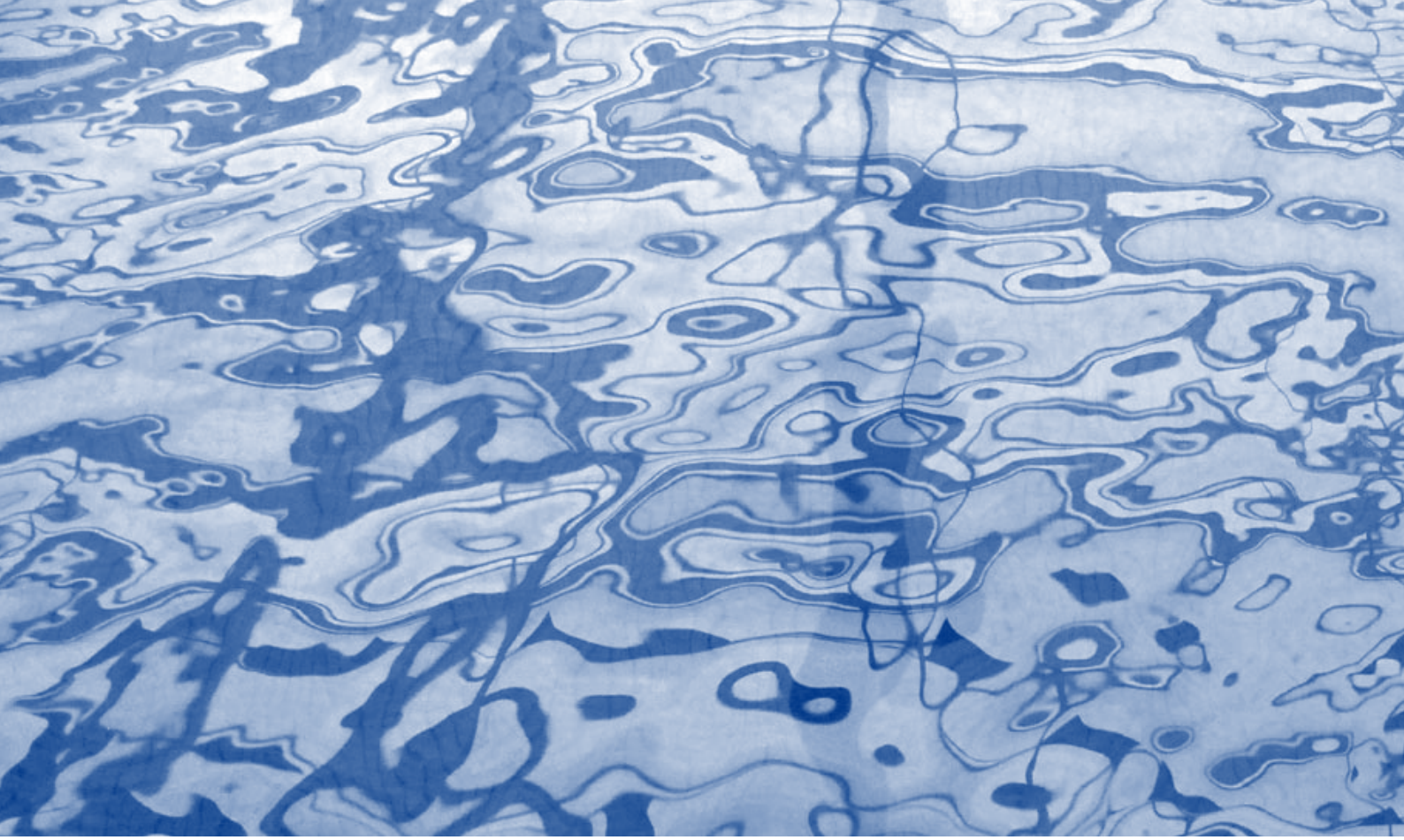
South Australian pilchard fishery

Allocation to manage spatial fishing effort across the South Australian pilchard fishery



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Allocation to manage spatial fishing effort across the South Australian pilchard fishery

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Abstract

The South Australian pilchard fishery is Australia's largest fishery by volume, with a total allowable commercial catch (TACC) of 51,100 tonnes set in 2005. At present, at least 90% of the catch is taken in the southern Spencer Gulf area. Taking such large volumes from a small area (approx 3,300km^2) has raised significant biological concerns. In order to address these concerns, a number of options for allocating the TACC spatially have been put forward. By limiting the proportion of the TACC that can be taken in southern Spencer Gulf the resource can be protected against localised depletion. This management approach is extremely precautionary, as no conclusive scientific information is available to suggest current fishing activities are causing localised depletion. Scientific views on localised depletion are completely opposed. Should the proportion of the TACC that can be taken in southern Spencer Gulf be restricted fishing costs will increase, as licence holders will be required to fish further from port. Alternatively, if the proportion of the TACC that is taken in southern Spencer Gulf is not restricted, localised depletion may occur. Further scientific research will be undertaken to address the concern that current fishing activities may result in localised depletion in southern Spencer Gulf. This research will focus on catch and effort data in the area, which has historically been an indicator of localised depletion. Following the completion of this research a determination of whether spatial allocation of the TACC to prevent localised depletion in southern Spencer Gulf is required will be made.

INTRODUCTION

Annual total allowable commercial catches (TACCs) were first introduced in the South Australian Pilchard Fishery in 1995. The initial TACC of 3,500 tonnes was set on a precautionary basis, as no scientific information was available to allow a higher level of exploitation (Table 1).

Table 1. Annual total allowable commercial catch (TACC) in the fishery from 1992 to 2004.

Year	TACC (tonnes)
1992	N/A
1993	N/A
1994	N/A
*1995	3,500
1996	3,500
1997	3,500
*1998	9,000
1999	4,700
2000	3,800
2001	9,100
2002	17,750
2003	36,000
2004	40,000
2005	51,100
2006	25,462

* denotes years in which mass mortality events occurred.

In 1998 the first annual TACC was set for the fishery based on the spawning biomass estimate obtained through the application of the daily egg production method (DEPM). The application of the DEPM in the fishery was pioneered through a Fisheries Research and Development Corporation (FRDC) project, which lasted from 1995 to 1997. The project provided the means to establish an index of abundance based on independent sampling in the fishery.

Over the period 1998-2001 the annual TACCs were set at 10% of the estimated spawning biomass. This level of exploitation is considered conservative compared to TACCs for pilchard fisheries in other countries, which are set up to 25–30% of the estimated spawning biomass.

Following mass mortality events in 1995 and 1998, it was considered that TACCs should be set conservatively. The purpose of setting conservative TACCs was to minimise the effect of commercial fishing activities on stock abundance and maximise the potential for ongoing recruitment (Shanks 2005).

Guidelines for setting the annual TACC were implemented in 2002 for the fishery (Table 2). These guidelines, which are directly linked to the annual estimate of spawning biomass, were applied to enable the TACC to increase when higher spawning biomass estimates were recorded. The application of these guidelines has resulted in a significant increase in the TACC since 2002, backed by considerable increases in spawning biomass estimates.

Table 2. TACC setting based on biological performance indicators.

Spawning biomass estimate	Presence of age classes	TACC setting as % of spawning biomass
< 100,000 tonnes		10% or 500 tonnes (which ever is greater).
100,000 – 150,000 tonnes	2 and 3 year old age classes weak or of average strength (<40% of catch).	10%
100,000 – 150,000 tonnes	2 and 3 year old age classes strong (>40% of catch).	12.5%
150,000 – 250,000 tonnes	2 and 3 year old age classes weak or of average strength (<40% of the catch).	12.5%
150,000 – 250,000 tonnes	2 and 3 year old age classes strong or of average strength (>40% of the catch).	15%
>250,000 tonnes	2 and 3 year old age classes weak or of average strength (<40% of the catch).	15%
>250,000 tonnes	2 and 3 year old age classes strong or of average strength (>40% of the catch).	17.5%

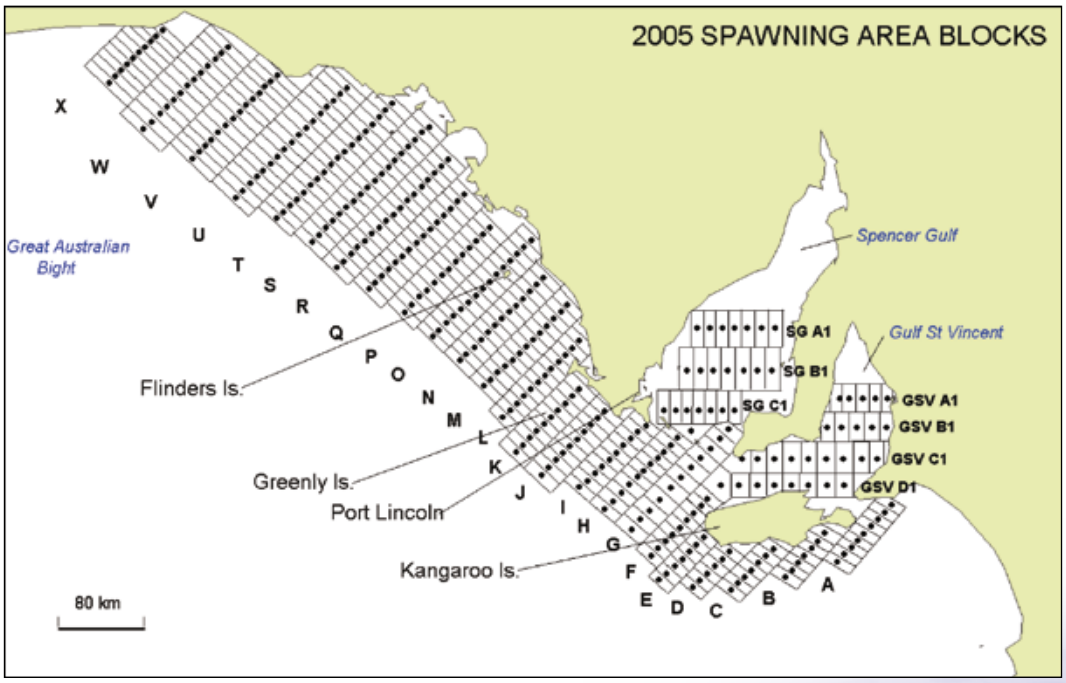
With the substantial increases in the annual TACC, during 2002-2005, increased fishing pressure has also been applied to the stock. As has traditionally occurred with commercial fishing activities, fishing has been undertaken on grounds closest to port. Consequently, large quantities of pilchards (i.e. 51,100 tonnes) are now being taken from the fishing grounds closest to Port Lincoln in the southern Spencer Gulf area.

In 1995, when the TACC was 3,500 tonnes concern surrounding the impact of localised depletion on the target species, as well as the ecological impacts on species dependent on pilchards for prey, was not considered. Following the substantial increases in the annual TACCs that took place during 2002-2005, scientists and policy makers are now considering these impacts.

Background

The information that has been used by scientists to suggest localised depletion in southern Spencer Gulf is the collection of pilchard eggs, as part of an annual fishery independent survey (Ward *et al*. 2005). In two separate surveys conducted between 5-17 February and 9-21 March 2005, a total of 334 stations were sampled for pilchard eggs between Victor Harbour and the head of the bight (Figure 1).

Figure 1. Location of survey stations used to undertake annual egg sampling. (Source: Ward ***et al***. 2005).



The primary purpose of the survey was to collect egg counts from sample sites. The egg count information is then applied to an equation to establish an estimate of spawning biomass. This estimate of spawning biomass is then

used as the primary biological performance indicator to set the annual TACC for the fishery (Table 2).

Scientists in this instance used information from the annual survey to demonstrate evidence of localised depletion, as a result of commercial fishing activities. The basis for demonstrating localised depletion in southern Spencer Gulf was the low egg count in 2005 when compared with previous years (Table 3).

However, the area where a low egg count was recorded was in the sampling sites SG A1, SG B1, SG C1, I, H and J (Figure 1). This area is significantly larger than the area in southern Spencer Gulf where commercial fishing activities are actually undertaken. Fishing activities are undertaken in the areas of SG A1, SG B1 and SG C1 (Figure 1).

Table 3. Total numbers of eggs and eggs collected in Spencer Gulf during sardine spawning biomass surveys between 2000 and 2005.

Year	Total sardine eggs collected	# eggs alive	Total # of sardine eggs collected in Spencer Gulf	# eggs alive in Spencer Gulf	% of total eggs collected in Spencer Gulf	# stns sampled in Spencer Gulf	# of stns in Spencer Gulf with sardine eggs	% positive stns sampled in Spencer Gulf
2000	1362	992	711	545	54.9	56	25	44.6
2001	1449	1122	508	349	31.1	52	16	30.8
2002	1475	1117	236	204	18.3	53	11	20.8
2003	1718	1260	223	185	14.7	53	17	32.1
2004	3186	2576	906	735	28.5	53	18	34
2005	1808	1303	86	68	5.2	54	9	16.7

The conclusion that localised depletion is occurring in southern Spencer Gulf has been drawn from the hypothesis that egg count is directly linked to fish abundance. Therefore, the low egg count obtained in the 2005 survey demonstrates localised depletion (Table 3). This hypothesis has a number of flaws, which are related to the intensity of surveying undertaken and the presence of spawning fish.

In South Australia female sardines spawn 10,000 to 30,000 eggs approximately every 5 to 7 days during a spawning period of 3-4 months during late summer and autumn (Ward *et al.* 2004). Annual egg surveying has historically been undertaken in February and March to coincide with the peak spawning period. Sampling when pilchard eggs are present is necessary as the spawning biomass estimate is proportionally related to the numbers of eggs collected at different sites.

The primary concern that has been raised is that the 2-day sampling of 21 sites in Spencer Gulf (i.e. SG A1, SG B1 and SG C1) may have occurred at a time of low spawning activity. This would account for the low number of eggs collected in Spencer Gulf as part of the survey in 2005 compared with previous years (Table 3).

This hypothesis is supported by the low spawning fractions that were recorded during the entire second 2005 survey from 9 to 21 March, and the fact that only 2 eggs were collected from 14 stations (i.e. SG A1 and SG B1) sampled within the Gulf over two days (Neira *et al.* 2005).

An alternative hypothesis that has been suggested is that spawning may take place in deeper water. This theory is based on research undertaken in Port Phillip Bay and Western Port Bay, Victoria (Hoedt *et al.* 1995; Neira *et al.* 1998) and Albany, Western Australia (Fletcher & Tregonning 1992; Fletcher *et al.* 1992). Research in both Victoria and Western Australia illustrated that spawning occurred predominately on the continental shelf. In addition, pilchards are known to spawn mainly in shelf waters in other areas of the world including New Zealand (Baker 1972), California (Ahlstrom 1959), South Africa (Beckley & Hewiston 1994) and Japan (Nakai & Hattori 1962). The continental shelf is defined as the area of water extending from the territorial sea baseline (12 nautical miles from shore) to a depth of about 200 metres (Geoscience Australia 2005).

The studies in Albany and Port Phillip Bay also illustrated that shallow bays / inlets were nursery areas where spawning was not evident. There are no previous records of pilchards using semi-enclosed bays or inlets as spawning areas. This lack of records may be due to the steep gradients of the continental shelfs that exist on the west coast of America where the largest pilchard fisheries for *Sardinops sagax* are located. The significant declines in depth prohibit the establishment of inshore nursery areas and develop continental shelf spawning environments close to shore.

Should it be concluded that the shallow waters of Spencer Gulf (i.e. <50m in SG A1, SG B1 and SG C1) are not spawning grounds then tidal or wind –driven currents may be moving eggs (advection) from deeper shelf waters. This advection of eggs has been demonstrated in Albany, where research illustrated that prolonged periods of onshore winds moved eggs to inshore areas, where they had not previously been found (Fletcher & Tregonning 1992).

Discussion

While the scientific evidence that has been used to justify localised depletion in Spencer Gulf is based on egg counts, localised depletion in the context of the fishery needs to be better defined.

There is currently no scientific information available on the degree of movement and mixing of pilchard stocks in waters adjacent to South Australia, or on how many stocks may congregate in South Australian waters (Ward *et al.* 2005). The assumption has historically been made that due to the highly motile nature of the species mixing is occurring between stocks throughout its geographical distribution across southern Australia. This is particularly relevant in the TACC setting, which is for the geographical area of waters adjacent to South Australia, even though 90% of the catch is taken in southern Spencer Gulf (i.e. SG A1, SG B1 and SG C1 of figure 1).

Under the assumption that mixing is occurring throughout the stock's geographical distribution localised depletion is an unfounded conclusion, as movement of fish into the southern Spencer Gulf area will offset those fish removed by commercial fishing activities. This constant replenishing of the stock questions the traditional definition of localised depletion. Localised depletion is defined as "the reduction in stock abundance in a localised area to a point where continued fishing will result in recruitment overfishing in that area".

Historically this definition has been linked to stocks that are geographically isolated and/or where limited mixing occurs. In the case of fish stocks with these characteristics localised depletion can be demonstrated by declines in abundance measures used as part of fishery independent assessments. This clearly definitive evidence of localised depletion is not possible in the case of the pilchard stock along the South Australian coast. Consequently, the decision to introduce management arrangements to address or prevent localised depletion would be on a precautionary basis.

Traditionally declines in catch per unit effort (CPUE) and/or catch are the primary indicators of localised depletion. In the case of pilchards the aggregating nature of the species means that the decline in these stock assessment indicators may be significantly more rapid. As a result, the stock in southern Spencer Gulf may become significantly depleted in a relatively short time frame, due to the aggregating nature of the species. This scenario means that the declines in CPUE and catch rates in southern Spencer Gulf may be so rapid that the stock may be significantly depleted before these indicators are able to illustrate a decline.

The movement of fishing effort and catches further from traditional fishing grounds has also historically indicated that localised depletion is occurring. However, the current distribution of CPUE does not illustrate that fishing has moved from traditional grounds.

The issue of localised depletion in southern Spencer Gulf has been discussed in a number of consultative forums with industry. Industry has rejected the position that localised depletion is occurring, as catch rates have remained constant, with no indication of decline. Should a case for localised depletion exist, industry has identified restrictions on the proportion of the TACC that can be taken in southern Spencer Gulf (i.e. zoning) as the preferred management option.

The impact of zoning arrangements on licence holders would result in a proportion of individual quota allocations being taken outside the southern Spencer Gulf area. This scenario will result in a significant increase in fuel costs, which constitutes the single largest expense associated with conducting fishing activities. It is estimated that the actual cost of undertaking fishing activities would double.

The general view amongst decision makers is that evidence demonstrating localised depletion is insufficient at this stage. Indeed, a number of factors could have led to the low egg counts recorded during the 2005 egg survey. The most conclusive position is that spawning occurs predominantly in deeper waters on the continental shelf and not within the main body of Spencer Gulf (i.e. fishing blocks SG A1, SG B1 and SG C1 in Figure 1). Furthermore, any action taken on a precautionary basis would result in significant financial expense being incurred by operators in the fishery. Therefore, until such time as conclusive evidence to illustrate localised depletion exists arrangements restricting the proportion of the TACC that can be harvested in southern Spencer Gulf will not be implemented.

Conclusion

Research will continue to focus on the monitoring of catch and effort data recorded by commercial licence holders in logbooks to ensure a decline in stock abundance in southern Spencer Gulf is not occurring. Should a decline be clearly evident, only then will management arrangements restricting the proportion of the TACC taken in southern Spencer Gulf will be implemented in consultation with industry.

The annual egg survey for 2006 will sample additional sites over a prolonged period in the southern Spencer Gulf to ensure sampling captures eggs from any spawning fish in the area. By increasing the intensity of the sampling more substantiated conclusions of whether or not southern Spencer Gulf is a spawning area can be made.

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