery assessment which establishes stock numbers, age and spatial distribution. Reliable estimates would exist of the potential production of stock, the proportion that can be harvested. This information provides a basis from which to formulate the setting of a reference point/s (target and/or limit) that triggers a management response. Management strategies should also be in place that are capable of controlling the level of take from the Fishery.

The current level of knowledge of the arrow squid in the SSJF has hindered the production of a stock assessment and as yet no reliable, quantitative stock assessment has been produced. Significant uncertainty exists in the understanding of arrow squid population biology, age structure, recruitment and the influence of environmental conditions relationships of the arrow squid. As such, reliable estimates of potential stock production and sustainable yields have not been able to be produced.

Given the above uncertainties controlling the year-to-year squid abundance in the Fishery, it would be unlikely that a reliable, biologically-based annual total allowable catch (TAC) could be determined for the Fishery at this time. The relative low value of the Fishery also constrains the economic viability of conducting pre-season stock assessment surveys, as carried out in other more valuable fisheries.

A Discussion Paper on the Future management arrangements for the Southern Squid Jig Fishery is currently under development. Rather than adopting a TAC for the Fishery, the Discussion Paper promotes management arrangements that comprise an annual catch trigger limit, along with various trigger limits on gear inputs. These triggers are anticipated to act as decision rules, activating reviews of management arrangements for the Fishery which may include the introduction of individual transferable gear units.

**Fishery Specific Objectives**

The management objectives for the Fishery are to:

- control fishing effort to a level which is consistent with the current state of knowledge of the stock
collect further scientific data so that management decisions can be based on a sound understanding of the biological and operational characteristics of the Fishery

- minimise the adverse impact of the Fishery on the marine environment

- facilitate participants to maximise their return from harvesting the resource by removing unnecessary restrictions on their fishing activities.

**Management Strategies**

The management strategies that are currently adopted for the Fishery are:

- develop and implement appropriate ecologically sustainable management arrangements for the Fishery

- collect accurate and up-to-date data for analysis and stock assessment

- review research priorities in accordance with the Five Year Strategic Research Plan.

- investigate measures to provide operators with flexibility to marry fishing activities with management arrangements.

**Government environmental initiatives**

Two significant Commonwealth Government initiatives have impacted on research requirements in the Fishery:

- The *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act) came into effect on 16 July 2000. This Act requires that a plan of management for a fishery must be accredited under the EPBC Act, having undergone an environmental impact assessment before it can be determined under the *Fisheries Management Act 1991*;

- In June 2000, the Minister for Environment and Heritage and the Minister for Agriculture, Fisheries and Forestry jointly released a comprehensive policy to reduce bycatch in Commonwealth fisheries. The Bycatch Action Plan for the SSJF took effect on 31 March 2001.
Issues likely to affect the management of the Fishery

Target species

Much of the current understanding of squid stocks has been based upon commercial fishing catch data. A real need exists to supplement commercial catch data with fishery independent data to feed into all aspects of research on the squid biology and stock research.

There is currently insufficient biological information for an estimation of biomass or determining a sustainable yield for arrow squid in Australian waters. Given the limited extent of research undertaken on the resource and the highly variable nature of squid stocks, there is a need for more detailed information on a number of aspects of squid biology necessary for the development of management strategies for the Fishery, namely:

- reproductivity, mortality and productivity
  
  The maximum age of arrow squid is thought to be 12 months old with the squid dying soon after spawning. Very little is known of the early life history of arrow squid and other squids from the same family. Egg masses are released but whether the masses are attached to the seabed or are released into open water has not been determined.

- recruitment biology
  
  A greater understanding of the early life history stages of squid is required in order to identify spawning grounds. An analysis of historical plankton samples used in fisheries and related research may provide insight into the spatial and temporal distribution of young squid. Ongoing sampling of early life stage squid in the Fishery using specific methods targeted at squid such as light traps would also be of benefit.

- stock structure
  
  Significant uncertainties exist over the stock structure of the Fishery. Data collected from Bass Strait has indicated that there may be more than one group or 'brood' of squid in the population. Little is known of the genetic differences within the stock, the extent of migration by the stock(s) in southeastern waters and seasonal patterns in schooling behaviour.

  Although limited tagging studies have been conducted, little is known of migration, aggregation and schooling behaviour of squid.

- environmental factors effecting stock size of squid
Environmental variability is likely to affect distribution, reproductive success, growth, mortality and catchability in the short and medium term.

- **Spatial distribution of squid abundance**

  Only a small area of the Commonwealth Squid Jig Fishery is currently fished for squid. Established fishing grounds in Bass Strait are often subject to high, localised effort. The Fishery would benefit from effort being spread over a larger area with the discovery of new fishing grounds. Foreign surveys of the late 1970s and early 1980s did spread effort over a large area in a coordinated approach, and produced an annual catch of up to nearly 8000 tonnes. Methods for facilitating a regular spatial squid abundance survey and providing incentives for industry to undertake more exploratory fishing need to be developed.

- **Predator-prey relationships**

  Currently we do not understand the impact that squid might have on their prey species or what all their prey species are. The data resulting from this study will provide food web information that will fill the information gap that now exists on squid predation. Such information allow management to make more informed decisions.

- **Biomass**

  The usual methods of fisheries biomass estimation are not cost effective for the Southern Squid Jig Fishery. However, cost effective, novel methods for biomass estimation may be useful.

**Bycatch, ecosystem and environment**

The major bycatch, ecosystem and environment management issues of concern are described in the Southern Squid Jig Fishery Bycatch Action Plan. Below are research needs arising from the Bycatch Action Plan plus wider issues:

- **assessments of the effectiveness of seal deterrent devices**

  A study on the effectiveness of seal deterrent devices including crackers to find the best practice for deterring seals to prevent bycatch and the impact of these devices on other fauna. The results of this study would be of use to other fisheries that also have interactions with seals.

- **record independent information on the amount and type of bycatch in the SSJF**.

  There are limited independent sources of information available on the amount and type of bycatch in the SSJF. Much of what is known of bycatch is anecdotal or fishery dependent information.
• assessment of blue shark catch in the SSJF by non jigging methods

Although logbook data shows only a very minor bycatch of blue shark, fishers also take blue shark by handline in order to prevent the sharks from tangling the jig lines. The handlining is specifically targeted at the offending sharks and is necessary as the sharks interfered with fishing to such a degree that fishing operations can no longer be carried out.

Research is required to determine a sustainable level of catch of blue shark for the SSJF. An assessment will need to take into account the cumulative impact of blue shark catches across all Commonwealth fisheries.

• Reduction of gear loss from barracouta interaction

Barracouta regularly bite off squid jig lines resulting in significant gear loss, loss of fishing time and additional steaming time. Large quantities of squid may be available at times but the barracouta interaction may make the grounds unfisherable. Research which reduces the impacts of barracouta on squid jigging would be very beneficial to the Fishery.

Management and Economics

To date there has been little economic research undertaken in respect of the SSJF. There are also factors affecting management which require further research:

• Development of appropriate methods for refining trigger points and decision rules for fishery management

The likely use of a catch trigger limit as a management tool acknowledges the need for a catch reference point in the Fishery, while also recognising the uncertainty associated in the setting of any reference point. Other trigger limits on gear inputs may also be introduced. Future triggered responses may include the introduction of transferable gear units. An assessment of how these possible future management arrangements can best refined over time is desirable.

• technology creep

Decision rules are currently being developed for the Fishery and these rules need to account for changes in technology and the effect on gear units. As there is potential for technology creep in the Fishery, an analysis of the impact of technology creep on the management of the Fishery is desirable.

• Assessment of management regimes for other squid jig fisheries

It would be beneficial to review the management regimes of other Squid fisheries such as the Japanese and South African fisheries, and how they have managed the uncertainties associated with similar squid species.
• Economic performance data collection
• Economic efficiency indicators
• The value adding of squid and marketing

Research for the Fishery

Funding sources for squid research

There are a number of major funding sources currently available to support management related research in the SSJF:

• AFMA Research Fund (ARF)

  The ARF is an annual appropriation for funding of Commonwealth Government fisheries research based on the recommendations of the AFMA Research Committee. The appropriation of funds to the ARF is determined annually by the Department of Finance. This funding is for 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 Fisheries Research and Development Corporation (FRDC).

  AFMA has only limited funding to allocate to its research function and uses a rigorous priority-setting process to choose the research programs that can be undertaken with the available resources. AFMA attempts to secure leverage for research projects by entering co-funding arrangements with other, more broadly based research funds.

• Fisheries Research and Development Corporation (FRDC)

  The FRDC funds projects that increase economic and social benefits for the fishing industry and the people of Australia, through planned investment in research and development.

  FRDC receives a total funding up to and equivalent to 1% of the Gross Value of Production (GVP) for any given Fishery for an average of the preceding three years, which is made up of the following contributions:

  • the Commonwealth Government provides unmatched funds at 0.5% of the average GVP
  • State, Territory and Commonwealth fishers and aquaculture operators provide funds at 0.25% of GVP
- the Commonwealth Government matches the contributions by State, Territory and Commonwealth fishers and aquaculture operators by contributing a maximum of 0.25% of GVP

- voluntary levies on industry known as MAC Initiated Research funds (MIRF)

  MIRFs are maintained by AFMA on the advice of SquidMAC for specific squid research. These funds are raised through levies on the holders of fishing concessions.

- AFFA Fisheries Resource Research Fund (FRRF)

  FRRF programs are intended to provide an agreed program of independent assessment of Commonwealth fisheries management performance, and support the development of new and improved policies for the management of Australia’s fisheries. Policy projects will generally be commissioned from Australian Bureau of Agricultural and Resource Economics (ABARE) and Bureau of Rural Sciences (BRS), although other providers may be contracted to undertake projects or provide input to other projects where required.
Current squid research

There has been little research undertaken in the Fishery since the foreign vessel surveys of the 1970s and 1980s. Currently there are two research projects being conducted and are detailed below in Table 1.

Table 1: Current research projects

<table>
<thead>
<tr>
<th>Project title</th>
<th>Cost</th>
<th>Brief description</th>
<th>Research body</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arrow squid in southern Australian waters - supplying management needs through biological investigations’</td>
<td>$239,152 funding by FRDC</td>
<td>Examining arrow squid biology, reproductive biology and genetic population. The aims of the investigation are to determine: age and population dynamics (statolith aging) maturity and reproduction (when, where, how often) genetics – whether there is a single population or a number of discrete stocks? Independent researchers will also record bycatch information while on board squid jigging vessels. This will include on board recording of observations of bycatch over a two and a half-year period. The information will be analysed and form part of the stock assessment process for the Fishery.</td>
<td>Dr George Jackson: University of Tasmania and Belinda McGrath University of Tasmania</td>
</tr>
<tr>
<td>Data collection and analysis of catch information on the Southern Squid Fishery</td>
<td>$25,250 funding by ARF</td>
<td>Examines catch and effort data and looks for correlation between squid catch and oceanographic conditions such as sea surface temperature variability</td>
<td>Dr Ian Knuckey: Marine and Freshwater Research institute (MARFI) and Phil Sahlquist: Bureau of Rural Sciences (BRS)</td>
</tr>
</tbody>
</table>
Research priorities for the Fishery

Setting research priorities: the process

Research agencies are increasingly affected by the adoption of a qualified “cost recovery” policy in fisheries, resulting in diminished research funding provided by Government. The diminished research funding and the implications of Offshore Constitutional Settlement Arrangements impact on where State fisheries agencies direct their research effort. AFMA, SquidMAC and the SquidFAG are not able to direct the research undertaken by these agencies, but they have a responsibility to advertise the research needs of the SSJF. They can influence how and where the research funds of FRDC, FRRF, the ARF and other agencies are used.

The SquidFAG develops an annual set of research priorities for consideration and adoption by the MAC. These priorities are developed based on consideration of:

- this Strategic Research Plan developed from discussions between researchers, industry and management as to issues and gaps in the knowledge for the Fishery
- current research projects and recent research results
- the previous year’s research priorities
- developments in the Fishery

AFMA does not undertake research in-house. Rather, it out sources research through the following process:

- SquidMAC solicits research proposals, in line with its priorities and 5 Year Research Plan, from a range of providers on an annual basis
- the proposals received are initially evaluated and ranked in terms of their cost-effectiveness in filling identified knowledge gaps and contributing to management objectives
- the MAC then submits their high-priority proposals seeking funding from research funds or chooses to fund the work directly through their MIRF
- the AFMA Research Committee (ARC) evaluates the proposals submitted against AFMA’s Strategic Research Plan, and for their need, feasibility, and likelihood of contributing to improved management for the subject fishery
- in its role as Commonwealth Fisheries Research Advisory Board (COMFRAB), the ARC recommends to the FRDC a set of research applications for funding support
In adopting this approach, AFMA is endeavouring to achieve greater awareness of fisheries research issues, as well as acceptance and ownership of the research priority-setting process.

Prioritised research projects

After advice from SquidFAG, the SquidMAC has adopted a set of research priorities for the SSJF (see below).

Table 2: Prioritised research projects

<table>
<thead>
<tr>
<th>Research Projects</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Target species</strong></td>
<td></td>
</tr>
<tr>
<td>• develop biological reference points for squid catch</td>
<td>Med</td>
</tr>
<tr>
<td>• growth, reproductively, mortality and productivity</td>
<td>Ongoing</td>
</tr>
<tr>
<td>• stock structure</td>
<td>Ongoing</td>
</tr>
<tr>
<td>• tagging/telemetry studies to provide information on movement, migration and schooling behaviour.</td>
<td>High</td>
</tr>
<tr>
<td>• biomass estimates</td>
<td>Low</td>
</tr>
<tr>
<td>• developing improved stock assessment techniques</td>
<td>Low</td>
</tr>
<tr>
<td>• produce yearly fishery assessment report</td>
<td>High</td>
</tr>
<tr>
<td>• understanding the effects of environmental variability on squid</td>
<td>Low / med</td>
</tr>
<tr>
<td>• squid predator-prey relationships</td>
<td>Med</td>
</tr>
<tr>
<td>• recruitment biology</td>
<td>High</td>
</tr>
<tr>
<td>• spatial distribution of squid abundance to locate new fishing grounds</td>
<td>High</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Bycatch, ecosystem and environment</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>• assessment of the effectiveness of seal deterrent devices</td>
<td>High</td>
</tr>
<tr>
<td>• assessment of bycatch information</td>
<td>High</td>
</tr>
<tr>
<td>• reduction of gear loss by barracouta interaction</td>
<td>High</td>
</tr>
</tbody>
</table>
- assessment of shark catch in the Fishery | High/ongoing

Management and economics
- assessment of management regimes for other squid fisheries | High
- develop appropriate method for refining trigger points and decision rules for fishery management | Med
- impact of technology creep | Low
- economic data collection programs | Med, ongoing
- develop economic efficiency indicators for the Fishery | Med
# List of acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARC</td>
<td>AFMA Research Committee</td>
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<tr>
<td>ARF</td>
<td>AFMA Research Fund</td>
</tr>
<tr>
<td>ABARE</td>
<td>Australian Bureau of Resource Economics</td>
</tr>
<tr>
<td>AFMA</td>
<td>Australian Fisheries Management Authority</td>
</tr>
<tr>
<td>BSCZSF</td>
<td>Bass Strait Central Zone Scallop Fishery</td>
</tr>
<tr>
<td>BRS</td>
<td>Bureau of Rural Sciences</td>
</tr>
<tr>
<td>BAP</td>
<td>Bycatch Action Plan</td>
</tr>
<tr>
<td>CSIRO</td>
<td>Commonwealth Scientific Industry Research Organisation</td>
</tr>
<tr>
<td>EPBC Act</td>
<td><em>Environmental Protection and Biodiversity Conservation Act 1999</em></td>
</tr>
<tr>
<td>FRDC</td>
<td>Fisheries Research and Development Corporation</td>
</tr>
<tr>
<td>FRRF</td>
<td>Fisheries Resource Research Fund</td>
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<td>FAG</td>
<td>Fishery Assessment Group</td>
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<tr>
<td>GABTF</td>
<td>Great Australian Bight Trawl Fishery</td>
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<tr>
<td>GVP</td>
<td>Gross Value of Production</td>
</tr>
<tr>
<td>ITQ</td>
<td>Individual Transferable Quota</td>
</tr>
<tr>
<td>MIRF</td>
<td>MAC-Initiated Research Funds</td>
</tr>
<tr>
<td>MAC</td>
<td>Management Advisory committee</td>
</tr>
<tr>
<td>MAFRI</td>
<td>Marine and Freshwater Research Institute</td>
</tr>
<tr>
<td>SETF</td>
<td>South East Trawl Fishery</td>
</tr>
<tr>
<td>SSJF</td>
<td>Southern Squid Jig Fishery</td>
</tr>
<tr>
<td>SquidFAG</td>
<td>Southern Squid Jig Fishery Assessment Group</td>
</tr>
<tr>
<td>SquidMAC</td>
<td>Southern Squid Jig Fishery Management Advisory Committee</td>
</tr>
<tr>
<td>TAC</td>
<td>Total Allowable Catch</td>
</tr>
</tbody>
</table>
References


### Attachment 1: Previous research projects for the Southern Squid Jig Fishery

<table>
<thead>
<tr>
<th>Project title</th>
<th>Cost</th>
<th>Research body/researcher</th>
</tr>
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<tbody>
<tr>
<td>Squid stocks in the South East Fishery: Status Report 1995</td>
<td>$8,582 funded by ARF.</td>
<td>CSIRO</td>
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<tr>
<td>Biological data on squid caught in the Fishery off southeastern Australia- a pilot study 1997</td>
<td>$2,800 funded by industry</td>
<td>MAFRI</td>
</tr>
<tr>
<td>Collection and preliminary analysis of southern squid data 1997</td>
<td>$24,884 funded by AFMA Research Fund</td>
<td>BRS</td>
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