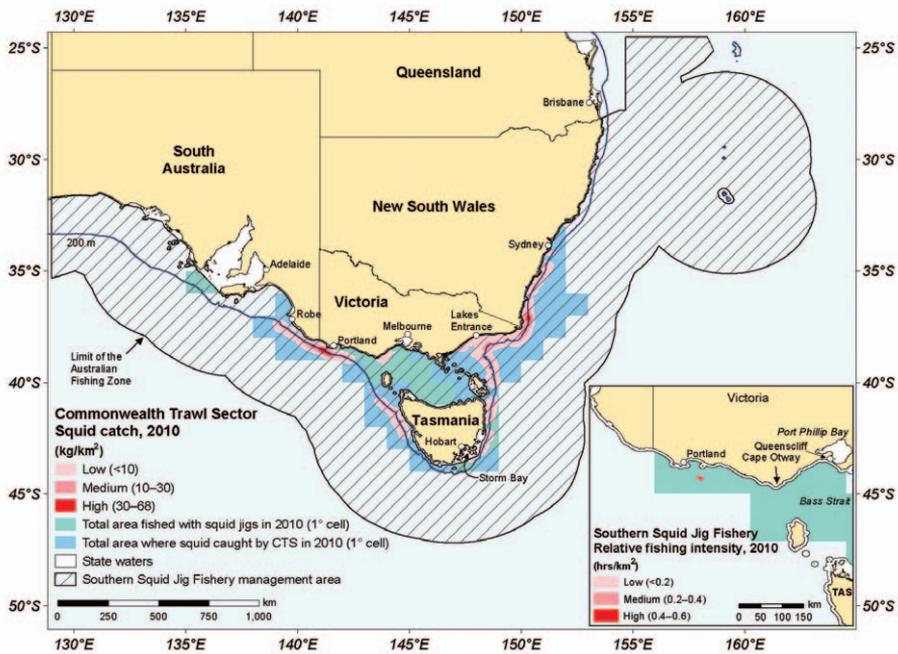


# 13 Southern Squid Jig Fishery

P Sahlqvist and M Skirtun



**FIGURE 13.1** Distribution of Commonwealth Trawl Sector squid catch and relative fishing intensity in the SSJF, 2010

**TABLE 13.1** Status of the SSJF

Fishery status	2009		2010		Comments
	Fishing mortality	Biomass	Fishing mortality	Biomass	
Gould's squid ( <i>Nototodarus gouldi</i> )					No formal assessment. Recent low annual catches compared with historical levels due to low prices. Catch rates from trawl and jig sectors still high in most seasons.
Economic status (Fishery level)	Net economic returns not available				Latent effort is high in the fishery, suggesting low economic returns. High costs, low prices and low catch rates in 2009–10 imply that MEY was likely to be associated with low levels of catch and effort.

Fishing mortality ■ Not subject to overfishing ■ Subject to overfishing ■ Uncertain  
 Biomass ■ Not overfished ■ Overfished ■ Uncertain

**TABLE 13.2** Main features and statistics of the SSJF

Feature	Description					
Target species	Gould's squid ( <i>Nototodarus gouldi</i> )					
Byproduct species	None reported in recent seasons					
Fishing methods	Squid jigging: jig vessels operate at night using high-powered lamps to attract squid. Up to 10 automatic jig machines are used on each vessel, each machine having two spools of heavy line with 20–25 jigs attached. SSJF gear SFRs only allow the capture of squid. Operators must have appropriate line endorsements for targeting scalefish or shark species.					
Primary landing ports	Portland, Queenscliff					
Management methods	Input controls: gear-based SFRs; annual TAE					
Management plan	<i>Southern Squid Jig Fishery management plan 2005</i> (DAFF 2005)					
Harvest strategy	<i>Southern Squid Jig Fishery harvest strategy</i> (AFMA 2007)					
Consultative forums	South East Management Advisory Committee (SEMAC), Southern Squid Jig Fishery Resource Assessment Group (SquidRAG)					
Main markets	Domestic: fresh International: China, Hong Kong and Canada					
EPBC Act assessments: —listed species (Part 13) —international movement of wildlife specimens (Part 13A)	Current accreditation dated 22 April 2010 Current accreditation (Wildlife Trade Operation) expires 30 April 2015					
Ecological risk assessment	Level 1: Scale, Intensity, Consequence Analysis (SICA) completed on 225 species (Furlani et al. 2007).					
Bycatch workplans	<i>Southern Squid Jig Fishery bycatch action plan 2004</i> (AFMA 2004)					
Fishery statistics <sup>a</sup>	2009			2010		
Fishing season	1 January 2009 – 31 December 2009			1 January 2010 – 31 December 2010		
TAE, catch and value (2009–10 dollars)	TAC/TAE	Catch (tonnes)	Real value (2008–09)	TAC/ TAE	Catch (tonnes)	Real value (2009–10)
SSJF	580 standard squid jigging machines	308	\$0.47 million	580 standard squid jigging machines	62	\$0.09 million
Other fisheries:						
CTS	–	573	n.a.	–	480	n.a.
GABTS	–	29	n.a.	–	18	n.a.
Effort	1229 hours of squid jigging			601 hours of squid jigging		
Fishing permits/licences	58 (5800 gear SFRs)			58 (5800 gear SFRs)		
Active vessels	8			7		
Observer coverage	0			0		
Real gross value of production (2009–10 dollars)	2008–09: \$0.47 million			2009–10: \$0.09 million		
Allocated management costs	2008–09: \$0.18 million			2009–10: \$0.18 million		

– = not applicable; CTS = Commonwealth Trawl Sector; EPBC Act = *Environment Protection and Biodiversity Conservation Act 1999*; GABTS = Great Australian Bight Trawl Sector; n.a. = not available; SFR = statutory fishing right; TAE = total allowable effort

a Fishery statistics are provided by fishing season unless otherwise indicated.

## 13.1 BACKGROUND

The Southern Squid Jig Fishery (SSJF) targets a single species, Gould’s squid (*Nototodarus gouldi*), by a single fishing method—squid jigging. The fishery is located offshore from the coastal waters of New South Wales, Victoria, Tasmania and South Australia, and in a small area of oceanic water off southern Queensland. The SSJF is managed by the Australian Government, but within coastal waters (inside the 3 nautical mile limit), squid jigging is managed by the adjacent state governments.

Before the commencement of the SSJF, Japanese commercial jig vessels fished in southern Australian waters in the summers of 1978–79 and 1979–80 under joint-venture partnerships with Australian companies. Commercial jig catch rates were achieved in south-east waters, particularly in western Bass Strait, proving the feasibility of the Gould’s squid fishery. Taiwanese and Korean vessels were also licensed to fish in Bass Strait until 1988 (table 13.3).

Jig vessels operate at night using high-powered lamps to attract squid. The squid attack the jigs as they are retrieved, and the squid tentacles become hooked by rows of barbless hooks on the jigs. The catch is chilled with ice and normally landed the next morning for direct sale to processors. Fishing is carried out in continental shelf waters, in depths between 60 m and 120 m. Waters outside Port Phillip Bay, near

Queenscliff, are usually fished in February and early March, and those near Portland in western Victoria from March to June (figure 13.1). A very small proportion of fishing effort is directed outside these traditional fishing grounds. The success of squid jigging is greatly affected by weather; heavy winds and swells in Bass Strait in winter effectively halt the jig fishery. Moon phase also influences the catchability of Gould’s squid, with lower catch rates close to the full moon.

Gould’s squid is also caught in other Commonwealth fisheries, mostly by demersal otter trawling, and particularly in the Southern and Eastern Scalefish and Shark Fishery (SESSF). In the Commonwealth Trawl Sector (CTS) of the SESSF, the annual catch of squid has ranged between 440 t and 900 t over the past 10 years. In the Great Australian Bight Trawl Sector (GABTS), the annual catch peaked in 2006 at 262 t, but has been much less in recent years. The main trawl catches are taken in depths of 100–200 m.

In some years, large amounts of Gould’s squid are caught by jigging in Tasmanian waters, especially in Storm Bay and nearby locations—694 t was caught in 2006–07, but catches have been less than 50 t in the past three years. In northern New South Wales waters, squid are taken as a small component of byproduct in the Ocean Prawn Trawl Fishery. These squid are mainly species of *Photololigo*, but some Gould’s squid is also caught.

**TABLE 13.3** History of the SSJF

Year	Description
Pre-1978	Australian catch of Gould’s squid was less than 100 t annually, largely as a byproduct of demersal trawling and Danish-seining off south-eastern Australia.
1978 to 1980	Japanese commercial squid jig vessels carried out feasibility fishing in southern waters under a joint venture with Australian companies. Nineteen vessels caught 3387 t in the first year, and 64 vessels caught 7914 t in the second year, most of the catch being taken off South Australia, Victoria and Tasmania.
1983 to 1988	Vessels from Taiwan and the Republic of Korea fished in Bass Strait. Annual catches ranged from 13 t to 2309 t.
1987	One local vessel actively fished Bass Strait Gould’s squid using jig gear.
1988 to 1995	Fishing effort increased slowly until 1995, when 1260 t was landed by 40 active vessels.
1997	Gould’s squid catch (about 2000 t) was the highest taken by domestic vessels.
1996 to 2005	Catches over 1000 t in most years; three seasons (1998, 2000, 2002) had low availability of squid.
2005	<i>Southern Squid Jig Fishery management plan</i> commenced. Catch disposal record forms (which record landing quantities) were required from jig operators.
2006	SFRs were granted to all SSJF permit holders in January 2006. TAE limit was introduced and set at 800 standard jig machines.
2007	<i>Southern Squid Jig Fishery harvest strategy</i> was adopted by AFMA. 1600 SFRs were surrendered in the voluntary fishing concession buyback scheme, including only one active fisher.
2006 to 2010	Fishing effort and number of active vessels declined significantly due to low profits. SFRs were reduced to 5800 due to surrender of packages over past four years (from 8000 SFRs in 2006).

AFMA = Australian Fisheries Management Authority; SFR = statutory fishing right; TAE = total allowable effort

## 13.2 THE 2010 FISHERY

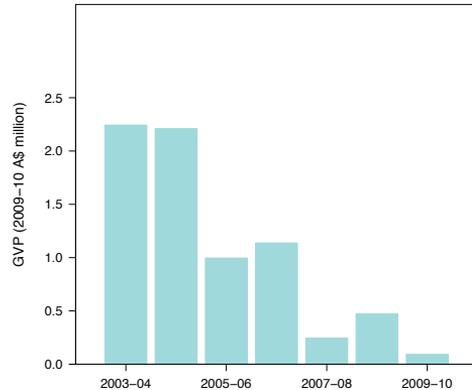
The 2010 catch of 62 t was the poorest on record for the SSJF. Only seven jig vessels fished the season, and effort was about half that of the previous year. Catch rates were poor on the Portland ground throughout the expected peak fishing period of February–May, so operators fished very few days in each month. In recent years, prices paid by processors for squid have been poor, and this has been a major factor behind the low levels of fishing effort in the SSJF. In 2010, although world prices for squid increased and prices paid for Australian product rose, poor catch rates in the SSJF became a major constraint on fishing effort and catch. In contrast, trawl catch rates of Gould’s squid from deeper shelf waters of the SESSF CTS were comparable to previous years, and catches (480 t) were only moderately lower than in the previous year (573 t). Landings from the GABTS fell from 29 t in 2009 to 18 t in 2010.

No squid species other than Gould’s squid are reported in squid jigging logbooks. However, species other than Gould’s squid form a very small byproduct of jigging, as indicated by scientific sampling (Dunning & Brandt 1985). In the deeper shelf waters, Southern Ocean arrow squid (*Todarodes filippovae*) and red ocean squid (*Ommastrephes bartrami*) constitute less than 1 per cent of the catch. No byproduct species or bycatch were reported in logbooks in 2009 or 2010. There was also no reported discarding of Gould’s squid in the past two years.

The poor jig catch rates reported in 2010 are consistent with conditions observed in previous years, including the 1988 and 2000 seasons. It is unclear whether the low catchability of Gould’s squid for jig vessels in some years is caused by poor conditions for fishing (e.g. high swell, strong winds, poor water clarity), low abundance of squid, or a combination of these factors. Many squid species, including Gould’s squid, display cycles in abundance. The cause of these cycles is unknown for Gould’s squid, but is likely to be related to environmental factors that affect larval survival, growth and recruitment to the jig fishery.

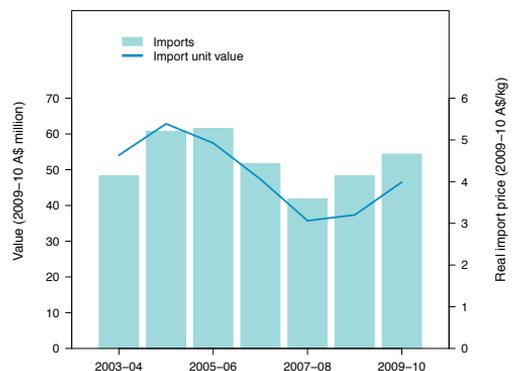
In line with the fluctuations in volume of squid caught, the fishery also faces considerable variability in gross value of production (GVP) (figure 13.2). This is primarily the result of changes in the catch levels and, to a lesser extent, changes in per-unit price for squid. GVP in the fishery doubled

in the 2008–09 financial year, to \$0.47 million. However, the GVP for 2009–10 decreased to \$0.09 million, about one-fifth of the GVP for 2008–09 (all values are in 2009–10 dollars). Moreover, the number of vessels operating in 2009–10 was reduced by one from the previous year, despite the increase in import unit value (figure 13.3).



**FIGURE 13.2** GVP of the SSJF by financial year, 2003–04 to 2009–10

Generally, operators in the SSJF sell their product to the domestic market, where they compete with large volumes of imports. For 2009–10, the Australian Bureau of Statistics estimated the value of squid and cuttlefish imports to be \$54.4 million (figure 13.3). Principal sources include China, New Zealand and Thailand. The value of exports of Australian cuttlefish and squid, which are sourced mainly from fisheries other than the SSJF, is very low. In 2009–10, \$0.4 million worth of cuttlefish and squid was exported, mostly to China, Canada and Hong Kong.



**FIGURE 13.3** Real value of squid and cuttlefish exports, imports and import unit value by financial year, 2003–04 to 2009–10

## 13.3 HARVEST STRATEGY

### 13.3.1 Harvest strategy description

The *Southern Squid Jig Fishery harvest strategy* (HS; AFMA 2007) uses a system of within-season monitoring against catch triggers for the jig and trawl sectors. It includes catch, effort, and catch per unit effort triggers that signal the need for assessment and review of management arrangements. Target and limit reference points are not defined.

The main elements are as follows:

#### Jig fishery

- › 3000 t intermediate catch trigger or 30 standard vessel effort trigger—requires a depletion analysis and increased investment in fishery monitoring and biological data collection. If there is no indication of impact (level of depletion is not defined in the HS), fishing may continue up to the next trigger limit. If there is impact, the trigger values may be revised.
- › 5000 t limit catch trigger—further catches are suspended pending another depletion analysis. If there is no indication of impact, a further (higher) trigger limit may be considered. If there is impact, catch or effort may be capped. Fishing beyond this trigger will require more rapid, real-time monitoring of the fishery.

The limit trigger may be overridden when there is a ‘boom’ year, which is defined in terms of catch rates, as well as the time of day and month that catches are taken.

There are also criteria that signal excessive fishing effort during periods of low squid availability, and similar decision rules to the intermediate catch trigger apply in that case.

#### Trawl fishery

- › 2000 t combined trawl sector catch limit trigger—control rules require depletion analyses equivalent to those required for the jig fishery rules. Catch trip limits may be set, depending on the outcome of the analyses.

#### Combined jig and trawl fishery

4000 t intermediate combined jig and trawl catch trigger—control rules are equivalent to those applying to the 3000 t intermediate jig catch trigger. However, assessment will involve depletion analysis that uses data for both fisheries.

- › 6000 t combined jig and trawl limit catch trigger—control rules are equivalent to those applying to the 5000 t jig catch limit trigger. However, assessment will involve depletion analysis using data for both fisheries, and any changes to catch triggers will require agreement by both the SSJF and the SSSF resource assessment groups.

### 13.3.2 Harvest strategy performance

A biomass-based economic target for this fishery is currently not defined. This is appropriate, given the short lifespan of Gould’s squid and the apparent significant variation in biomass across seasons. Although it may be possible to set escapement targets to limit the percentage of biomass removed in a season, the current HS is not sophisticated enough to achieve these targets.

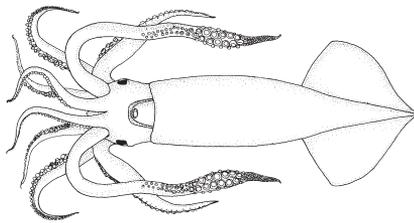
Trigger points for changes in the HS are currently well above current catch and effort levels. It is likely that the Southern Squid Jig Fishery Resource Assessment Group (SquidRAG) will need to consider application of separate triggers for the main fishing grounds off western Victoria or more complex geographic triggers. This is because the total 3000 t trigger could be applied to a single fishing ground, with increased risk of overfishing and localised depletion, before control rules are enacted. The current systems for monitoring catch and effort are not suitable for the real-time reporting required by the HS, so there is a lag of up to one month in updating landings statistics, and longer for catch-and-effort logbooks. Catch-and-effort reporting could be improved to meet the needs of the HS if electronic logbooks were introduced, together with protocols for electronic transmission.

The Australian Fisheries Management Authority has a policy on the apportionment of the squid total allowable catch (TAC) that could come into effect if the jig catch were to exceed a trigger limit of 4000 t or the trawl catch were to exceed a trigger limit of 2000 t in a season. This would also require decisions on the apportionment of a squid TAC between the jig and trawl fisheries. The policy on apportionment will continue in parallel with the HS. Although the catch triggers in the policy and the strategy differ, both instruments have similar objectives and require consideration of stock status before the operational aspects of fishery management are reviewed.

## 13.4 BIOLOGICAL STATUS

### 13.4.1 GOULD'S SQUID

(*Nototodarus gouldi*)



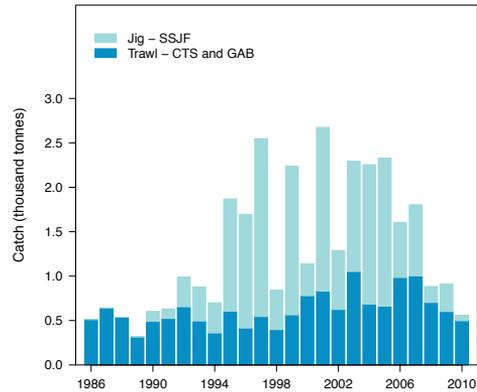
Line drawing: FAO

**TABLE 13.4** Biology of Gould's squid

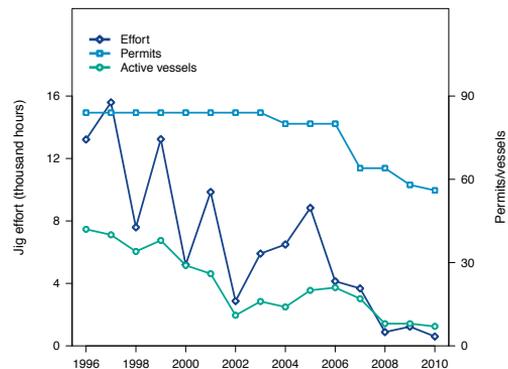
Parameter	Description
Range	<p><b>Species:</b> Southern Australian waters south of latitude 27°S, and waters of the New Zealand Exclusive Economic Zone</p> <p><b>Stock:</b> Genetics of Gould's squid support the existence of a single stock over most of the species' Australian distribution. For stock assessment purposes, all catches from within the SSJF management area are used in analysis (SSJF, CTS, GABTS).</p>
Depth	Continental shelf, but have been recorded over the continental slope to 500 m depth. Aggregate in large schools near the seabed during the day, and then disperse to some extent into the water column at night.
Longevity	1 year
50% maturity	Varies according to season and location (171–275 days)
Spawning season	Year round, with peak periods of activity. Larval distribution indicates that spawning occurs throughout the continental shelf waters of southern Australia. Up to four cohorts per year, but only one cohort usually fished in the SSJF. Continue to grow during the spawning phase, and females release a number of batches of fertilised eggs.
Size	<p><b>Maximum:</b> Females: ~40 cm mantle length; males: 35 cm mantle length</p> <p><b>Recruitment into the fishery:</b> ~10 cm mantle length</p>

CTS = Commonwealth Trawl Sector; GABTS = Great Australian Bight Trawl Sector; SSJF = Southern Squid Jig Fishery

Sources: Dunning & Brandt (1985); Jackson & McGrath-Steer (2003)



**FIGURE 13.4** Gould's squid catch history, 1986 to 2010



**FIGURE 13.5** Fishing effort history for the SSJF, 1996 to 2010

### Stock assessment

No formal stock assessment exists for this stock. As discussed above, the HS triggers have been set on a precautionary basis for the whole fishery. However, the lack of certainty about stock structure and mixing of aggregations means that there may still be a risk of depletion in areas subject to intensive fishing.

In 2008, SquidRAG analysed catch, effort and catch rates since 2000 for four regions in the SSJF, showing that only one region (the central region from Cape Otway in Victoria to Robe in South Australia) had levels of fishing that could cause substantial depletion. A preliminary depletion analysis was also conducted for the central region using jig catch-and-effort data for the 2001 fishing season. High catch rates were reported in that season, and the total jig fishery catch was the second highest on record (figure 13.4). The results of the

analysis indicated that the stock was not overfished in that region for that year. These results, along with current knowledge of Gould's squid biology, were the main evidence for the stock being assessed as not overfished in 2008 and 2009.

The 2008 depletion analysis was limited in its scope, in terms of the seasons analysed and model inputs for growth and natural mortality. The Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) is undertaking further depletion analyses for the central region of the SSJF for foreign fishing in 1980 and 1984, and the SSJF for 1995 to 2006. The initial findings are that the depletion curves reveal declines in stock for most of the seasons analysed, and there is considerable variability in recruitment between seasons. However, the limited data on squid growth for the domestic fishery and lack of an agreed estimate of natural mortality affect the magnitude of depletion estimates.

Catches of Gould's squid within the SSJF, from all sources, have been less than 1000 t in each of the past three seasons. The jig catch has declined significantly due to a major reduction in fishing effort (figure 13.5). High costs and low revenues due to poor prices paid by processors have been the main factors behind the contraction of the jig fishery. The nominal annual average catch rates from the jig fishery also declined significantly in 2010, compared with the two previous seasons (203 kg/h in 2008, 251 kg/h in 2009, 103 kg/h in 2010). Average jig catch rates below this level have been recorded in past seasons (e.g. 1998, 2000) and have been attributed to environmental conditions that are unfavourable to squid recruitment and catchability. The trawl catch rate in 2010 was lower than in 2008 and 2009 but in the middle range of catch rates during the past 20 years.

### Stock status determination

Although poor jig catch rates were reported in 2010, the low catches in recent years have been caused mainly by economic factors rather than availability of squid. When consideration is given to the cyclic patterns of catch in the SSJF history and the known ability of squid species to thrive when environmental conditions are favourable, there is strong evidence that the Gould's squid stock is not overfished. Maintenance of good jig catch rates in two of the past three seasons, and lack of any signs of major stock depletion in the SESSF trawl catch rates support the decision to assess the stock as **not overfished**. The recent low levels of jig fishing effort and consistent levels of trawl effort mean that the stock is also **not subject to overfishing**.

The practicality of conducting in-season depletion analysis and the data needs for such analysis (such as real-time catch-and-effort data, current size monitoring and growth estimates) are important considerations for SquidRAG and may need to be specified in more detail in the decision rules of the HS.



Squid jigs, Mike Gerner, AFMA

## 13.5 ECONOMIC STATUS

The SSJF has not been recently surveyed by ABARES. Hence, no estimates of recent net economic returns exist for the fishery. The only readily available economic indicator for performance is effort latency, measured in number of concessions.

### 13.5.1 Level of latency

The level of latent effort in the SSJF has been high in recent years. In 2008–09, 58 Commonwealth statutory fishing right (SFR) packages were present in the fishery, but only eight vessels operated, and at least six packages were voluntarily surrendered during the year. In 2009–10, two more SFR packages were surrendered, and only seven packages were used by active vessels.

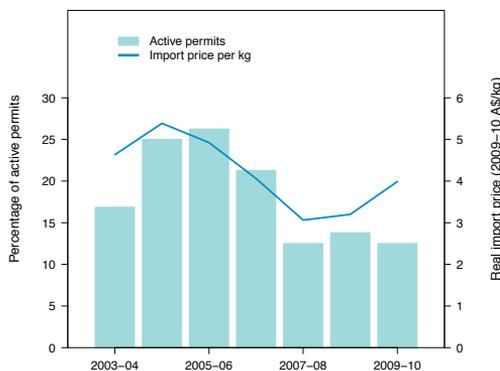
A number of factors have contributed to low participation numbers and investment in the fishery. They include relatively high set-up and running costs for squid jigging operations (associated with configuring vessels for jigging operations), rising global fuel prices, low catch rates, and possibly consumer preference for southern calamari (*Sepioteuthis australis*). The

most significant factor, however, has been the low market price received by fishers for squid, which can be attributed to competition from low-cost imports. Since domestic-caught squid constitutes a small proportion of the total squid consumed in Australia, the unit price of imported squid has a large bearing on the price of domestic squid.

In 2008–09 and 2009–10, the increase in the average price for imported squid products has driven an increase in average beach prices received by fishers, but average beach prices remain around 26 per cent below 2000–01 prices.

There is generally a correlation between the percentage of active permits used in the fishery and import prices (figure 13.6). In 2009–10, despite the increase in import prices, the percentage of active gear SFRs operating in the fishery decreased, suggesting that environmental factors have contributed to lower participation in the fishery in 2009–10.

The tendency for squid catch rates to fluctuate from season to season also influences participation in the jig sector, and the lack of a reliable supply for the domestic market has limited the development of processing facilities. Currently, most of the vessels operating in the fishery have no on-board refrigeration or processing equipment. The catch is chilled on board but must be returned to port each morning for processing or freezing. Most of the vessels are also not equipped to operate in extreme weather conditions, and heavy winds and swells in Bass Strait halt activity in the fishery during the winter months.



**FIGURE 13.6** Percentage of active permits and import price per kilogram

### 13.5.2 Overall economic status

The 2010 jig season has been the poorest on record. Low catch rates, high costs and low prices in recent years have all contributed to the fishery’s poor performance. In 2009–10, supply constraints associated with a poor south Atlantic catch significantly pushed up prices for squid (SEMAC 2011), but average beach prices remained well down on 2000–01 levels. There is ample flexibility in the trigger points established under the HS to increase catch levels in line with improved prices.

The variable relationship between recruitment and stock abundance in the fishery makes targeting a fixed  $B_{MEY}$  inappropriate. The apparent low squid availability in the areas typically fished in 2010 implies an increased cost of fishing. Together with low prices, this indicates that maximum economic yield (MEY) is likely to have been associated with low levels of effort and catch for the 2010 season. The level of catch associated with MEY is likely to increase if prices continue to improve.

## 13.6 ENVIRONMENTAL STATUS

### 13.6.1 Ecological risk assessment

The ecological risk assessment (ERA) of the fishery completed in 2006 did not identify any indicators of threat to the environment from jig fishing (AFMA 2009; Furlani et al. 2007). All of the 216 threatened, endangered or protected (TEP) species identified for assessment were determined to have a minor or negligible risk of being affected by squid jigging operations.

The ERA did not identify significant habitat effects. Occasionally, schools of pelagic sharks, especially blue shark (*Prionace glauca*), are attracted by the schooling squid, and barracouta (*Thyrstites atun*) frequently attack squid jigs and cause loss of jigs and lines. Operators usually move on to another area when this occurs. There is some loss of gear at times, but this will not remain in the pelagic zone due to line weights.

### 13.6.2 Threatened, endangered and protected species

No TEP species interactions have been reported to date. The occurrence of seals in the vicinity of working jig vessels has been raised as a concern in the past. However, observers on board jig vessels in 2002 (Arnould 2002) found no evidence of negative effects on seals from jig fishing. Updated analysis of this issue would be valuable.

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Squid, Heather Patterson, ABARES