

Southern Squid Jig Fishery



Main features

STATUS

Uncertain in western Bass Strait;
probably not overfished in other areas

RELIABILITY OF THE ASSESSMENT

No reliable assessment to date

CURRENT CATCH

2004: Jig fishery 1567 t valued at
A\$1.9m; trawl bycatch 685 t
2005: Jig fishery 1668 t (estimated); trawl
season catch not yet available

LONG-TERM POTENTIAL YIELD

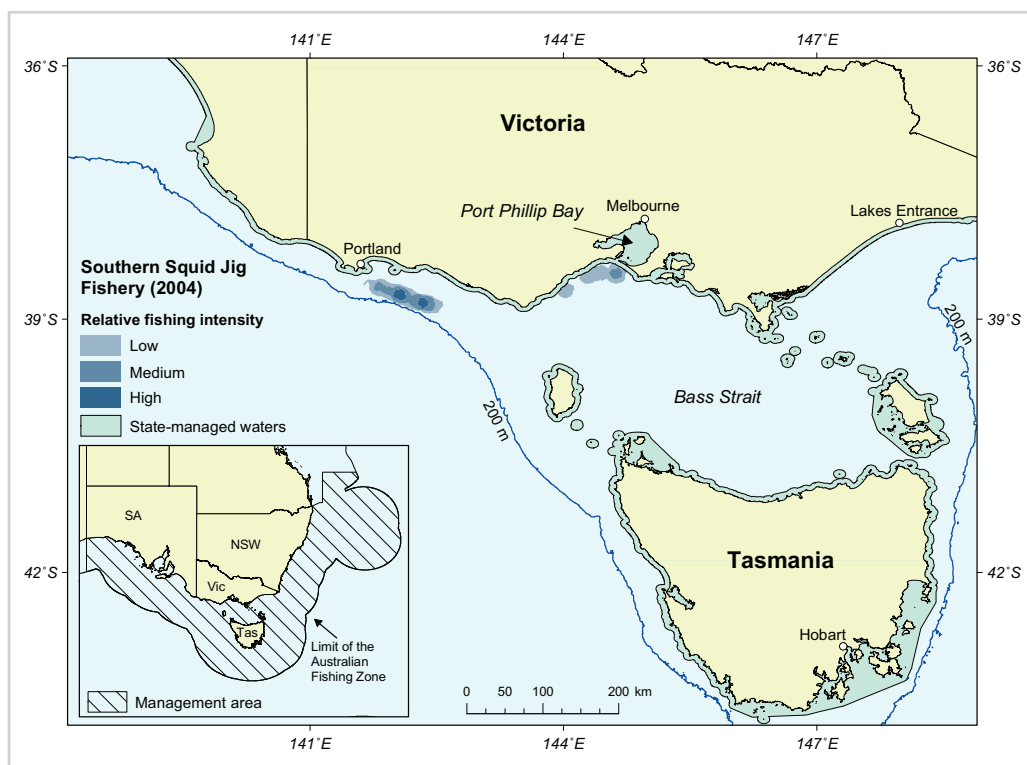
Unknown

MAIN MANAGEMENT OBJECTIVE

Sustainable use and efficient exploitation
of the squid resource

MANAGEMENT METHODS

Limited entry; annual fishing permits
(multi-fishery or squid jigging only);
gear-based statutory fishing rights from
January 2006



Highlights

- Squid are caught in targeted squid-jigging operations in the Southern Squid Jig Fishery and as a byproduct of other fishing, especially trawling in the Southern and Eastern Scalefish and Shark Fishery (SESSF).
- A management plan was introduced for the fishery in 2005. Statutory Fishing Rights, to be granted to 2005 permit holders in January 2006, will allow the implementation of a total allowable effort limit—set at 800 standard jig machines for 2006.
- The management plan includes triggers for review of the fishery's status and options for introducing total allowable catch limits in the jig and trawl fisheries.
- The availability of arrow squid to jig fishers on the main fishing grounds in past years has been markedly variable: in 2002, for example, the jig catch (663 t) was less than half the 2001 catch of 1838 t. The 2002 to 2005 seasons have been more consistent, with annual catches in the range 1239 t to 1668 t.



Arrow squid

Background

History of the fishery

Arrow squid (*Nototodarus gouldi*) are found over a wide area of southern Australia, including waters off Western Australia south of latitude 27°S and extending to parts of the New Zealand Exclusive Economic Zone. They are typically caught on the continental shelf, but have been recorded over the continental slope to 500 m depth. The Southern Squid Jig Fishery (SSJF) is almost exclusively a fishery for arrow squid. The fishery is managed by the Australian Government in waters more than 3 n.mile from the territorial baselines of New South Wales, Victoria, Tasmania, South Australia, and a small area in oceanic waters off southern Queensland. SSJF permit holders are restricted to the use of squid-jig gear, but may fish anywhere within the SSJF management area. Prior to 1999, there were restrictions on fishing area for many of the squid-jig permits. Inside the 3 n.mile limit, squid jigging is managed by State governments. Many fishers from the SSJF also hold Victorian and Tasmanian licences.

Before 1972, the annual catch of arrow squid was less than 100 t, most of it bycatch of demersal trawling and Danish-seining off southeastern Australia. In December 1972 large numbers of arrow squid were found in the Derwent estuary near Hobart during squid-jigging trials; in the next two months up to 30 local vessels fished the schools with improvised jigging gear, taking a total of 154 t. Feasibility surveys of Tasmanian waters in 1972–73 and off Victoria in 1973–74 did not result in the development of a jig fishery.

In the late 1970s, arrow squid stocks in Bass Strait and Tasmanian waters were surveyed by the Japan Marine Fishery Resource Research Center's vessel *Hoyo Maru No. 63*. In 1980–81 this vessel also fished off South Australia, Victoria and southern Queensland. Japanese commercial squid-jig vessels carried out feasibility surveys in southeastern waters in 1978–79 and 1979–80. In the first year, 19 vessels

caught 3387 t, and in the second, 64 vessels caught 7914 t. Taiwanese and Korean vessels subsequently fished Bass Strait (and also off New Zealand) each season from 1983–84 to 1987–88, with annual catches ranging from 13 t to 2309 t. The most productive domestic waters fished were off northern Tasmania and in western Bass Strait. There has been no squid jigging by foreign vessels since 1988.

Domestic interest in the SSJF was revived in 1987 by a local vessel fishing in Bass Strait. Effort increased slowly up until 1995, the fleet size fluctuating between 7 and 17 vessels. Annual arrow squid catches in the SSJF did not exceed 400 t until the 1995 season, when 1260 t were landed. The success of the 1995 season generated increased interest from fishers holding jig endorsements and, as a result, 43 vessels fished during the 1996 season. In 1997 the catch increased by 65% to about 2000 t. Almost half of the 1997 catch was landed in May. Since then, the annual jig catches have followed a pattern of alternating good and bad seasons until 2003. The 2003 to 2005 seasons have yielded more consistent jig catches (see 2004 fishery section). The unpredictable nature of the jig fishery and low prices have caused a gradual reduction in the number of active vessels since 1997.

Until 1999, most of the jig fishing was in Bass Strait near Port Phillip Bay and in western Victoria southeast of Portland. In 1999 a large part of the catch was taken off eastern Victoria, and in 2000 most of the catch came from the same grounds. Waters outside Port Phillip Bay are usually fished in February and early March, and in western Victoria from January to June (but mostly in April and May). Some vessels fish in the wider management area—for example, off southern New South Wales or eastern Tasmania—but fishing effort is much less than in the Victorian grounds. Many jig fishers hold endorsements for other fisheries such as the scallop and shark fisheries, and have tended to fish opportunistically for arrow squid during closures or unproductive periods in other fisheries.

The jig vessels operate at night, using high-powered lamps to attract squid close to the boat, where they are caught on the jigs. Automatic jig machines take most of the catch, but manual-jigging spools are also used at times. Fishing is carried out in continental-shelf waters, where depths are between 60 m and 120 m. The vessels and fishing gear have been stable over the last five years, except for a small increase in the average number of jigs fished per line and an increase in average total lighting capacity per vessel.

The catch is chilled with flaked ice and landed the next morning for direct sale to processors. The success of squid jigging is greatly affected by the weather; heavy winds and swells in Bass Strait in winter effectively halt the jig fishery at that time. Moon phase also influences the catchability of arrow squid, with lower catch rates close to the full moon.

Species other than arrow squid form a very small bycatch of jigging. In the deeper shelf waters, Southern Ocean arrow squid (*Todarodes filippovae*) and red ocean squid (*Ommastrephes bartrami*) constitute less than 1% of the catch. Occasionally, schools of pelagic sharks, especially blue shark (*Prionace glauca*), are encountered while jigging, and small numbers of entangled shark may be retained by fishers. Barracouta (*Thyrsites atun*) frequently attack squid jigs and cause loss of jigs and lines. Operators generally move on to another area when this occurs.

Arrow squid are also caught by trawling in the SSJF management area. They are a byproduct of demersal otter-trawling in the Commonwealth trawl sector (SESSF-CTS), of the SESSF but some fishers may target squid when markets are favourable. The annual catches ranged between 300 t and 800 t from 1986 to 2002. The highest trawl catch to date (884 t) was taken in 2003. The squid are largely caught on shelf grounds, particularly in depths of 100–200 m, most from heavily fished areas at these depths off New South Wales and the Victorian–South Australian border. Some are also taken in the Great Australian Bight trawl sector of the SESSF, which retained between 10 t and 90 t annually between 1986 and 2002, and

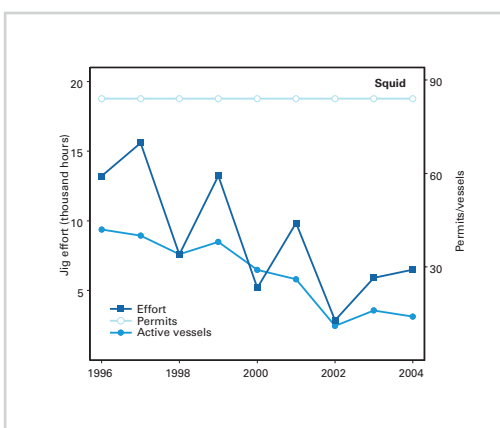
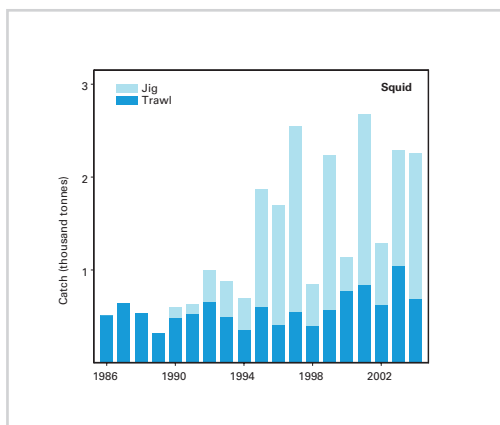
reached a peak of 169 t in 2003. In northern New South Wales waters, squid are taken as a small component of byproduct in the Ocean Prawn Trawl Fishery. The squid are mainly *Photololigo* species, but some arrow squid are also caught.

Australians have been progressively eating more squid since the 1970s. Imports of squid were 10 160 t in 2003–2004 and 11 000 in 2004–05, most of it coming from China and New Zealand. The prospect of replacing some of the imported squid with high-quality, jig-caught arrow squid has continued to maintain the interest of fishers wishing to diversify their operations. However, the generally low prices of squid on the world market, and consequently on the Australian market, have discouraged fishers from investing in the fishery.

Biology

Arrow squid live for up to one year. In a recent study of age and growth of arrow squid in southeastern Australia, the oldest age recorded was 360 days. The distribution of arrow squid larvae shows spawning occurs throughout the continental-shelf waters of southern Australia. They spawn throughout the year, but in some years there are distinct modes in length–frequency distributions from jig-catch samples, indicating peak periods of spawning activity. Recent research on arrow squid from the Portland region indicates at least four cohorts of squid are present in trawl catches over a year. Short-lived squid species such as arrow squid typically produce a large number of eggs, but recruitment tends to be variable, probably regulated mainly by environmental factors. Reproductive studies suggest that arrow squid continue to grow during the spawning phase, and that females release a number of batches of fertilised eggs. Growth rates are extremely variable between years, seasons and locations. The age at maturity also varies according to season and location.

Research into the genetics of arrow squid supports existence of a single stock over most of its Australian distribution. The greatest genetic variation appears in squid from



northern NSW waters. The genetic relationship between New Zealand arrow squid and local populations is unknown.

Arrow squid aggregate into large schools near the seabed during the day and then disperse to some extent into the water column at night. Jig vessels are able to target aggregations for a few weeks or even months on the grounds off Portland. Arrow squid feed mainly at night, eating pelagic crustaceans, fish and squid, including smaller arrow squid.

The 2004 fishery

The total jig fishery catch of arrow squid increased to 1567 t in 2004 from 1239 t in 2003. The total fishing effort in the jig fishery reached 6492 hours in 2004 and 14 vessels were active during the year. The jig fishing

season followed a normal pattern of activity, starting in January and ending in June. More than half of the total effort was applied in March and April and the mean catch rate was particularly high in April at 360 kg/h. This is the highest monthly jig catch rate recorded in nine years of SSJF logbooks. Most of the jig catch (77% by weight) was taken from the Portland grounds and 19% of landings came from the Queenscliff–Cape Otway region.

The trawl catch of 685 t of squid in 2004 consisted of 550 t from the SESSF-CTS and 135 t from the SESSF Great Australian Bight trawl sector (SESSF-GABTS). In the SESSF-CTS, monthly total landings were high between March and June, and in the SESSF-GABTS, the months of March to May accounted for 60% of the landings.

The 2005 jig fishery

The 2005 jig fishery season produced a total catch of 1668 t. The jig fleet had ceased fishing by early July, but fishing effort was maintained at a high level from February through to late June and more vessels fished into June than in previous seasons. The total jig-fishing effort increased in 2005 to 8805 hours and 20 vessels were active in the fishery. The pattern of fishing was different from other years, in that after fishing moved from the Port Phillip Bay area to Portland in March, there was a second period of fishing off Port Phillip Bay in April and May. Fishing during June concentrated on the Portland grounds. The price paid by processors for fresh arrow squid (A\$1.50 to A\$2.00 per kg) was considerably higher than the 2004 season, when A\$1.20 per kg was the average.

The catch statistics for the SESSF trawl sectors are not complete at this time, but squid catches in the SESSF-CTS for 2005 are expected to be around those taken in 2004. SESSF-GABTS catches in 2005 are unlikely to exceed the 2004 total.

Current monitoring and research

The Australian Fisheries Management Authority (AFMA) logbook database holds catch-and-effort logbook data for the SSJF since 1996, as well as for SESSF-CTS operations since 1986. A catch-disposal record form was introduced before the 2005 jig season to ensure that accurate statistics on arrow squid landings were available for management. In 2005, there were also 20 days of onboard observer activity in the SSJF, and a similar amount of observer time is planned for 2006. The observers are validating the quality of catch and bycatch reporting as well as collecting sample data on arrow squid population parameters.

The Squid Jig Fishery Resource Assessment Group (SquidRAG) advises the Southern Squid Jig Fishery Management Advisory Committee (SquidMAC) and the AFMA Research Committee on priorities for research into arrow squid stocks. A five-year strategic research plan was prepared by the

group in 2002. Among the high-priority needs were development of a fishery-assessment report and assessment of management regimes operating in other squid fisheries.

The Fisheries Research and Development Corporation funded a research project spanning the 2000–02 seasons to examine the growth rates, age structure, genetics and general life history of arrow squid in Australian waters. The project was a cooperative effort of the University of Tasmania and the Victorian Government Department of Primary Industries. The final report of the project was completed in mid-2004.

There are no current research projects into the biology or fisheries science of arrow squid. The Australian Government Department of the Environment and Heritage recommendations from strategic assessment include support for research into production of ecologically sustainable yield estimates and reference points for management of the fishery. There is some interest from researchers in the links between the growth and recruitment of arrow squid and environmental factors such as ocean productivity and sea temperature.

Status of stocks

Previous assessments

Most of the information on the wider distribution and abundance of arrow squid has come from the seasonal Japanese jig-fishing surveys between 1977 and 1981 and the foreign-licensed, joint-venture and feasibility fishing from 1978 to 1988. However, these data have been little used for assessing the squid resource. Catch rates recorded by the Japanese research cruise in 1980–81 did not show any effects on the squid population of the previous year's 8000 t catch. This observation was the basis for assigning a nominal annual total allowable catch (TAC) of 10 000 t to squid-jig vessels from Korea and Taiwan between 1983 and 1988. The Japan Marine Fishery Resource Research



Squid boat

Center and Australian observers collected a quantity of biological data between 1979 and 1987. These observer reports and biological data sets have recently been converted to electronic documents by AFMA.

Before catch-and-effort logbooks were introduced in 1996, the arrow squid resource in the management area was assessed by estimating the annual catch and examining the catch trend. The fishery was still developing in 1995, so the fishing effort, which was concentrated off Portland, was assumed to have little effect on the arrow squid stocks.

2005 update

No 2005 stock assessment has been undertaken for the SSJF. Under the management plan there is a requirement for AFMA to determine reference points for squid, appropriate for maintaining ecologically viable stocks of squid and an ecologically sustainable fishery. In the absence of scientific advice that fulfils this need, AFMA prepared an apportionment policy for a TAC between the SSJF, SESSF-CTS and SESSF-GABTS that will be applied in a series of steps. The first step set trigger limits of 4000 t for the SSJF and 2000 t combined for the trawl fisheries. If the trigger is reached in any season, then AFMA will seek advice from the assessment group and relevant MACs on when to apply an overall squid TAC to the fisheries and what that amount should be.

The fishery status of the SSJF can only be viewed as uncertain at this time. However, the catch history of foreign jig vessels indicates that a jig fishery with fishing effort distributed more widely across the management area could safely harvest more than the current average annual landings. The 1979–80 foreign squid catch was used as the basis for setting the jig-fishery trigger limits, i.e. half the highest previous squid catch.

Reliability of the assessment

Currently there is no reliable assessment of the status of the stock.

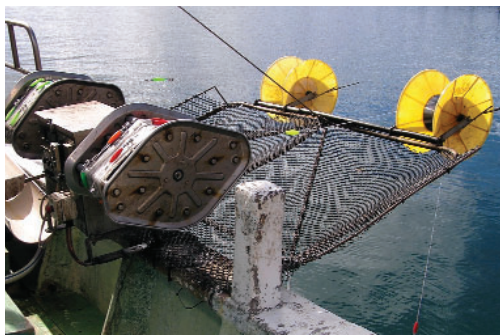
Future assessment needs

The SquidRAG was required to provide advice to the AFMA Board by 31 December 2005 on a sustainable level of catch, and to consider the present scientific knowledge and ability to set reference points for management of the fishery. Were the SquidRAG is unable to provide advice on sustainable catch or reference points, it would be required to advise on the specific data that must be collected to enable future setting of appropriate reference points.

Environmental issues

The environmental effects of jig fishing are relatively small. It is an effective method for targeting squid and has very low incidental catch rates of fish. This assessment was supported by the Australian Government Department of the Environment and Heritage in its strategic assessment of the fishery under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The second Bycatch Action Plan (BAP) for the SSJF was finalised in 2004 in conjunction with the strategic assessment process. The new plan proposes to improve monitoring of bycatch and wildlife interactions. The plan



Squid jig gear side view

was drafted in conjunction with the Ecological Risk Assessment project, which assessed the risk posed by the SSJF to sustainability of marine species. This project is expected to be completed for the SSJF by the end of 2005. Progress towards achieving the BAP's objectives is being reported every six months by AFMA through its website.

Further reading

- Kailola, P.J., Williams, M.J., Stewart, P.C., Reichelt, R.E., McNee, A. and Grieve, C. (1993) *Australian Fisheries Resources*. Bureau of Resource Sciences and the Fisheries Research and Development Corporation, Canberra, 422 pp.
- Jackson, G.D., McGrath Steer, B.L., Wotherspoon, S. and Hobday, A.J. (2003) Variation in age, growth and maturity in the Australian arrow squid *Nototodarus gouldi* over time and space—what is the pattern? *Marine Ecology Progress Series* 264: 57–71.
- Lynch, A. (2005) *Southern Squid Fishery: Data Summary 2003–2004*. Australian Fisheries Management Authority, 23 pp.
- McGrath, B.L. and Jackson, G.D. (2002) Egg production in the arrow squid *Nototodarus gouldi* (Cephalopoda: Ommastrephidae); fast and furious or slow and steady? *Marine Biology* 141: 699–706.

Management performance

The *Southern Squid Jig Fishery Management Plan 2005* was determined by AFMA on 28 April 2005. The plan grants statutory fishing rights (SFRs) to eligible applicants, namely SSJF permit holders as of 8 July 2005. Until the SFRs take effect on 1 January 2006, the fishery is managed under the transitional arrangements of the management plan. The AFMA Board has endorsed the Independent Allocation Advisory Panel's recommendation of an equal share of gear SFRs for each eligible

SSJF permit holder. The 2006 total allowable effort has been set at 800 standard squid-jigging machines, and therefore each of the 80 eligible permit holders will be granted 100 gear SFRs in the initial allocation. This is sufficient for most of the active SSJF fishers to maintain current operations. A few permit holders will be disadvantaged under this allocation and will need to purchase gear SFRs to maintain their previous amount of fishing gear. It is unlikely that total allowable effort for the next few years will be limiting on jig fishers. However, if the jig trigger limit of 4000 t under the AFMA Board policy on apportionment of a squid TAC is reached in one season, then the management arrangements will be reviewed and more constrained limits may be required.

The management plan includes specific ecosystem requirements for preparing and implementing the BAP for the fishery and determining reference points for ecologically sustainable management of the fishery. The plan was accredited in November 2004 by the Department of the Environment and Heritage under the strategic assessment process of the EPBC Act. The SSJF was also exempted from the export requirements of the EPBC Act for five years, thus allowing access to export markets for all SSJF fishers and processors. The Department recommended improvements of management arrangements for the SSJF over the five years leading to the next strategic assessment.

There is continuing interest from trawl fishers in the SESSF-CTS and SESSF-GABTS in arrow squid as an alternative target species. Although the demersal trawl catches have changed little in recent seasons, there is a proposal before AFMA to use mid-water trawl gear to target arrow squid under scientific permits. This development gives further weight to the increased monitoring needs of the southern squid fisheries, including catch validation by landing documents and on-board observer sampling. AFMA has made progress in monitoring the SSJF through introducing catch-disposal records in late 2004 and basic coverage of the jig fishery by observers in 2005.