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Great Australian Bight Fisheries: Economic and Social Benchmark Study

Final Report GABRP Project 6.3 - PART A

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GREAT AUSTRALIAN BIGHT RESEARCH PROGRAM

The Great Australian Bight Research Program is a collaboration between BP, CSIRO, the South Australian Research and Development Institute (SARDI), the University of Adelaide, and Flinders University. The Program aims to provide a whole-of-system understanding of the environmental, economic and social values of the region; providing an information source for all to use.

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1. EXECUTIVE SUMMARY

The objective of the study was to establish a benchmark of the current economic and social conditions of the fisheries in the Great Australian Bight (GAB) and their contribution to local and State economies, as well as document current social indicators of satisfaction where available.

Current economic and social conditions

The study was desk based, relying on existing economic and social studies undertaken on fisheries and aquaculture in the region. Fortunately, unlike most Australian States, regular economic surveys have been conducted in South Australia for more than a decade. More recent surveys have also included social metrics. Information on Commonwealth managed fisheries in the region was less available.

In South Australia, total gross value of production (GVP) from fisheries and aquaculture over the last fifteen years has ranged from $400-$500 million per annum, although in real terms (i.e. adjusting for inflation) has declined by around one third. The most valuable South Australian commercial fisheries are the lobster fisheries, where most of the value is taken in the area roughly south west of Kangaroo Island. Other key fisheries (e.g. prawns, blue crab and sardines) largely operate within Spencer Gulf, although catch is taken outside of the Gulf also. The most extensive fishery – the Marine Scalefish Fishery (MSF) – operates mainly along the central and west coast. While relatively low in value, and also relatively low in terms of profitability, this fishery is the largest in terms of number of participants and employment.

Profitability of the South Australian wild caught fisheries has also fluctuated, although for most fisheries has remained positive. However, the profitability of the largest fishery in terms of fishers and vessels, the MSF, has fluctuated between small positive and negative profits. While most fishers are generally satisfied with their incomes, the MSF also contains the highest proportion of dissatisfied fishers. Despite the large proportion of fishers in the MSF that were generally dissatisfied with the income earned, relatively few were considering leaving the industry in the near future, suggesting a strong attachment to the industry for those wanting to stay, and perhaps a lack of alternative employment opportunities for those wanting to leave

Aquaculture production in South Australia is virtually equivalent to wild caught fisheries in terms of GVP. Production is largely found along the Eyre Peninsular and the west coast. Tuna ranching takes place largely around Port Lincoln, on the Eyre Peninsular near the mouth of Spencer Gulf and is the largest aquaculture sector by value in South Australia. Oysters are grown primarily along the west coast from Coffin Bay. Oyster production had increased substantially over the last decade, but has recently been adversely affected as a consequent of the outbreak of Pacific Oyster Mortality Syndrome (POMS) in Tasmania, namely a restriction on importing Spat into SA from Tasmania.

Western Australian fisheries along the GAB are relatively small by comparison, with a GVP of around $21 million in 2013-14. This value, however, derives from a wide range of fisheries, mostly inshore and estuarine based. While aquaculture is undertaken in the area, only a handful of operators exist and information on the value of production is unavailable.

Commonwealth fisheries contribute around $60 million to the fisheries GVP in the GAB. This has declined by 50% in real terms from its peak in 2001-02. Production is dominated by the Southern Bluefin Tuna (SBT) Fishery, which provides the stock for the tuna ranching industry.

Impacts on regional economies

The estimated downstream and flow on effects to other sectors associated with fishing and aquaculture in 2013-14 are substantial. Downstream impacts include fish processing and other

economic activities dependent on the industry, while flow-on impacts represent the derived demand for other services in the region such as boat building, fuel supplies and other related input supplying industries. In South Australia, both wild fisheries and aquaculture each result in total output of around $700 million a year – resulting in a combined downstream and flow on impact of around $1.4 billion – and the generation of household incomes of around $350 million a year.

In the Western Australian fisheries in the GAB, the impact on the local economy is uncertain. No recent study has been done, and the only previous (and non-recent) study was at the State wide level. From this, the fisheries may generate up to an additional $23 million in flow-on benefits to the regional economy.

Recreational fishing

Recreational fishing in South Australia involves a charter boat sector as well as non-charter boat fishing. The total revenue of the charter boat sector is around $4.3 million a year – relatively small compared with the commercial fishing fleet. However, GVP in this case is based on revenue raised from charging recreational fishers rather than reflecting the value of the fish caught. Charter boat based recreational fishing provides other indirect economic impacts, namely as most anglers also need to travel to the ports and stay in local accommodation. This is estimated to generate an additional $20 million in benefits to the local economies.

From the last available recreational fishing survey (2013-14), over a quarter of a million recreational fishers were estimated to have fished for nearly one million days (with around 20,000 of these days potentially included also in the charter boat GVP). Based on these values, and assuming similar levels of recreational benefits per trip as found in other South Australian studies, recreational fishing in South Australia may generate around $115 million a year in non-market benefits (i.e. consumer surplus, the benefit to fishers over and above their actual expenditure). However, comparing these values with commercial fisheries is complex. Recreational fishers have been found elsewhere to have alternative recreational activities with similar values. As a result, loss of access to recreational fishing may have little cost (in terms of forgone recreational benefits) for many fishers if they are able to substitute this for other activities.

2. INTRODUCTION

2.1 Overview

The Great Australian Bight (GAB) supports a wide range of anthropogenic activities including fisheries (both recreational and commercial) and tourism, as well as providing habitat for a range of iconic marine mammals (e.g. seals and whales). The exact definition of the GAB varies, with the International Hydrographic Organization (IHO) considering it ranging from the south west tip of Western Australia across to the southern tip of Tasmania (the area enclosed by the red lines in Figure 1), while the Australian Hydrographic Service (AHS) considers it to be the area between Cape Pasley in Western Australia to Cape Carnot in South Australia (the area enclosed by the green line in Figure 1).

The primary aim of this study is to provide an overview of the most recently available information on the economic value and contribution of the fisheries and aquaculture sectors in the GAB to the local communities. The purpose in this is to provide a benchmark of current conditions and economic drivers in these fisheries. Given that the areas of the fisheries extend beyond the area of the GAB defined by the AHS, but not as far as the area defined by the IHO, a pragmatic approach to defining GAB fisheries has been adopted, namely to consider all South Australian managed fisheries, Western Australian fisheries in the South Coast Bioregion, and the Commonwealth fisheries that are identified as operating in the GAB (i.e. the GAB trawl and the Southern Bluefin Tuna (SBT) fishery). Analysis of recreational fisheries are limited to those in South Australia only (as comparable data for the Western Australian area are not available). For the purposes of the Great Australian Bight Research Program (GABRP) the GAB is defined as extending from Cape Pasley, Western Australia to Cape Catastrophe, Kangaroo Island, South Australia.

Figure 1. Area of the Great Australian Bight as defined by the IHO and AHS

Source: Urhixidur, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=32097099

2.2 Background and need

The GAB has substantial fisheries resources that form the basis of a number of State and Commonwealth managed fisheries. Under the broader definition of the GAB (i.e. that of the IHO), South Australian, and parts of the Western Australian, Victorian and Tasmanian State fisheries, all contribute to the total fisheries production from the GAB. As noted above, for the purposes of this study we are considering only South Australian and Western Australian fisheries in the south coast, as well as Commonwealth fisheries that occur in the GAB.

South Australia is the second largest Australian producer of wild caught fish by value (after Western Australia) from State fisheries, and the second largest aquaculture producer by value (after Tasmania) (ABARES 2015b). Several Commonwealth managed fisheries – the SBT Fishery, Southern and Eastern Scalefish and Shark Fishery, Small Pelagics Fishery and Southern Squid – also operate in the GAB, while the range of several other Commonwealth fisheries extend into the GAB.

While relatively small at the State level, commercial fishing is a major component of many regional economies, especially those away from the main metropolitan regions, contributing as much as 14% of gross value of production (GVP) in some regions (EconSearch 2012). Despite its relative economic importance, a survey of social indicators in several South Australian fisheries in 2011-12 found that satisfaction with fishing in some parts of the industry was low (Triantafillos *et al.* 2014).

2.3 Study objective

The objective of the study was to establish a benchmark of the current economic and social conditions of the fisheries in the Great Australian Bight (GAB) and their contribution to local and State economies, as well as document current social indicators of satisfaction where available.

To this end, the study compiles information from a number of previous studies and data sources to provide a composite overview of the most recent information on the social and economic performance of the fisheries in the GAB. These include the commercial fishing industry, and to the extent possible, recreational fishing and aquaculture.

3. METHODS

The main focus of the study was the development of an economic and social benchmark indicating recent conditions in the fisheries and aquaculture sector. This part of the project largely involved a desktop compilation of existing information on the fisheries and aquaculture, including information collected in previous social and economics surveys of the fisheries as well as available spatial information collected on both the State and Commonwealth fishing fleets active in the GAB.

Regular economic surveys of the key South Australian fisheries are undertaken by EconSearch, the results from which are publically available (e.g. EconSearch 2014b). Similar reports on the aquaculture sector are also available on a less frequent basis (e.g. EconSearch 2014a). Economic surveys of Commonwealth fisheries in the GAB are not routinely undertaken, although assessments of the economic performance of these fisheries are provided in the annual fisheries status reports (e.g. Georgeson *et al.* 2014). Information on recreational fishing activity is limited, with recreational fishing surveys undertaken only in 2000-01 (Henry and Lyle 2003), 2009 (Jones 2009) and 2013-14 (Giri and Hall 2015). A recreational charter sector also exists which is more regularly surveyed. The recreational charter sector is considered as part of the commercial fisheries for management purposes in SA, although operates differently to other commercial fisheries.

Data from the economic surveys were used to provide a snapshot of the most recent economic performance of the fleets involved in the GAB. Sensitivity of economic performance to changes in catch, prices and costs were assessed through a simple stochastic analysis (i.e. the revenues and costs were varied stochastically and effects on average economic performance were derived). This provided an indication of the potential economic resilience of the different fleet segments to short term shocks.

Social surveys of key inshore fisheries as well as recreational fisheries in South Australia were undertaken in 2011 as part of an FRDC project assessing social performance of management (Triantafillos *et al*. 2014) and have also been undertaken as part of the more recent economic surveys of selected fisheries (e.g. EconSearch 2014c). Of key relevance to this project are assessments about current levels of satisfaction with fishing, attachment to the industry, and relative income, as each of these measures is potentially affected by the development of an oil industry in the area. Other social indicators have been collected in studies related to the marine park impact assessment (EconSearch 2012).

4. RESULTS

The fisheries industry in the GAB consists of three main components: a number of State managed fisheries that comprise most of the wild catch; a relatively small number of Commonwealth managed fisheries; and an aquaculture industry in inshore and coastal waters. Under the offshore constitutional settlement, management responsibility for fisheries is devolved to either the State or the Commonwealth government (Haward 1989). While responsibility is determined fishery-by-fishery, the general principle is that fisheries that are wholly within State waters are managed by the State, while those fisheries that straddle State waters, or occur wholly within Commonwealth waters, are managed by the Commonwealth.

Recreational fisheries also exist, mostly within State waters.

The following sections will outline the key current economic status of the different fisheries in the region, their contribution to the broader economy and, where possible, the social performance of these fisheries.

4.1 South Australian fisheries and aquaculture

4.1.1 Economic activity of fisheries in South Australia

Total gross value of production (GVP) from fisheries and aquaculture has remained relatively constant over the last decade in nominal terms, generally ranging between $400-$500 million per annum (Figure 2), although in real terms[1] (2013-14 dollars) has declined by around one third (Figure 3). Most of the inter-annual variation occurs in aquaculture production, with the wild caught fisheries being relatively stable in terms of value of production in nominal terms. Similarly, most of the reduction in fisheries and aquaculture GVP in real terms since 2000-01 has been in aquaculture, with this sector declining in value by 50% in real terms over this period.

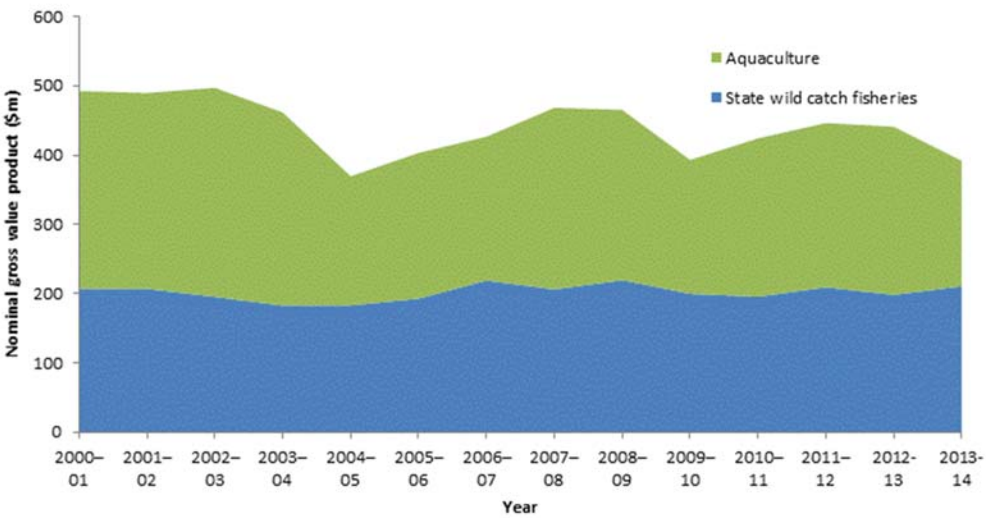

Figure 2. Nominal gross value of production, SA fisheries

Derived from ABARES (2013),(ABARES 2015b) (EconSearch 2014a; b)

[1] Real values are annual values adjusted for the general inflationary effects. Details on the calculation of real values are given in the Appendix.

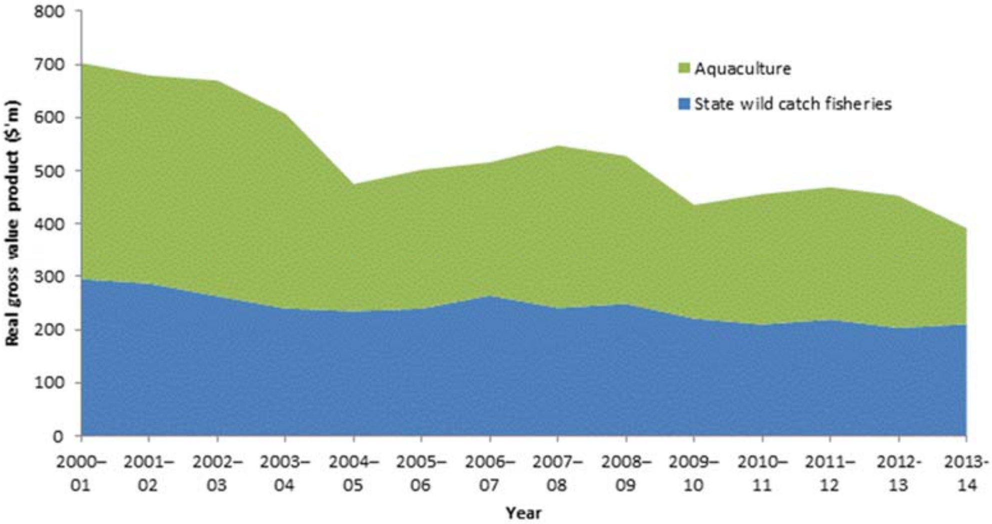

Figure 3. Real gross value of production, SA fisheries, 2013-14 dollars

Derived from ABARES (2013),ABARES (2015b) and (EconSearch 2014a; b)

The South Australian share of Australian fisheries and aquaculture GVP has declined from around 25% at the start of the century to around 18% in 2013-14 (Figure 4). However, South Australian fisheries' and aquaculture GVP is second only to Western Australia in terms of wild caught fisheries, and second to Tasmania in terms of aquaculture value (ABARES 2013; 2015b).

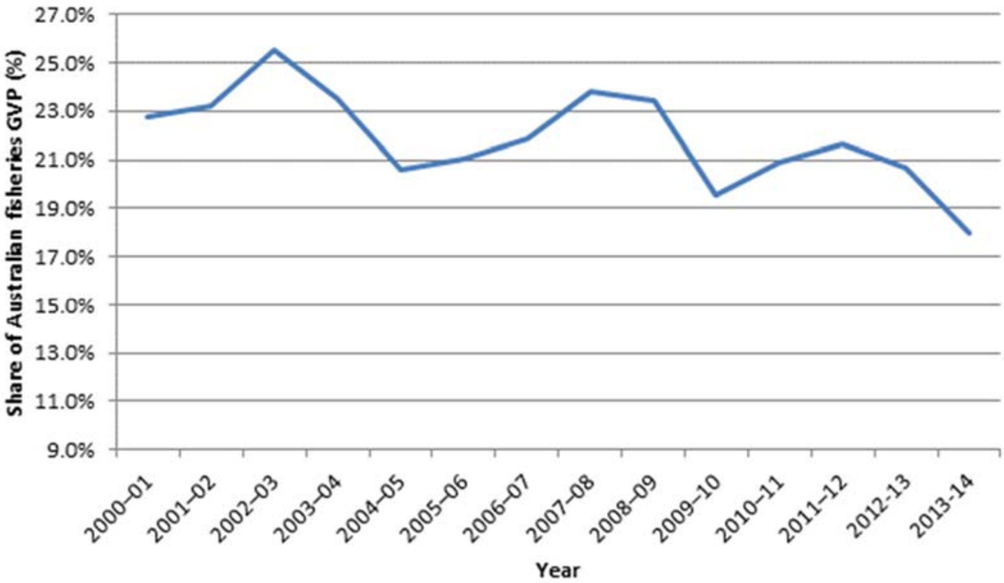

Figure 4. SA share of Australian gross value of fisheries and aquaculture production

Derived from ABARES (2013); 2015b)

Wild caught fisheries are dominated by high valued species such as lobster, prawns and abalone (ABARES 2013; 2015b). Lobsters comprised over 40% of the total value of production in 2010-11, increasing to over 50% in 2013-14 (Figure 5). In contrast, sardines constitute almost 80% of the catch

by volume, but only less than 10% by value (Knight and Tsolos 2012; ABARES 2015b). Other fish species are largely taken in the Marine Scalefish Fishery (MSF), a multispecies fishery dominated by snapper and King George whiting. Prawns and abalone comprise most of the remainder of the value of catch (Figure 5).

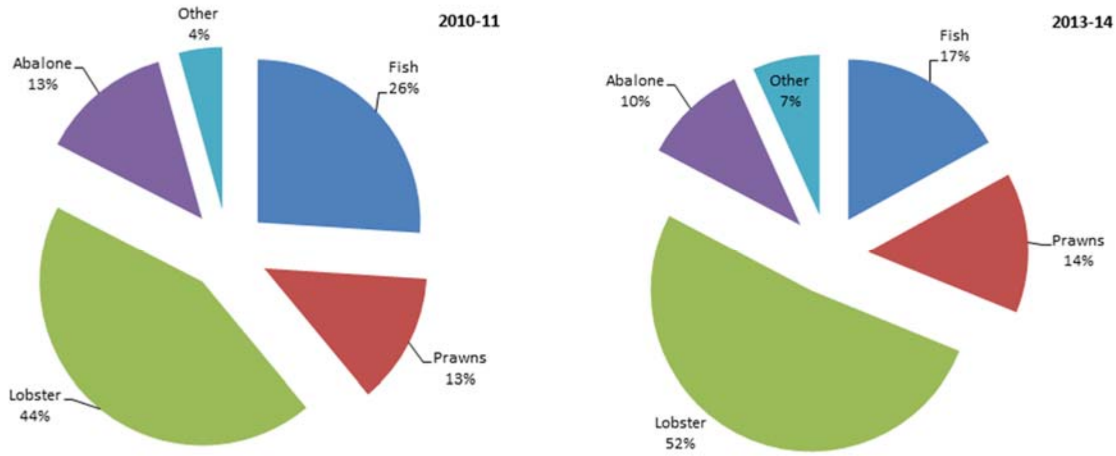

Figure 5. Key species group by value, SA wild fisheries, 2010-11 and 2013-14

Derived from ABARES (2013); (ABARES 2015b)

The aquaculture industry is largely based on grow-out (or ranching) of juvenile SBT initially taken from the wild fishery. The tuna ranching activity contributes around two thirds of the value of aquaculture production in South Australia. The pacific oyster industry has also developed into a major aquaculture industry, with South Australia now the major producer of pacific oysters in Australia (Schrobback *et al.* 2014b; a).However, the recent (2016) outbreak of Pacific Oyster Mortality Syndrome (POMS) in Tasmania has indirectly also affected SA producers. As much as 80 per cent of oyster spat had been obtained from Tasmania, the supply of which banned following the POMS outbreak. As a result, oyster production will be substantially lower in 2017 and 2018, with oyster production not expected to fully recover to recent levels until mid-2019.

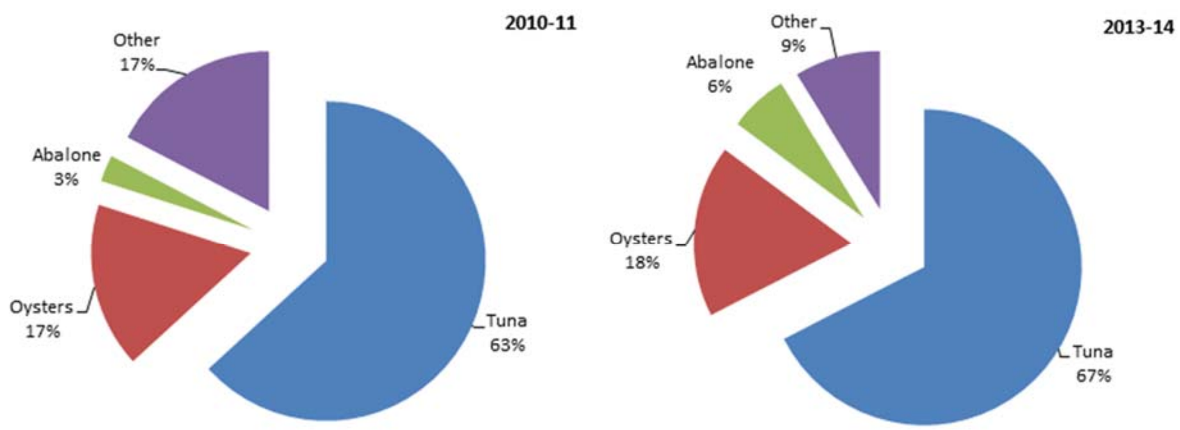

Figure 6. Key species group by value, SA aquaculture, 2010-11 and 2013-14

Derived from ABARES (2013); 2015b)

Two years are illustrated in Figure 5 and Figure 6 to show that these relationships are not static, but vary between years due to relative changes in stock abundance and prices. The different fisheries and aquaculture sectors have demonstrated substantially different changes over time in regard to both of these components. Real prices received for most key species have declined over the last decade (Figure 7), although trends in prices and quantity landed varied considerably between species groups.

In the case of fish species, the large increase in the quantity of fish landed predominantly reflects the increase in sardine landings, increasing from an average of around 4,000 tonnes prior to 2000-01 to peak at 46,000 tonnes in 2004-05 (the average was 37,000 tonnes from 2005-06 to 2013-14) (Knight and Tsolos 2012; ABARES 2015b). This increase in the relatively low value species was a main factor driving average fish prices to around half that of fifteen years ago, although it was sufficient to maintain (or increase) real gross value of product over the period of the data.

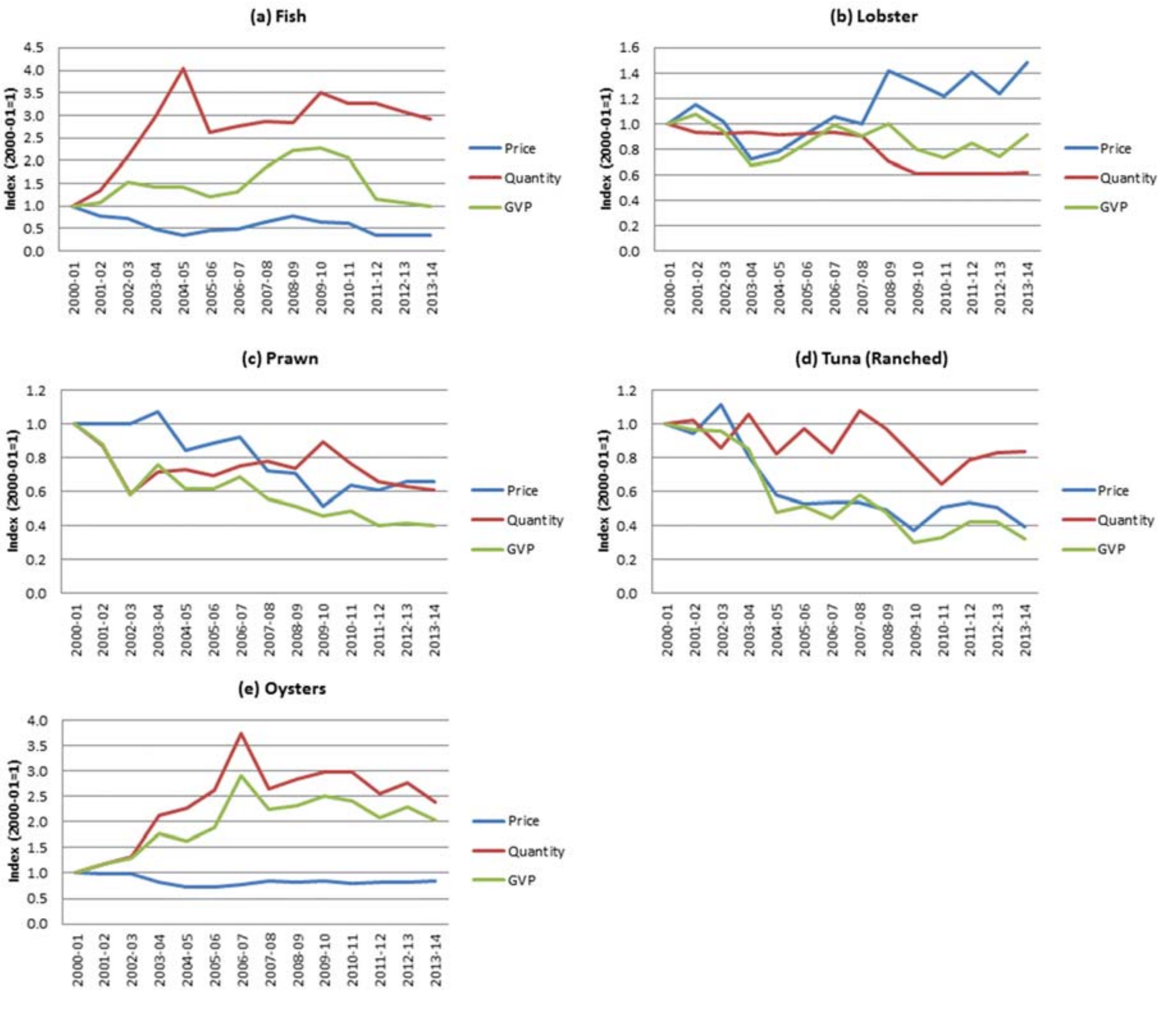

Figure 7. Drivers of revenue change, key South Australian fisheries

Derived from ABARES (2015b) and previous issues

In contrast, lobster prices increased (in real terms) largely due to the development of the live lobster market in Hong Kong (Norman-López *et al.* 2014), with over 90 per cent of the current catch exported live (Linnane *et al.* 2014). Total allowable catches were also reduced from 2007-08 due to concerns about stocks following a period of declining catch and catch rates between 1998 and 2008 (Linnane *et al.* 2014), but have remained relatively constant since 2009-10.

Prawn prices have also declined in real terms over the last decade, following a national trend largely driven by an increase in imported farmed prawns. Fishing effort has correspondingly decreased, although increasing catch rates resulted in catches remaining relatively constant over much of the last decade (Noell *et al.* 2014). The decline in GVP of the prawn fisheries largely tracks the decline in price.

Aquaculture production has also had different underlying drivers of value change. Tuna prices declined in real terms substantially between 2002-03 and 2004-05, and have continued to decline at a lesser rate ever since. As with prawns, the decline in GVP reflects this price decline rather than quantity changes, although production has declined in recent years (most likely due to the lower price).

The development of the pacific oyster industry in South Australia has resulted in substantial increases in production, with South Australia now being the dominant producer of the species in Australia. This increased production has had a small negative impact on oyster prices nationally (Schrobback *et al*. 2014b), although, until recently due to the POMS outbreak in Tasmania, the increased production has resulted in a net increase in GVP since 2000-01 (Figure 7).[2]

4.1.2 Economic performance of key South Australian fisheries

Over the last decade, the total number of active fishing vessels in South Australian fisheries has declined, largely driven by declines in the MSF (Figure 8), which declined by roughly 25% between 2001-01 and 2013-14. During this period, the fleet experienced negative full equity profits on average,[3] with relatively few years of positive economic profits (Figure 9).

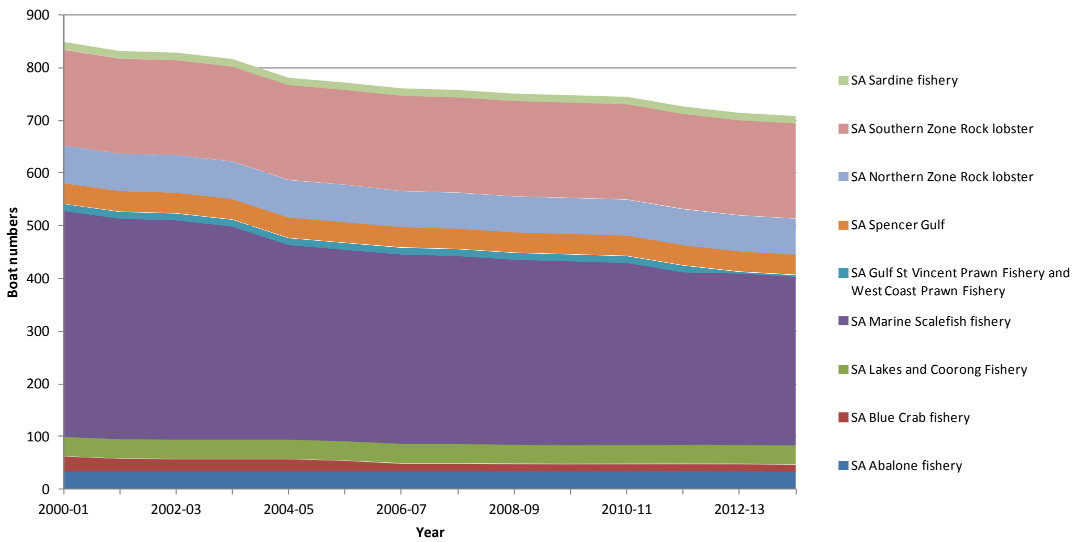

Figure 8. Active boat numbers in key SA fisheries, 2000-01 to 2013-14

[2] An outbreak of Pacific Oyster Mortality Syndrome (POMS) in Tasmania in 2016 has had a subsequent indirect impact on the South Australian Oyster industry. The South Australian industry sources much of its spat from Tasmania. A ban on moving spat from Tasmania following the POMS outbreak has caused a shortage in SA, which will affect production in the coming years. Hatchery production in SA has increased, but is still short of industry demands. On the positive side, prices received are believed to have increased by 20% due to the decrease in supply from Tasmania (Neindorf 2017). These changes are not reflected in the available information (which goes to 2013-14 only).

[3] Full equity profits are revenue less all cash costs, depreciation and an allowance for unpaid labour, but excluding any interest paid or lease costs (as these are effectively transfers of profits from the fishers to the owners of the assets, and also vary from vessel to vessel based on levels of equity rather than economic performance per se). They represent the return to the vessel and other boat capital (e.g. quota, gear etc.) assuming it was fully owned by the operator.

In 2013-14, the fisheries directly employed over 1,150 full time equivalent fishers, almost half of which were employed in the Southern Zone Rock Lobster Fishery (Table 1). In contrast, the largest fleet (the MSF) employed around one quarter of the total fishers. This was largely due to the fleet consisting primarily of owner operators, at least some of which operated on a less than full time basis.

Table 1. Direct employment by fishery, SA fisheries, 2013-14

Fishery	Active boats	FTEs	FTE/boat
Abalone	35	71	2.0
Blue Crab	13	28	2.2
Lakes and Coorong	36	40	1.1
Marine Scalefish	321	287	0.9
Spencer Gulf and West Coast Prawn (Prawn SGWC)	39	88	2.3
Northern Zone Rock lobster (RLNZ)	68	112	1.6
Southern Zone Rock lobster (RLSZ)	181	493	2.7
Sardine	14	37	2.6

Derived from EconSearch (2015b)

Profitability of the fisheries also varies considerably. The most consistently profitable fisheries over the last decade have been the abalone and southern zone rock lobster fisheries (Figure 9).[4] The blue crab, sardine and Lakes and Coorong fisheries also generally returned positive full equity profits, although at a lower level. The Gulf St Vincent Prawn Fishery had a median full equity profit level of zero, indicating that it made economic losses on average 50% of time over the period examined,[5] while the MSF had a median full equity profit of less than zero.

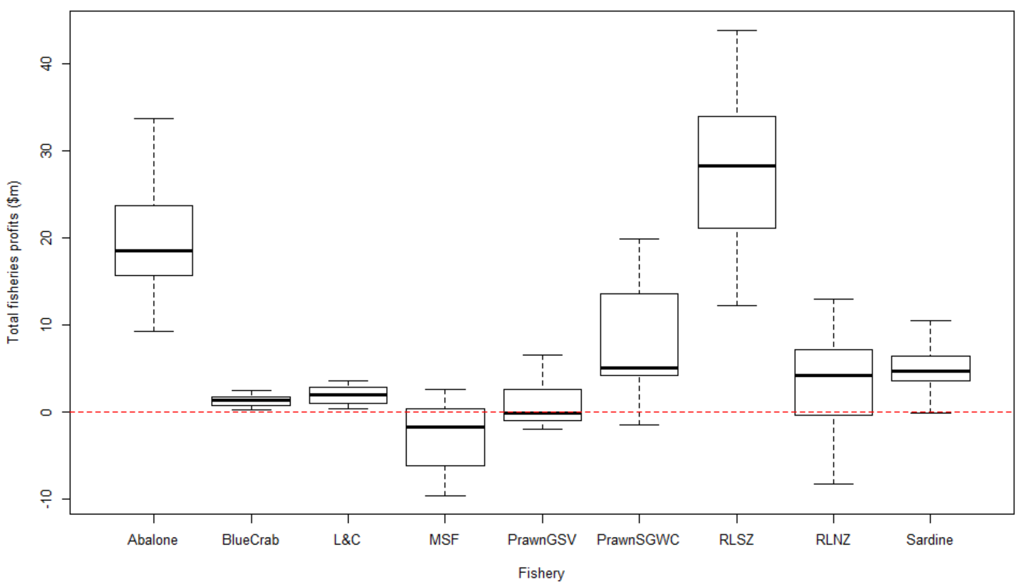

Figure 9. Fishery full equity profits, 1997-98 to 2013-14 (real 2013-14 dollars)

Derived from EconSearch (2015b) and earlier editions

[4] The thick line within the boxes in Figure 9 represent the median value observed in the data; the box itself represents the range of values making up 50% of all observations, while the bounds at either end represent the 95% range of data. Observations outside the 95% range are not shown.

[5] The fishery was closed in 2012-13.

Absolute full equity profit levels do not take into account the levels of investment in the area. The rate of return to capital represents full equity profits as a percentage of capital values, which include both the value of licence (including quota where applicable) and physical assets (e.g. boat, gear, etc.). Rates of return to capital can be compared with returns from other industries to determine if economic profits (i.e. resource rents) exist in the fishery. Over the period of the data, the average risk free interest rate (based on the 10 year Government Bond rate) was around 5%.[6]

The full equity rate of return to capital (RFE) is given by

$$RFE = \frac{full\ equity\ profit}{boat\,value + licence\ value} \tag{1}$$

where boat value is the estimated market value of the fishing vessel, gear and associated electronics (and also includes on-shore capital such as sheds if applicable). Licence values are based on licence holders' estimates of the value of their licences based on survey responses (i.e. EconSearch (2015b) and earlier editions). Given that the market for second hand vessels is "thin" (i.e. very few transactions occur in any one year), and that licences are also not permanently traded often,[7] the estimates are uncertain. In some fisheries there was a high degree of variability in the licence holders' estimates of licence value. As the analysis is based on average values from the survey, it is assumed that "on average", the estimates are reasonably reliable.

The rates of return to total boat capital (licence/quota values and boat capital value) for the different fisheries are compared to the break-even (red line) and average long run risk-free normal return (blue line) in Figure 10. Theoretically, licence values reflect the discounted expected future rent generated in the fishery. In most years, the majority of fisheries are earning below normal rates of return, suggesting that either licences are overvalued relative to the level of profitability (i.e. includes a substantial option value or reflecting some other non-monetary benefit associated with fishing), that the fishery is consistently performing below its expected long term level of profitability, or that the fishers have a lower discount rate than the risk free rate.

While the ranges of the observed data overlap, the type of management, and the strength of property rights in particular, seemed to affect the rate of return (Figure 10b). The median rate of return for fisheries managed under individual transferable quotas (ITQs) was at the long term risk free rate, suggesting that the licence values were reliable estimates of the future discounted profits in the fishery. For the individual transferable effort (ITE) quota and input controlled fisheries (which had the weakest property rights),[8] the median rate of return was less than the expected risk free rate, suggesting that expectations about future profits exceeded those realised during the period examined. The considerable variation around the median of the input controlled fisheries reflects the variation in annual profitability rather than variations in licence values, suggesting that the input control fisheries were also subject to greater inter-annual fluctuations than those fisheries with better defined property rights.

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[6] Reserve Bank of Australia historical data http://www.rba.gov.au/statistics/historical-data.html#interest-rates. Over the period of the data the rate ranged from 2.6% to 7.18%.

[7] Annual leasing, especially of quota, is more common. In theory, lease prices should be proportional to sale value, but this relationship is not constant and can be influenced by management (Newell *et al.* 2005).

[8] ITQ fisheries: Abalone, Blue crab, southern zone rock lobster (and northern zone for some years), sardines; ITE Northern zone rock lobster (most years); input controls: GSV Prawn, SGWC Prawn, Lakes and Coorong, MSF.

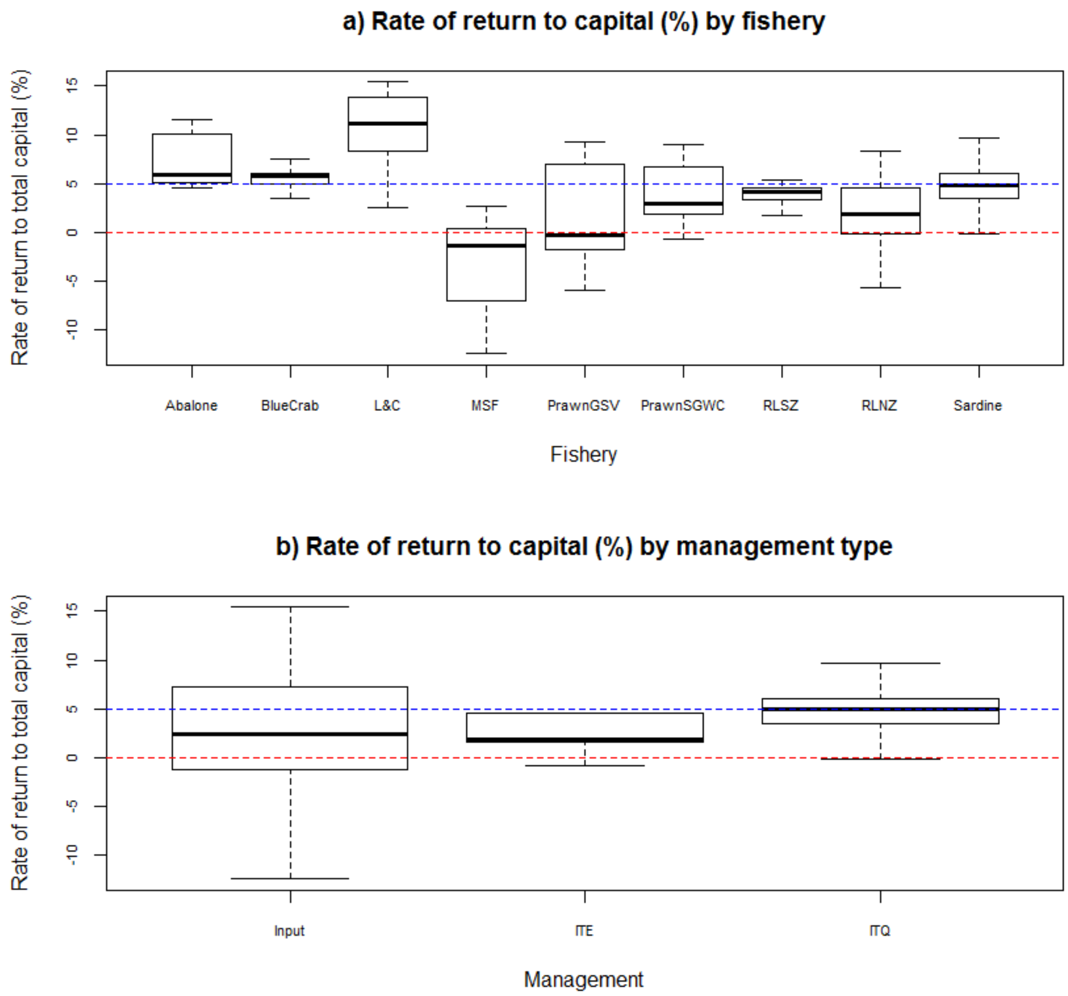

Figure 10. Rate of return to capital by a) fishery and b) management type, 1997-98 to 2013-14

For all fisheries, licence value made up over half of the total capital value, and for some fisheries (e.g. abalone and southern zone rock lobster), licence value was almost all of the capital value in the fishery (Figure 11). As with rates of return to capital, there is an apparent relationship between the share of licence value to total capital value and the strength of property rights, with the ITQ fisheries generally having a greater share of licence value than ITE and input controlled fisheries (Figure 12).

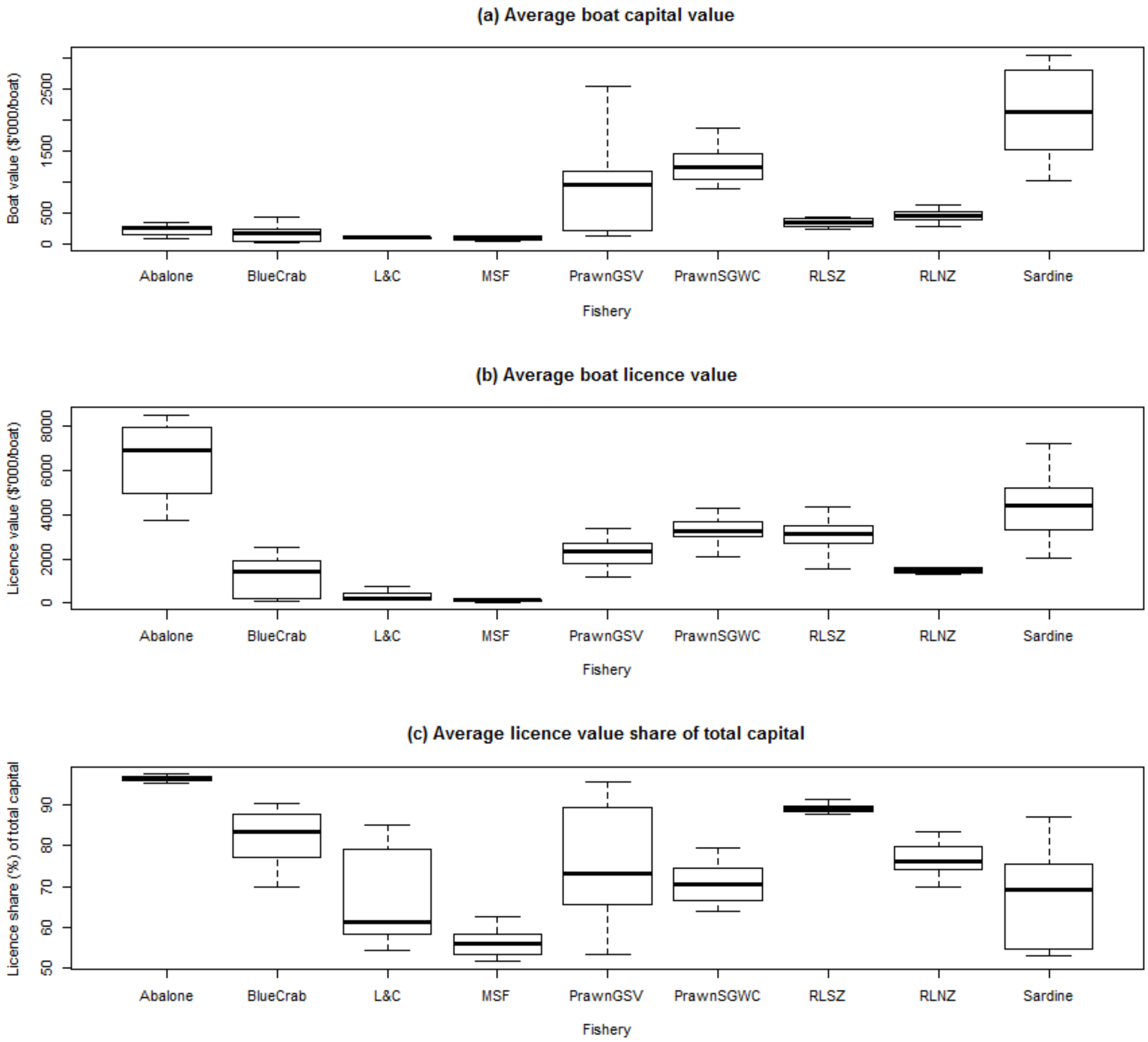

Figure 11. Boat capital values Vs licence values, 1997-98 to 2013-14

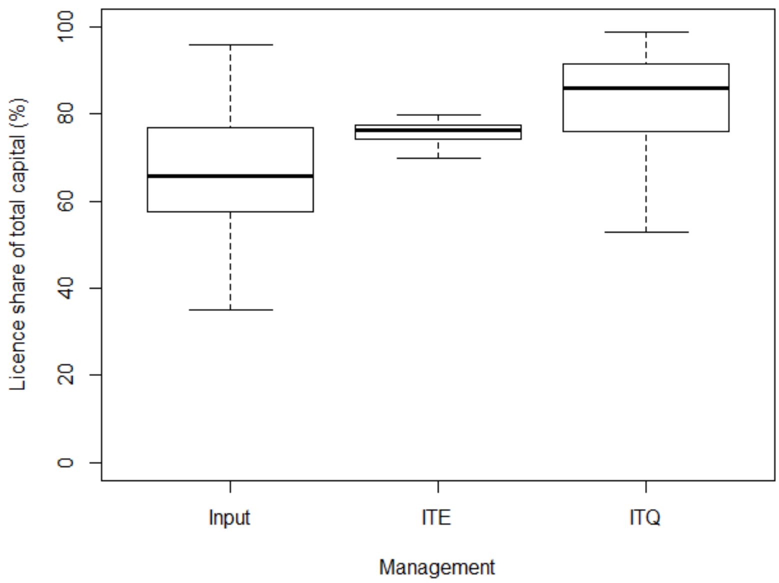

Figure 12. Licence share of capital by fishery management type, 1997-98 to 2013-14

Given that licence values (in theory) reflect discounted *expected* future profits in the fishery,[9] an alternative measure of GVP to measure fisheries' values is the total licence value. Based on this, the total value of South Australian fisheries (as an asset) is between $1.6 billion and $1.7 billion in real terms (2013-14 dollars) (Figure 13). This excludes the value of physical capital involved in the fishery, and reflects the value of the fisheries resource as currently managed. Changes in management, particularly through improved property rights, where practical, may result in further increases in value.

Most of the value is embedded in two fisheries, namely the southern zone rock lobster (SZRL) and abalone fisheries. Since 2004-05, total values have declined in real terms (Figure 13), largely driven by declines in the abalone fishery.

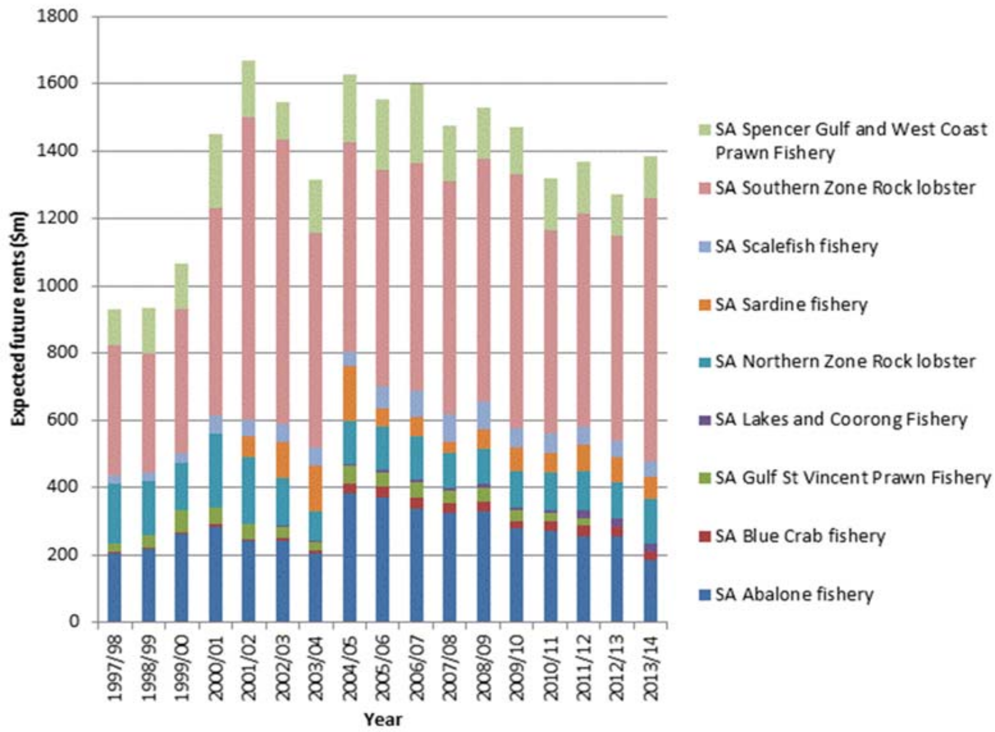

Figure 13. Total value of SA commercial fisheries resources, 1997-98 to 2013-14 (2013-14 real values)

4.1.3 Sensitivity of vessel profits to changes in input prices

To determine the potential impact of any input price changes, the relative sensitivity of fishery (modified) cash profits to a range of input price changes was tested in a simulation framework. Cash profits, rather than full equity profits, were used as one of the fleets (the MSF) was making negative full equity profits in 2013-14. Interest payments were excluded (consistent with full equity profits), and an allowance for unpaid owner-operator costs was included with crew costs. Consequently, only depreciation costs were excluded from the measure of profits.

Economic data for the key fleets in 2013-14 were used to develop a simple model of the fisheries. The model was static; in that only one component was assumed to change at a time, and there was

[9] From the previous equation (1), and assuming that the RFE represents the fishers' discount rate, then licence values can be given by $licence\ value = \left(\left[E(full\,equity\,profit) - i(boat\,value)\right]/i\right)$, where the second term in the numerator represents the opportunity cost of capital.

assumed to be no effort response as a result of that change (e.g. effort was assumed not to change in response to fuel prices). For each fleet, variable costs were given by:

$$VarCost_i = Fuel_i * p_f + RM_i * p_{rm} + p_{crew} * crewshare_i * Rev_i + BaitIce_i + Provisions_i + Other_i \quad (2)$$

where *VarCost*$_i$ is the total variable costs for each fleet *i* (average per boat), *Fuel*$_i$ is the observed (2012-13) fuel costs, *RM*$_i$ is the observed repairs and maintenance costs, *crewshare*$_i$ is the average observed crew share of revenue (including an allowance for owner-operator labour), *BaitIce*$_i$ is the observed bait and ice costs, *Provisions*$_i$ is the observed food and provisions costs, *Other*$_i$ are other running costs and *Rev*$_i$ is the observed average revenue of vessels in fleet *i*. The parameters p_f, p_{rm}, and p_{crew} are stochastic relative input price shifters, assumed to have a truncated distribution at 1 (i.e. all values greater than 1). These change the associated cost due to a change in price (assuming quantity used remains the same).

Average cash profits (*Profits*$_i$) were given by

$$Profit_i = Rev_i - VarCost_i - FixCost_i \quad (3)$$

where *FixCost*$_i$ is the fixed costs associated with fleet *i.* These fixed costs did not include interest payments or leasing costs.

The sensitivity of the vessel profits was given by

$$SI_i = abs\left[\left(\frac{Profit_i - Profitbase_i}{Profitbase_i}\right) \Big/ (p_* - 1)\right] \quad (4)$$

where SI_i is a sensitivity index of vessel profits to the change in input price p^*, where p^* is either p_f, p_{rm}, or p_{crew} depending on which price is being tested,[10] and *Profitbase*$_i$ is the original profit before the price change. The sensitivity index is essentially an elasticity representing the percentage change in profits from a one percent change in input price.

The key economic information used in the analysis is presented in Table 2, relating to the 2013-14 financial year (EconSearch 2015b).

Table 2. Key financial data by fishery, $'000 average per boat 2013-14

Fishery	Abalone	Prawn SGWC	RLSZ	RLNZ	Blue Crab	MSF	Sardines
Revenue	644.5	717.5	610.6	530.8	452.6	80.8	1,448.7
Fuel	18.3	83.0	38.0	35.7	43.3	10.2	159.7
R&M	23.8	49.6	33.4	27.1	31.8	5.8	107.5
Bait, Ice	0.4	6.5	16.7	14.0	8.1	2.3	0.4
Provisions	0.7	5.7	0.6	4.5	2.4	0.5	23.1
Crew costs[a]	183.7	247.6	158.6	135.1	132.7	27.6	406.0
Other	9.4	0.6	2.1	4.0	0.3	0.5	18.3
Fixed cost	101.7	90.6	65.0	76.3	54.1	21.9	193.2

a) Includes an allowance for unpaid crew costs i.e. owner-operators. Source: derived from EconSearch (2015b)

[10] The value of p_* had a minimum value of 1.001 to ensure the denominator of (4) could not equal zero.

The results of the analysis relating to changes in input prices are presented in Table 3. A sensitivity index value greater than 1 indicates that there is a greater than proportional impact on profits. A value less than 0.5 suggests that there is a relatively low impact on profits.

Table 3. Average sensitivity of vessel cash profits to key input price changes: Sensitivity Index (SI) scores

Fishery	Abalone	Blue Crab	MSF	Prawn SGWC	RLNZ	RLSZ	Sardines
Fuel price	0.06	0.24	0.87	0.35	0.15	0.13	0.30
R&M costs	0.08	0.18	0.49	0.21	0.12	0.11	0.20
Crew share	0.60	0.74	2.33	1.06	0.58	0.54	0.75

Sensitivity of cash profits to input price changes varied considerably between fleets and also between different inputs. All fisheries were most sensitive to changes in crew shares, as these tend to represent a substantial proportion of the fishing revenue (Figure 14). In the case of the MSF, a one percent increase in the crew share would result in a 2.3 per cent decrease in profits. The high sensitivity of the MSF to all input price changes largely reflects the low level of profitability in the sector (Figure 14). With profits being only 10 per cent of revenue, any cost change will have a substantial proportional impact on profits. Changes in crew costs in particular affect the profitability of this and the other fleets by the greatest proportion.

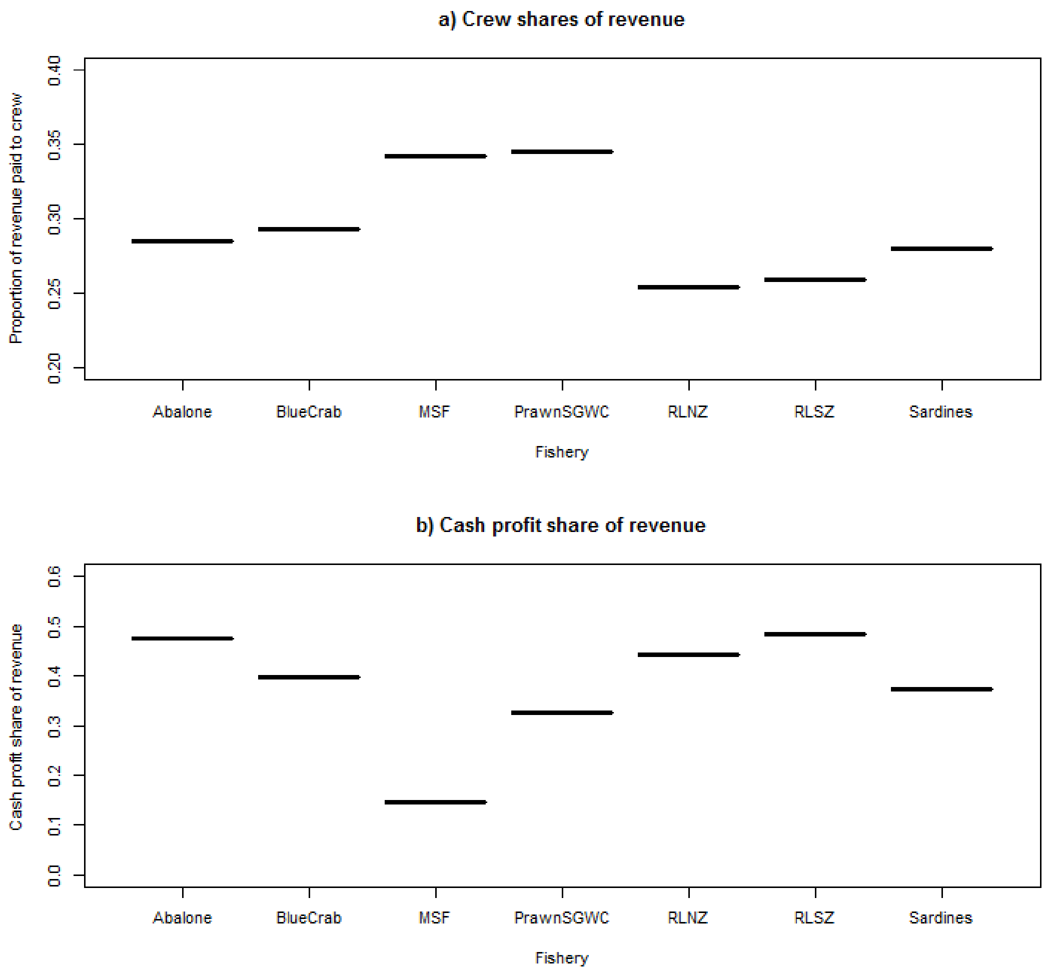

Figure 14. Crew share and profit share of revenue, 2013-14

Sensitivity to changes in fuel prices also varied considerably. Abalone vessels were relatively insensitive to fuel price changes, as fuel comprised a relatively small proportion of the costs. The MSF was again the most sensitive, with a one percent increase in fuel costs resulting in almost a 0.9 per cent decline in profits, reflecting function of the relatively low profitability of the fishery.

4.1.4 Sensitivity of vessel profits to changes in output prices and stock conditions

Profitability is also affected by changes in revenue as well as changes in costs. Revenues can change as a result of either changes in output prices or catch rates (which affect total catch). The latter are largely dependent on the relative stock abundance.

While both prices and stock changes affect revenue, their effect on profits is potentially not the same. In the case of a reduction in output due to stock changes, there is potentially a price response given by the own-price flexibility. Own price flexibility represents the percentage change in price given a one percent change in quantity supplied (i.e. landed). To allow for this, we redefine revenue as

$$NewRev_i = Rev_i * s_i * (1 + f_i(s_i - 1)) \quad (5)$$

where *NewRev*$_i$ is the revised estimate of revenue for Fleet *i*, s_i is the stochastic stock change multiplier, assumed to have a truncated distribution at 1 (i.e. all values less than 1), and f_i is the price flexibility. Empirical studies of own price flexibilities for Australian fisheries are very limited. Recent (as yet unpublished) CSIRO work suggests that the own price flexibility for lobsters on the domestic market is around -0.3 (Norman-López *et al.* 2015). Other earlier studies suggested that price flexibilities for common inshore fish species ranged from around -0.3 to -0.6 (Pascoe *et al.* 1987; Smith *et al.* 1998; Bose 2004). For the sake of the analysis, three levels of price flexibility were assumed: zero for the abalone as these are predominantly exported (on the assumption that SA quantities do not affect world market supplies and hence prices are exogenous), -0.25 for lobster fisheries assuming a mix of domestic and international sales, and -0.5 for the remaining species that are predominantly sold on local markets.

In the case of the analysis involving price changes only, we redefine revenue as

$$NewRev_i = Rev_i * p_f \quad (6)$$

where p_f is a stochastic output price change factor, again assumed to have a truncated distribution at 1 (i.e. all values less than 1). The other equations (i.e. 2-4) remained effectively the same, with *NewRev*$_i$ replacing *Rev*$_{i.}$

The results of the analysis relating to revenue related changes are presented in Table 4. As before, a sensitivity index value greater than 1 indicates that there is a greater than proportional impact on profits. A value less than 0.5 suggests that there is a relatively low impact on profits.

Table 4. Average sensitivity of vessel profits to stock and output price changes: Sensitivity Index (SI) scores

Fishery	Abalone	Blue Crab	MSF	Prawn SGWC	RLNZ	RLSZ	Sardines
Stocks	1.50	0.93	2.36	1.05	1.29	1.16	1.01
Output prices	1.50	1.78	4.49	2.01	1.69	1.53	1.93

As expected, the fisheries profits are more sensitive to changes in output prices than changes in stocks, largely due to the potential partial compensatory impact on prices of reduced overall landings. If such price responses are not achieved, then the effect of changes in output and prices would be identical as both would have the same proportional impact on revenue.

Comparing Table 4 with Table 3, the fisheries are substantially more sensitive to stock and output price chances than input price changes. The high sensitivity of the MSF to both prices and outputs again are consistent with the low level of profitability in the fishery relative to revenue.

4.1.5 Flow-on effects to SA economy

As well as the direct impact through production, fishing and aquaculture also generate secondary benefits to the South Australian economy. For example, the costs to fishers are the income of other businesses, such as service based businesses (accounting, banking), trades (e.g. boat repairs and maintenance, electrical work) and retail (e.g. food, fuel). These other businesses generate income and employment, and in turn rely on other business to supply their needs (e.g. transport, raw materials etc.). Hence, there is a multiplier effect, with each dollar generated in fishing or aquaculture resulting in additional dollars generated in other sectors further "upstream".

Similarly, "downstream" benefits are generated as the output from fishing and aquaculture becomes an input into other sectors, such as processing, retail and restaurants. This further generates economic activity in the region.

The estimated downstream and flow on effects to other sectors associated with fishing for 2013-14 and aquaculture for 2012-13[11] are given in Figure 15. Both wild fisheries and aquaculture result in total output of around $700 million a year, of which around half is value added.[12] In terms of household incomes generated, fishing and aquaculture result in $200 million and $150 million respectively.

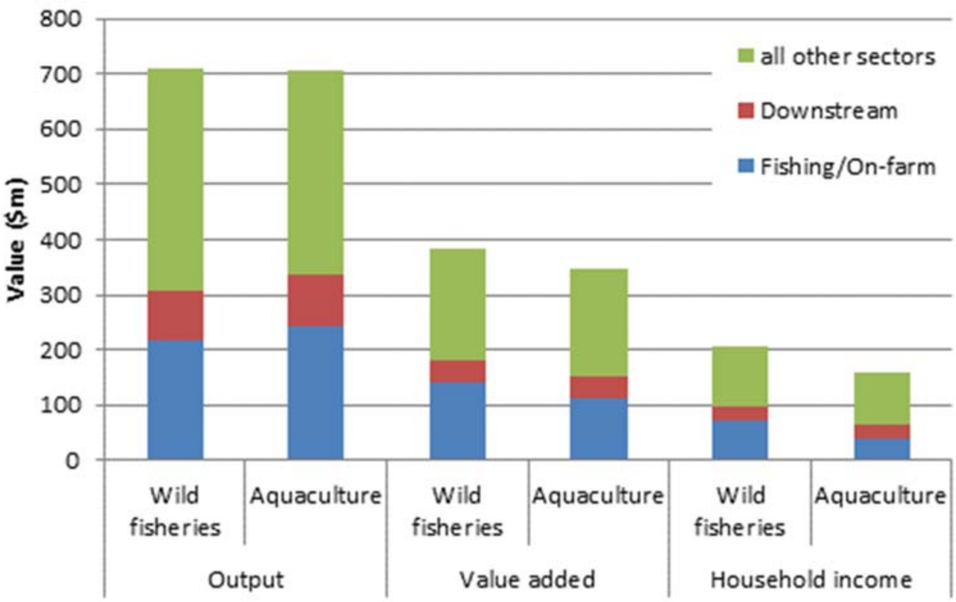

Figure 15. Economic impact of wild fisheries and aquaculture in South Australia

Source: Wild fisheries 2013-14 (EconSearch 2015b); Aquaculture 2012-13 (EconSearch 2014a)

As with output and incomes, the economic activity also results in employment benefits over and above those directly generated in the fishing and aquaculture sectors (Figure 16). Commercial fishing is

[11] More recent information on flow on effects of agriculture was not available.

[12] Value added is the total value of output less the costs of intermediate inputs, and effectively represents the additional profits and incomes generated from the activities.

estimated to result in around 3,100 total jobs in South Australia, of which just over 1,150 are directly in the fishing industry. Similarly, aquaculture is estimated to be responsible for a total of over 2,500 jobs, of which around 750 jobs are directly in the sector.

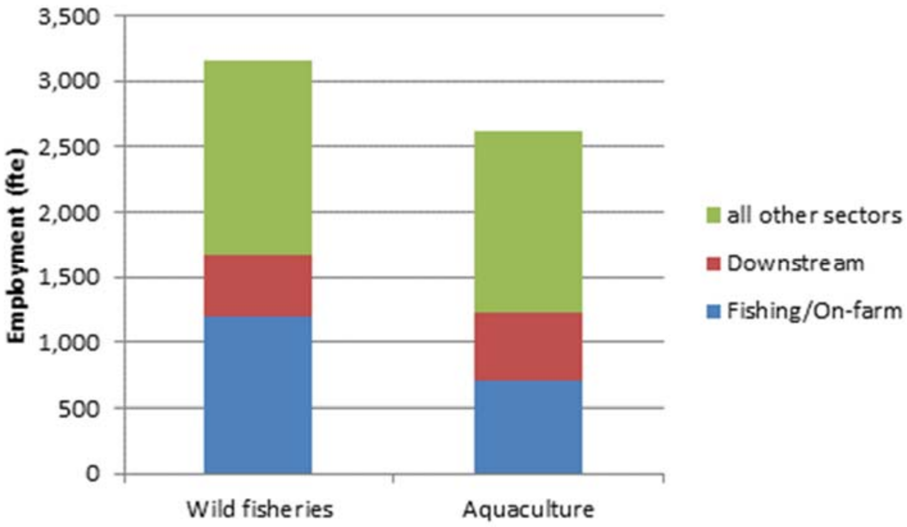

Figure 16. Employment impact of wild fisheries (2013-14) and aquaculture (2012-13) in South Australia

Source: (EconSearch 2014a; 2015b)

Most (in excess of 90%) of the economic activity generated by aquaculture is along the Eyre Peninsula and West Coast (EconSearch 2014a) (Figure 17), corresponding to where most of the aquaculture activities are undertaken (Figure 23).

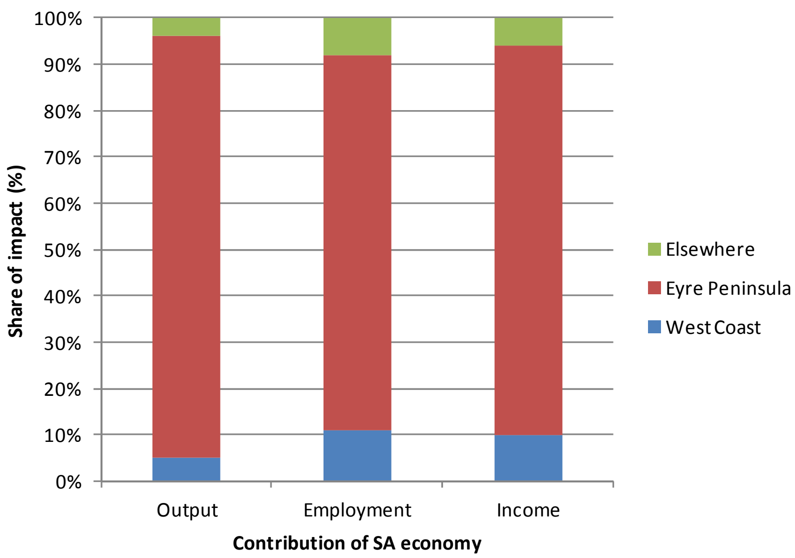

Figure 17. Regional impact of aquaculture in South Australia, 2012-13

Source: (EconSearch 2014a)

4.2 Western Australian fisheries in the GAB

The South Coast Bioregion of Western Australia (Figure 18) overlaps with the western part of the GAB, and contains several fisheries (Table 5). Separating these to identify production in the GAB is complex, partially due to information reporting levels, but largely due to the spatial structure of the fisheries which straddle the geographic border of the GAB.

Further, South Coast commercial fishing vessel operators often hold a number of licences to create a viable year-round fishing operation (Fletcher and Santoro 2015). Hence the same operators may be fishing inside and outside the GAB at different times of the year.

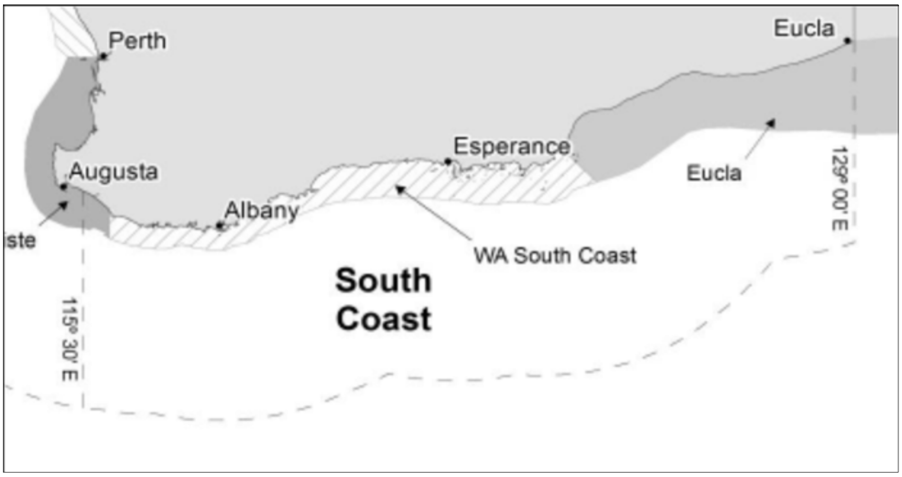

Figure 18. South Coast Bioregion, Western Australia

Derived from Fletcher and Santoro (2015)

4.2.1 Economic activity of fisheries in the Western Australian part of the GAB

Total value of wild fisheries production in 2013-14 prices is relatively small, amounting to around $20.6 million in total (Table 5). The major commercial fisheries of the South Coast Bioregion are the abalone fishery, the purse seine fishery targeting pilchards and other small pelagics, and a demersal gillnet fishery for sharks (Fletcher and Santoro 2015). Total production value, dominated by these three fisheries, has remained relatively constant since 2006-07 in real terms (Figure 18). Other smaller commercial fisheries are the beach seine fishery for Australian salmon and herring (included in the near shore and estuarine fishery), a trap fishery targeting southern rock lobsters and deep-water crabs, and an intermittent scallop fishery (which has not recorded landings since 2006-07 and is excluded from Table 5 and Figure 18). There is also a small commercial net fishery for finfish operating in a number of South Coast estuaries (Fletcher and Santoro 2015). Total value production of each individual fishery in the region in real terms has also remained relatively constant since 2006-07 (Figure 18).

In recent years, much of the fish catch has been taken in the western part of the region, technically outside the GAB (although this relationship could change). In contrast, abalone is taken along the whole south coast region. Lobster are taken along the whole coast also, but most of the catch is taken in the western and central areas of the South Coast Bioregion.

Aquaculture in the area is limited by the high-energy marine environment and availability of protected deep waters (Fletcher and Santoro 2015) The main aquaculture activity undertaken on the south coast

is the production of mussels and oysters from Oyster Harbour at Albany, along with some onshore 'raceway' culture of abalone. These industries are relatively small in terms of numbers of producers, with the abalone aquaculture also still largely in a development phase. Information on volume and value is consequently unavailable.

Table 5. Western Australian fisheries in the South Coast Bioregion

Fishery	Main species	2013-14	
		Tonnes	Value[a]
South Coast Crustacean fishery	Lobster, crab	70	3.8
Abalone fishery	Abalone	193	7.2
Near shore and estuarine finfish fisheries	Salmon (beach seine), herring (traps), other species	572	1.3
Purse seine fishery	Pilchards	1501	0.9
Demersal Gillnet and Longline	Sharks and rays, scalefish	1186	6.7
Demersal line scalefish	Snapper, Bight redfish, others	121	0.7
Aquaculture	Abalone, mussels, oysters	N/A	N/A

a) Catch in 2013-14, $m, 2013-14 prices. Source: derived from Fletcher and Santoro (2015); ABARES (2015b)

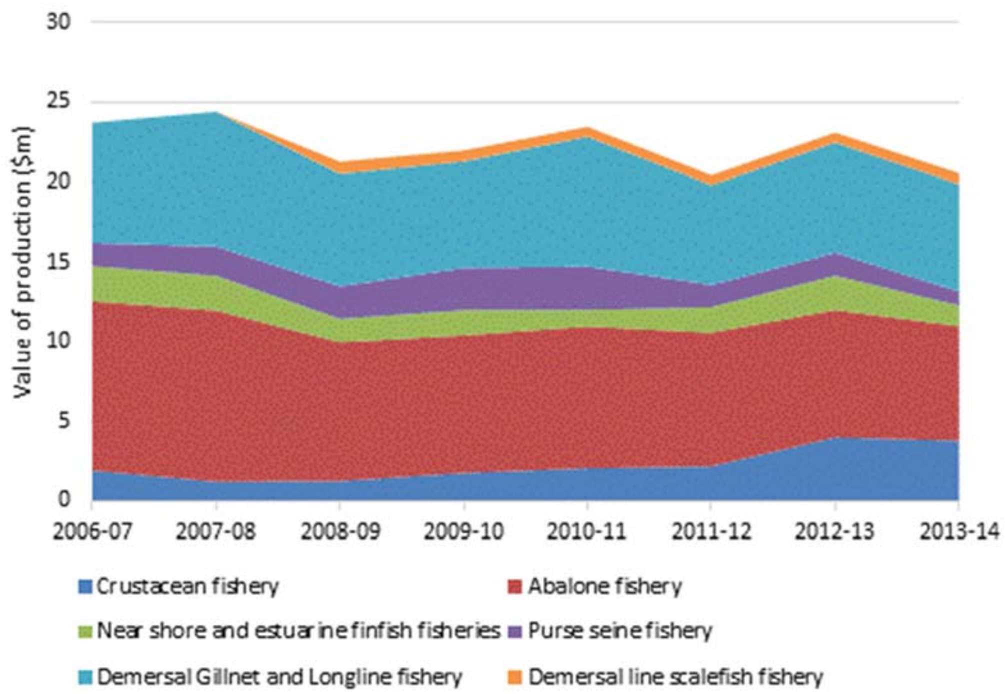

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Figure 19. Gross value of production, South Coast Bioregion, Western Australia, (real 2013-14 values)

Source: derived from Fletcher and Santoro (2015) and previous issues; ABARE (2009); ABARES (2011); 2013); 2015b)

The area has seen a substantial reduction in commercial fishing licence numbers over the last 20 years, largely through a voluntary effort reduction program (buyback) which has removed over half the fleet

since the mid-1980s. Existing licences are also underutilised: only 7 of 18 licences for the salmon fishery were active in 2012-13, and 3 out of 11 trap fishery licences, while catch of pilchards was about one third the total allowable catch (Fletcher and Santoro 2015), most likely reflecting low profitability in these fisheries.[13] While catches of lobster, crab and abalone are thought to be sustainable, there are some concerns over the near-shore and demersal finfish species (Fletcher and Santoro 2015).

4.2.2 Flow-on effects to the Western Australian economy

Very little analysis has been undertaken to consider the flow-on effects of fishing in Western Australia. The most recent, undertaken by McLeod and McGinley (1994), estimated output multipliers for WA fisheries at the State level. These can provide an indication of the flow-on effects of the fishing sector in the South Coast Bioregion, although the values are potentially unreliable for a number of reasons. First, the data are over 20 years old, and the structure of the fishing sectors as well as the structure of the local economy will have changed considerably since they were estimated. Second, the multipliers were estimated at the State level rather than regional level. If the structure of the regional economy differs substantially from that of the State as a whole then the multipliers may be misleading. Finally, related to the last issue, the level of regional imports is likely to be greater than the level of imports to the state as a whole, so the multipliers are likely to overestimate the regional economic impact.

These issues notwithstanding, the estimated flow on-effects to the regional economy in the south coast bioregion based on the multipliers estimated by McLeod and McGinley (1994) are illustrated in Figure 20. Direct impacts are around $20.6 million (this being the value of fisheries production). This production induces a further $11.4 million of economic activity through the purchases of inputs, and an additional $12.2 million from the consumption induced effects related to the additional income generated in the region. However, as noted above, these values are not entirely reliable.

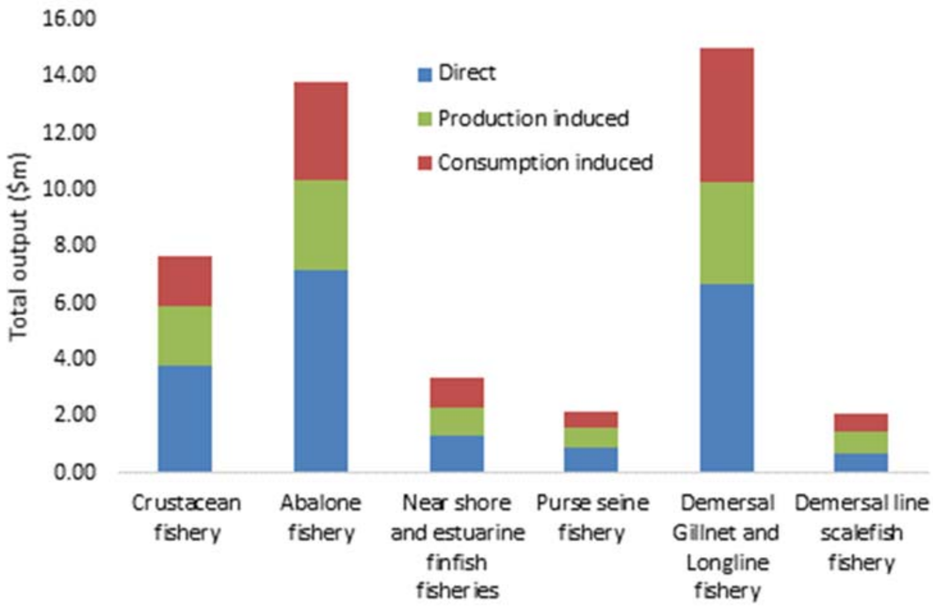

Figure 20. Potential regional economic impact of fisheries production, South Coast Bioregion, Western Australia, 2013-14

[13] There are insufficient data to verify this or to reproduce measures of profitability /return on capital as was done for the SA fisheries

4.2.3 Spatial value of key State fisheries and aquaculture (SA and WA)

The fishing activities vary substantially along the coast. Four fairly distinctive fishing areas have been identified based on catch composition (Figure 21) as well as administrative boundaries (i.e. WA).

The WA component (which extends to the WA/SA border) is dominated by fish and abalone species as noted previously (Figure 22). Much of the fish catch is taken in the western parts of the WA zone, with relatively little catch in the eastern part of the region (the Nullarbor area) since 2010 (Fletcher and Santoro 2015). Other higher valued species (particularly abalone) are distributed across the area.

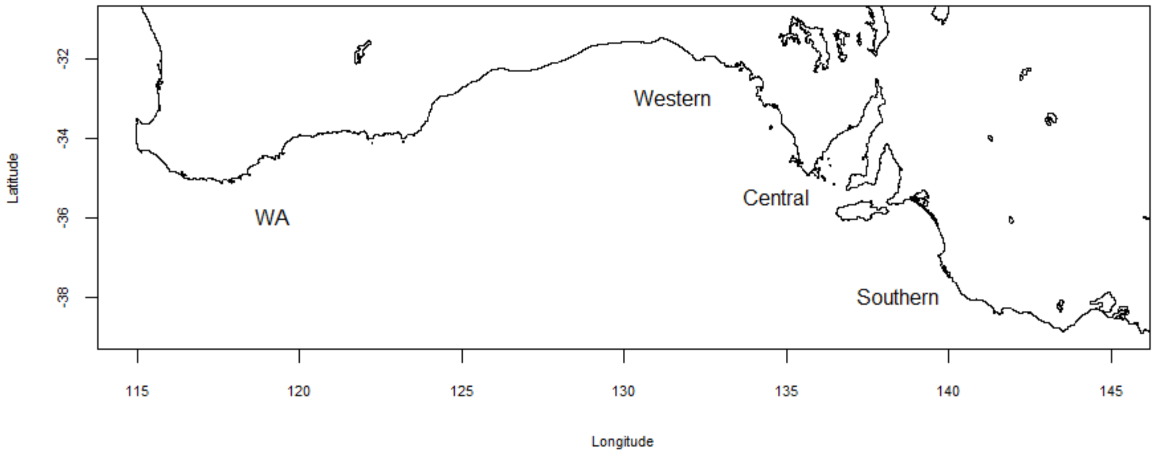

Figure 21. Fishing areas

The Western area runs from the WA/SA border to tip of the Eyre Peninsula, with fishing activity largely dominated by abalone, with some prawn and fish catch also. As with the WA area, catch is predominantly taken close inshore.

The central area produced more value than the WA and western areas combined, with an estimated value of around $86 million in 2013-14 (Figure 22). Much of the value in the central area is taken from within the two Gulfs and mainly through prawn and crab catches. Outside the Gulfs, lobster tends to be the dominant species (by value). The southern area is the largest in terms of value of landings (just over $95 million in 2013-14), and is dominated by southern rock lobster.

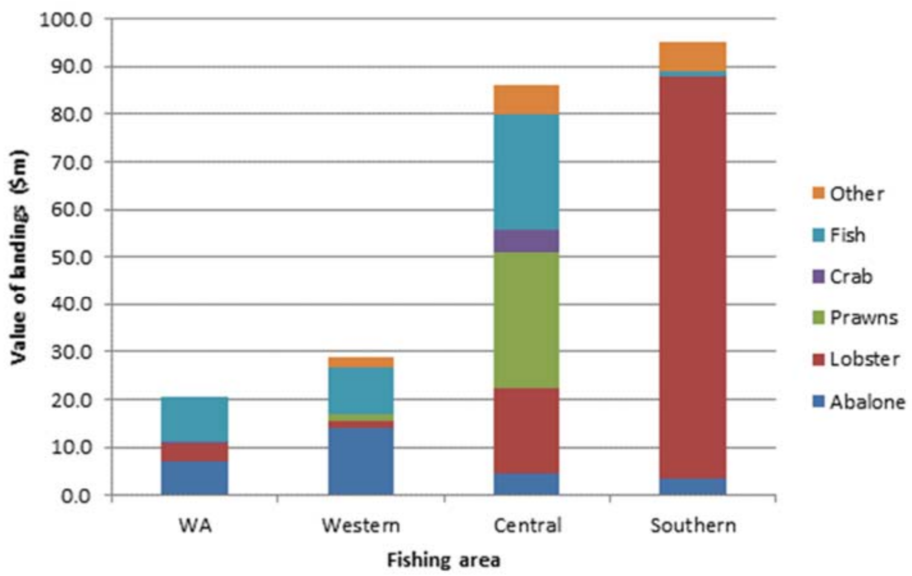

Figure 22. Estimated value of wild fisheries production by fishing area, 2013-14

Aquaculture production is predominantly undertaken around the Eyre Peninsular, with tuna ranching around the Port Lincoln area (inshore east coast), oyster production along the west coast and other aquaculture (fish, abalone and mussels) also around the coast (Figure 23) (EconSearch 2014a).

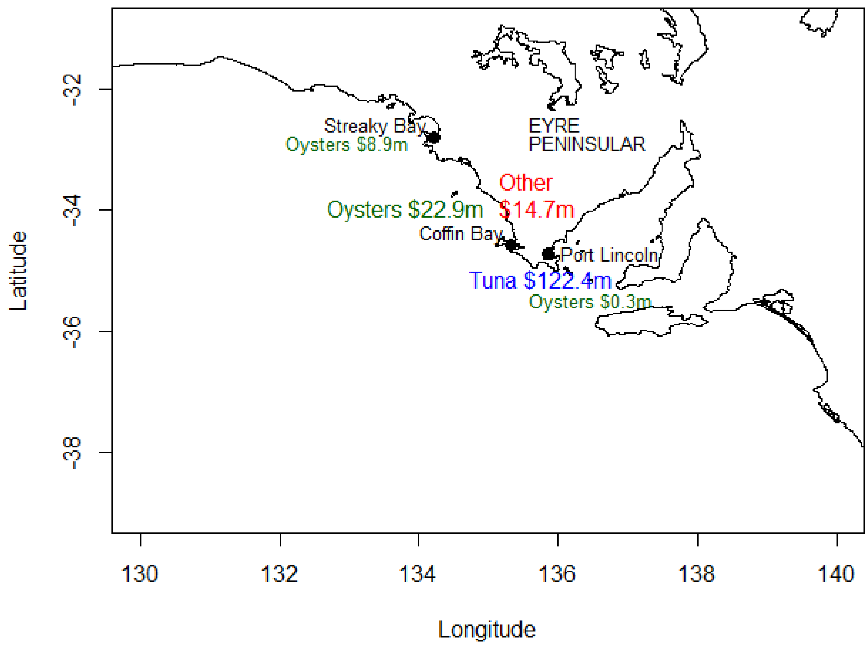

Figure 23. Aquaculture production value by area, 2013-14

As noted in the previous section, aquaculture in the Western Australian part of the GAB is relatively small, and information on value of production is unavailable.

Most aquaculture sectors are expected to continue to grow over coming years, with oyster production expected to continue to grow at around 10% a year once the supply of spat is restored, and mussels

by as much as 20% a year (from a relatively low base). SBT production is limited by the available quota for the wild stock, but is also expected to grow in coming years (EconSearch 2014a).

4.3 Commonwealth managed fisheries

Several Commonwealth managed fisheries – the SBT fishery, Southern and Eastern Scalefish and Shark Fishery, Small Pelagics Fishery and Southern Squid – operate in the GAB, while the range of several other Commonwealth fisheries extend into the GAB. These latter fisheries (mainly tuna based fisheries) rarely have activity in the GAB and are mostly tropical based.

Most activity in the GAB is undertaken in only two main Commonwealth managed fisheries – the SBT fishery and part of the Southern and Eastern Scalefish and Shark Fishery (SESSF). The latter consists of two main sectors in the GAB, the first a trawl fishery entirely within the GAB, and the second being the Gillnet, Hook and Trap (GHT) sector that extends into Victoria, Tasmania and NSW (Figure 24).

More recently, increased activity in the Small Pelagics Fishery (SPF) has been undertaken in the waters of the GAB. However, data are not available on the proportion of catches taken within the GAB due to the small number of vessels operating in the fishery. Catches in the fishery are taken within waters off NSW, Victoria and SA. Much of the SPF catch in the GAB is taken by the SA (State managed) fleet and has been included in the State catches previously described. Catches in the SPF, however, are well below the total allowable catch, and there is the potential for increased activity in this fishery in the GAB.

The Southern Squid fishery also extends into the GAB, however most of the catch in this fishery is taken from waters off Victoria and Southern NSW. Information on catches within the GAB is not available, but catches are understood to be relatively small.

Given this, the focus of this section will be on the SBT and SESSF fisheries in the GAB. The estimated (real) value of production of the Commonwealth sectors in the GAB is shown in Figure 25 (in 2013-14 dollars). Most of the value produced by Commonwealth fisheries in the GAB derives from the SBT fishery. The SBT fishery once extended from the southern tip of Western Australia to the south coast of NSW. However, the introduction of individual transferable quotas in 1984 resulted in a substantial contraction in the industry, with nearly all quota moving to South Australia within a decade (Campbell *et al.* 2000). The development of tuna ranching has also resulted in a substantial change in the industry, with around 98 per cent of the quota now focused on juvenile fish and used to supply aquaculture (Metian *et al.* 2014). The value of production of the SBT fishery has declined substantially over the last decade, almost halving in value. This has largely been driven by falling real prices, as quantity landed has declined only around 12% over the same period (ABARES 2013; 2015b).

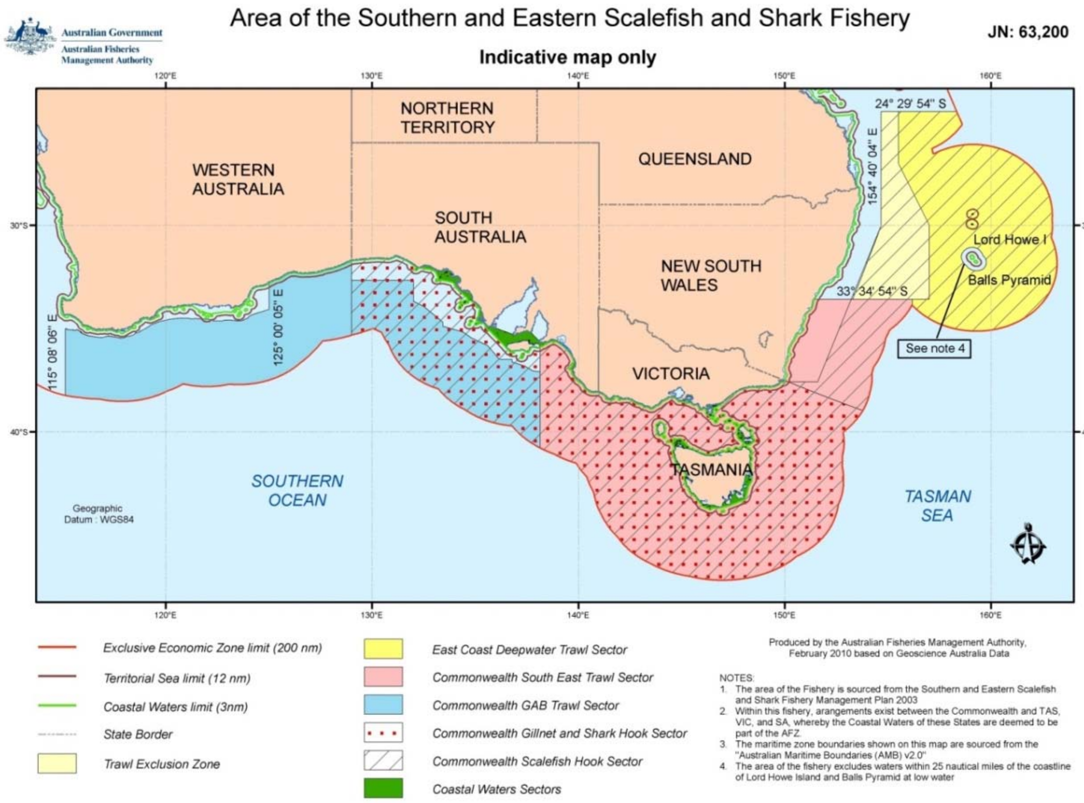

Figure 24. Area of the SESSF, highlighting the GAB trawl and GHT sectors

(source: www.afma.gov.au)

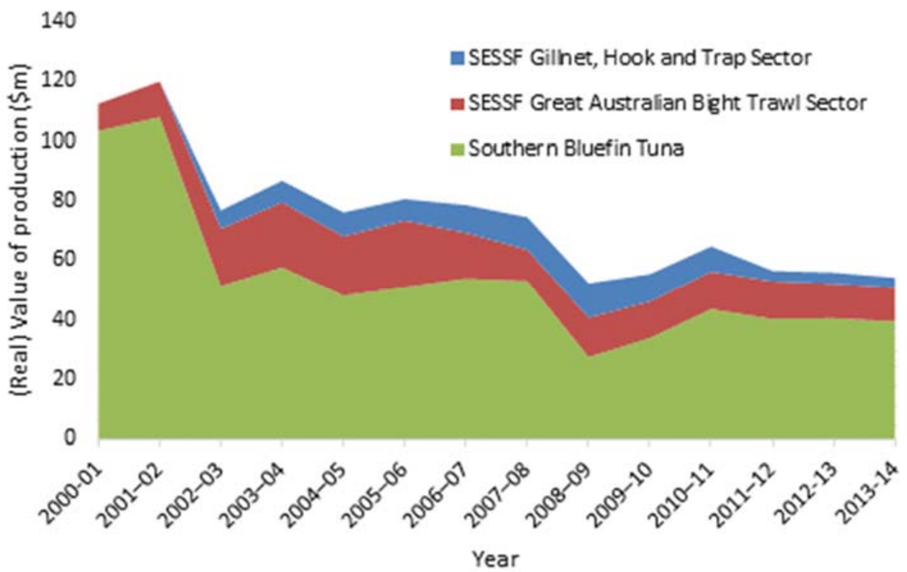

Figure 25. Estimated (real) value of production of key Commonwealth fisheries in the GAB

The GAB trawl sector consists of a relatively small fleet (less than 10 boats) that targets a wide range of species, with most (around 65%) of the value of landings deriving from deep water flathead and Bight redfish. While information on the GAB trawl directly relates to the GAB, data for the GHT sector were not directly available by State of landing, but instead are reported only at the level of the fishery

(which includes Victoria, Tasmania and NSW waters). However, some information was available that allowed estimation of the GAB portion of the fishery. Disaggregated catch data by species and State landed were available for the period 2000 to 2006 (Walker and Gason 2009). From this, the share of total GHT value could be allocated to the GAB over this period. However, a number of assumptions were required for the years following this period.

A series of closures were introduced into the fishery in May 2011, predominantly in the GAB portion of the GHT, to reduce bycatch of Australian sea lions (ASL) by the shark boats operating in the area. While the exact effect of this on catches cannot be ascertained from the aggregate data, of the 15 Commonwealth gillnet boats fishing in the area prior to the closure, three switched to fishing by hooks, five relocated their fishing effort outside of South Australia, five continued fishing in SA waters but outside the closures and two left the fishery (AFMA 2013). Preliminary analysis by AFMA (2013) suggested that catch and effort in the South Australian gillnet component of the GHT declined by around 50% following the introduction of the ASL Management Strategy. Given this, and the information derived from Walker and Gason (2009), the share of GHT catch caught in the GAB can be estimated (Figure 26). The solid line component in Figure 26 represents the actual share derived from Walker and Gason (2009) while the dotted line component represents the assumed share based on information provided by AFMA (2013). From this, the value of GHT catch in the GAB, presented in Figure 25, can be derived from the time series of data given in (ABARES 2015b).

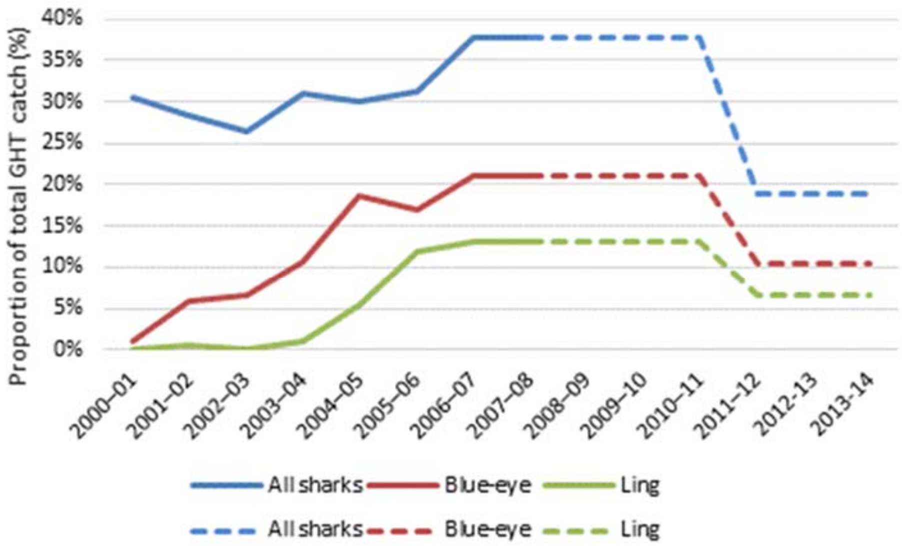

Figure 26. Estimated share of GHT catch of the major species groups caught in the GAB

4.4 Social indicators: commercial fishing

In 2011, a series of social surveys were undertaken for several commercial fisheries in South Australia (and Queensland) with the intention of assessing social performance of fisheries management (Triantafillos *et al*. 2014). Similar surveys have also since been conducted as part of the ongoing economic monitoring of South Australian fisheries. Two fisheries were surveyed in 2014 (MSF (EconSearch 2014c) and Spencer Gulf Prawn (EconSearch 2014d) fisheries), and three were surveyed in 2015 (Northern and Southern Zone Rock lobster fisheries (EconSearch 2015c; d) and the Blue Crab fishery (EconSearch 2015e)), although not all indicators have been examined in the more recent surveys. Further, while the earlier surveys (Triantafillos *et al.* 2014) provide a regional breakdown for a limited number of fisheries, the latter survey results are reported only at the total fishery level.

All surveys found considerable heterogeneity in fishers' satisfaction levels and attitudes towards fishing, although the general trends in the data were very similar. For example, roughly equal proportions were satisfied or unsatisfied with the level of income they earned from fishing in the MSF and prawn fisheries (Figure 27), while all were satisfied in the blue crab fishery. Similarly, more fishers tended to consider lifestyle as an important part of fishing, with generally only a third or less considering it more of a business (Figure 28) in the MSF and prawn fisheries, while nearly all fishers considered fishing as a business in the other fisheries.

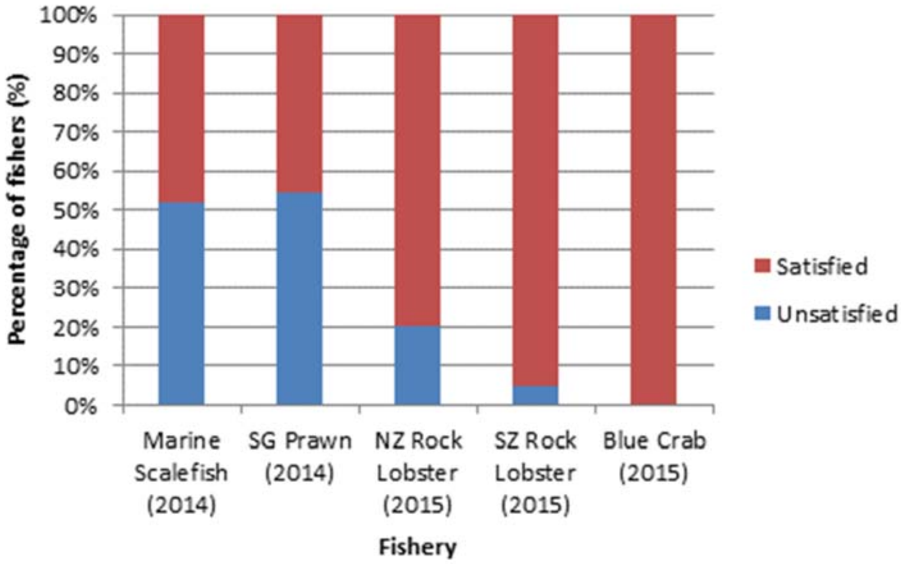

Figure 27. Satisfaction with fishing income

Source: (EconSearch 2014c; d; 2015f; g; c; d; e)

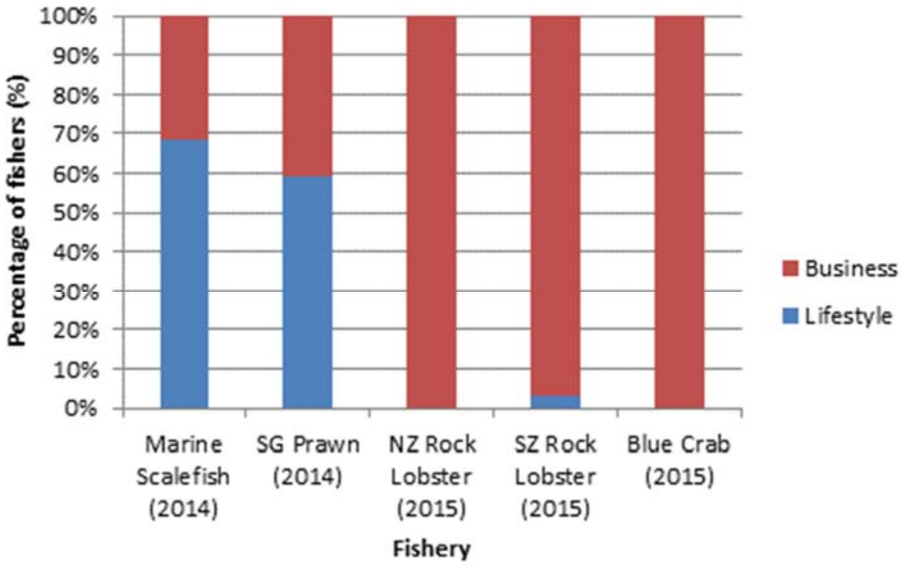

Figure 28. Fishing more of a lifestyle or business?

Source: (EconSearch 2014c; d; 2015f; g; c; d; e)

Despite the large proportions that were generally dissatisfied with the income earned, relatively few were considering leaving the industry in the near future (Figure 29), suggesting a strong attachment to the industry for those wanting to stay, and perhaps a lack of alternative employment opportunities for those wanting to leave. The earlier study by Triantafillos *et al*. (2014) similarly found that Marine Scalefish fishers required considerable increases in income to leave the fishing industry, even though they were largely dissatisfied with their current incomes, further suggesting many have a strong attachment to the industry.

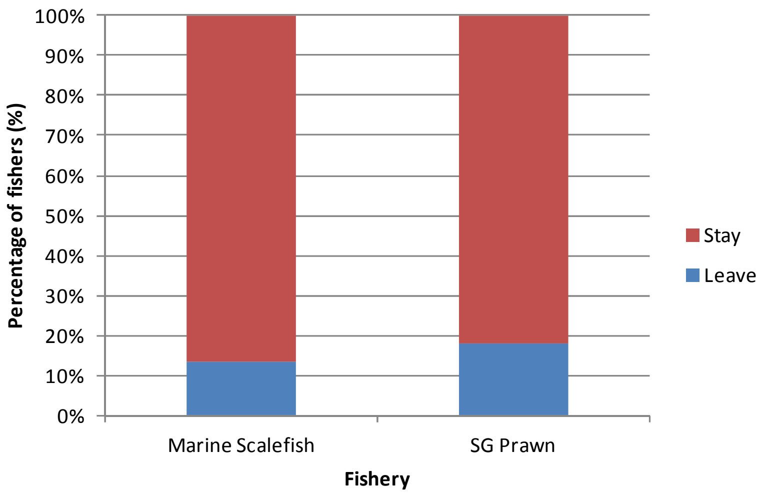

Figure 29. Desire to leave or stay in the fishery?

Source: (EconSearch 2014c; d)

The previous study (Triantafillos *et al*. 2014) also found that fishers' trust in management, as well as perceptions of transparency and equity, varied spatially. In particular, Marine Scalefish fishers based in Port Lincoln and the west coast were particularly mistrustful of management, whereas those based on the eastern coast of Spenser Gulf had greater faith in the ability of management, and greater perceptions of transparency and equity.

4.5 Recreational fishing

Recreational fishing in SA has both a "commercial" side and a non-commercial component. The commercial component is the charter boat industry, which takes recreational anglers out for fishing trips. The non-commercial component is largely individual based, where individuals undertake recreational fishing activities either shore based or from privately owned boats. These components have different impacts on the SA economy.

4.5.1 Charter boat industry

In 2013-14, 109 charter vessels were licensed to take recreational fishers (EconSearch 2015a), although only 74 of these were active. The number of clients and GVP has remained relatively constant since 2005-06 despite the increase in licensed boat numbers (Figure 30), although declined slightly in 2013-14 from the longer term average. GVP in this sector represents the payments to the vessels by the recreational fishers rather than the value of the catch, so is not directly comparable to commercial fishing GVP.

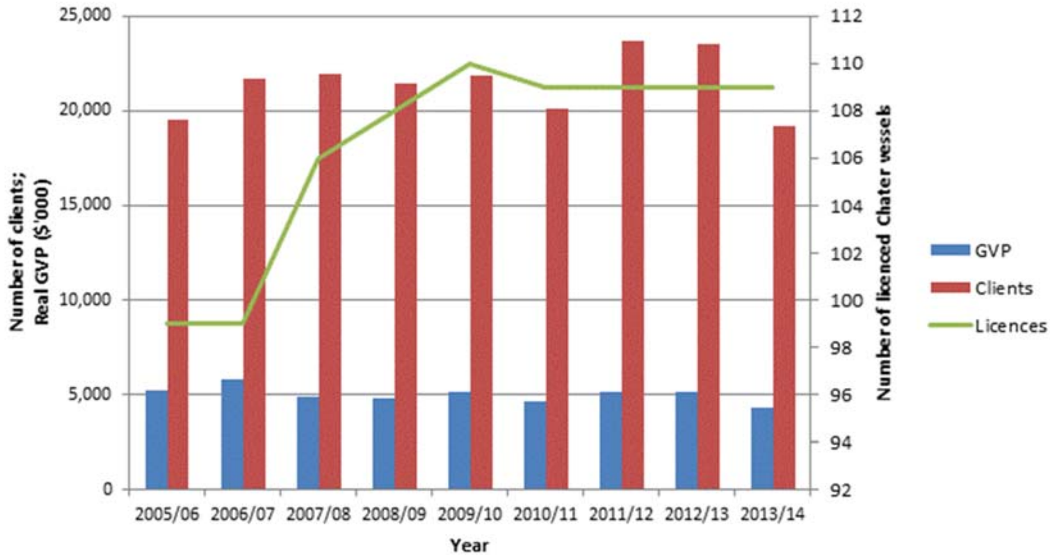

Figure 30. Trends in Charter Boat sector, 2005-06 to 2013-14

Source: derived from EconSearch (2015a)

The profitability of the sector provides an indicator as to its longer term sustainability at the current levels. Full equity profits in 2010-11 and 2011-12 were negative, although reduced costs in 2012-13 and 2013-14 resulted in positive profits at full equity (EconSearch 2015a). While some of the cost decrease was due to lower fuel prices, labour and repairs and maintenance costs also decreased substantially in 2012-13 (EconSearch 2015a). These latter cost decreases may not be sustainable longer term, and may reflect a short-term response to negative profitability in the preceding years.

The economic contribution of the charter boat sector to the SA economy is estimated differently from that of the commercial fishing sector. Flow on effects take into consideration not just the effects of purchases on inputs of the vessels, but also the other expenditure incurred by the recreational fishers, such as accommodation and travel costs to access the charter vessels.

The combined flow on effects from the charter and associated expenditure provides an economic impact greater than just that of the direct industry expenditure itself. For example, in 2013-14, in addition to the $4.3 million payments to the charter vessels (Figure 30), recreational fishers incurred an additional $6.3 million in direct associated expenditure, with a further $14.9 million in flow-on effects, resulting in a total value of $25.5 million or roughly $1,300 per fisher (compared to a charter boat value of $225 per fisher) (EconSearch 2015a).

Most of the direct and flow-on effects associated with the Charter Boat sector occur around Eyre Peninsular (particularly within Spencer Gulf and Coffin Bay) and also in the Gulf St Vincent/Kangaroo Island area (Table 6), with the latter having the greatest flow-on effects and associated expenditure.

Comparison of these impacts with commercial fisheries is difficult. While a reduction in recreational fishing would result in a reduction in the revenue (and profits) generated by the charter boat sector, associated expenditure and flow on effects may be less impacted if the recreational fishing activity was diverted to another recreational or tourism activity in the region. The potential for substitution of recreational activities may result in a substantially lesser impact if recreational fishing was decreased than the standard multiplier analysis suggests.[14]

[14] Substitutability of recreational fishing activities is a well-established issue when considering the value of a recreational

Table 6. Output and employment impacts, Charter Boat sector, 2013-14

Region	Charter boat sector	Associated expenditure	Flow-on effect	Total impact
Output ($m)				
• Spencer Gulf/Coffin Bay	1.6	1.2	2.1	5.1
• Gulf St Vincent/Kangaroo Island	2.5	2.4	7.4	12.3
• Other areas	0.2	7	5.4	8.1
• Total SA	4.3	10.6	14.9	25.5
Employment (FTE)				
• Spencer Gulf/Coffin Bay	16	8	8	32
• Gulf St Vincent/Kangaroo Island	20	12	27	59
• Other areas	8	54	18	36
• Total SA	44	74	53	127

Derived from EconSearch (2015a)

4.5.2 Non-charter based recreational fishing

Surveys of recreational fishing activity are undertaken infrequently in South Australia (as with most States). The most recently available comprehensive information on recreational fishing in South Australia relates to 2013-14 (Giri and Hall 2015), with previous surveys being undertaken in 2007-08 (Jones 2009) and 2000-01 (Henry and Lyle 2003). Recreational fishing also takes place in the South Coast Bioregion in Western Australia (Fletcher and Santoro 2015), although quantitative information on this is unavailable.

In 2013-14, some 277,000 individuals did some form of recreational fishing in South Australia, fishing for at least one day in the 12 months prior to November 2013 (Giri and Hall 2015). The total level of fishing effort was estimated to be around 970,000 days (Giri and Hall 2015). Participation rates in South Australia, unlike in most other States (e.g. Taylor *et al.* 2012; McIlgorm and Pepperell 2013), increased marginally between 2007-08 and 2013-14. Recreational fishing participation declined from 23.3% in 2000-01 to 16.2% in 2007-08, with most of this reduction coming from the younger age groups (Jones 2009), although increased to 18.3% in 2013-14 (Giri and Hall 2015).

The largest number of fishers were located in Adelaide, representing around two thirds of all recreational fishers in the State, with the area just outside Adelaide contributing a further 9.5% of the State's recreational fishers. However, as a proportion of the total regional population, Adelaide had the lowest participation rate (16.1%). In contrast, the Eyre Peninsula – with a low absolute number of fishers – had the highest participation rate in the State (34.5%) (Giri and Hall 2015), suggesting that recreational fishing is a relatively important recreational activity in the area.

Fishing activity varies across the State and between individual fishers. Around 70% of recreational fishers fished for less than 4 days over the year. However, the top 20% of fishers (in terms of days fished) produced 56% of the total fishing effort. The greatest number of fishing days were in areas close to Adelaide (the fishing areas in Gulf St Vincent and Kangaroo Island) (Figure 31).

Relatively few attempts have been made to derive estimates of the value of recreational fishing in

activity and its potential supply (Wyman 1982). Studies of recreational fishing elsewhere in Australia have found that more than half of fishers would be satisfied with an alternative activity if fishing was not available (Sutton and Ditton 2005). Other studies have found that the increasing availability of alternative outdoor recreational activities is contributing to the general decline in participation in recreational fisheries (Arlinghaus *et al.* 2015).

South Australia. Rolfe and Dyack (2011), using a travel cost approach, estimated that the consumer surplus (the benefits over and above expenditure) of recreational activities (including fishing) in the Coorong region was roughly $111 per adult day in 2006, equivalent to $137 per day in 2013-14 prices. This value is similar in magnitude to those that have been estimated elsewhere. For example, Pascoe *et al.* (2014) estimated values between $60 and $110 (depending on the assumptions about number of trips and travel costs) for Moreton Bay, while Ezzy *et al.* (2012) estimated trip values of between $33 and $132 for recreational fishing in western Victoria. However, as most of the fishing activity occurs in close proximity to Adelaide, the average recreational benefits may be less than those estimated for the Coorong (which is further away).[15]

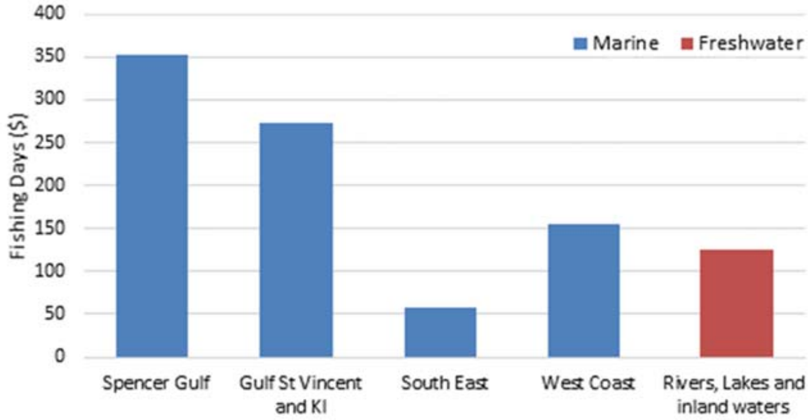

Figure 31. Recreational fishing days by regions

Source: Derived from Giri and Hall (2015)

Based on per day value estimate of Rolfe and Dyack (2011), and assuming similar levels of recreational benefit exist in other areas per day fished, marine based recreational fishing in South Australia (i.e. excluding freshwater fishing) may generate around $115 million a year in economic benefits to fishers based on 2013-14 participation rates. As noted above, as much of the activity occurs relatively close to the fisher population, the total recreational benefits may be overestimated.

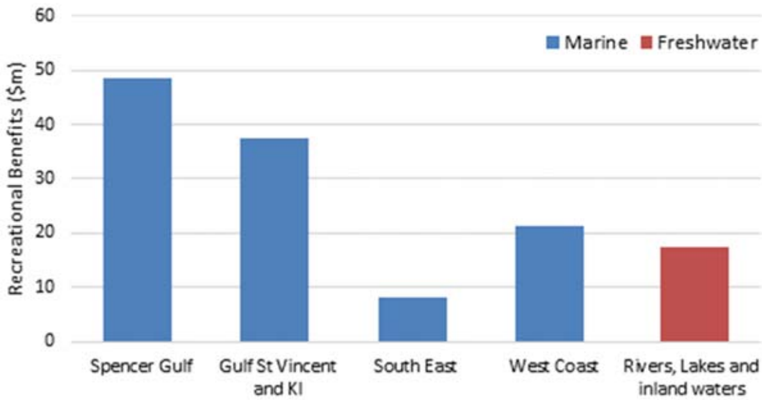

Figure 32. Recreational fishing benefits ($m) by regions

Source: Derived from Giri and Hall (2015) and Rolfe and Dyack (2011)

[15] For example, work commissioned for the Gladstone Healthy Harbours Partnership (2014) estimated recreational fishing benefits from activity within the Gladstone region averaged around $60 per day to the local residents. Other factors that affect willingness to pay, such as income levels, may also differ between those fishing in the Coorong and general recreational fishers.

Comparing these values with commercial fisheries is complex. To some extent, they are the non-market equivalent of profits as they represent the value to fishers over and above their expenditure. However, they are not directly comparable, as commercial fishers may also gain non-market benefits in their activities which are generally not considered in the economic assessment of values. The attachment to industry and the stated income increase needed to leave the fishery described earlier provide some evidence to the extent of this non-market value.

Further, recreational fishers have alternative recreational activities. While they value recreational fishing, the opportunity cost (in terms of the foregone value of their next best activity) may not be high. As a result, loss of access to recreational fishing may have little cost for many fishers if they are able to substitute this for other activities. Studies elsewhere suggest that the majority of fishers had substitute recreational activities that provided the same level of recreational benefits (Ditton and Sutton 2004), while most were willing to substitute species or fishing area with no loss of recreational benefits (Sutton and Ditton 2005).

Expenditure studies are often undertaken for recreational fisheries as an alternative measure of the economic contribution to the economy. No recent expenditure study has been undertaken in South Australia, and it would be inappropriate to estimate expenditure based on studies in other States.

5. DISCUSSION AND CONCLUSION

The aim of this study was to document the current (or most recent) information pertaining to the economic and social performance of fisheries in the Great Australian Bight. This was to provide a benchmark against which any changes arising in the future from development of an offshore oil and gas industry in the GAB could be identified.

The commercial fisheries in the Great Australian Bight vary substantially, from spatially extensive fisheries consisting of a large number of participants (i.e. the MSF), to geographically small fisheries with fewer participants but targeting high value species (i.e. the blue crab fishery). Combined, these fisheries provide a major source of employment and income in many rural areas.

Most of the fisheries production is undertaken by South Australian fisheries, with much of this occurring in the central and eastern parts of the State. Production along the south coast of Western Australia is relatively small, but derives from a wide variety of fisheries. Production in Commonwealth fisheries is limited to three fisheries, one of which primarily supplies the tuna aquaculture industry.

The SA wild caught fisheries have declined in real value over the last 15 years, in most cases due to declining real prices (i.e. prices adjusted for inflation). Despite this, most fisheries have continued to remain profitable, with a small number of exceptions. An analysis of sensitivity of SA vessel profits to input and output price changes suggests that these sensitivities vary substantially by fleet, but in general the fleets with the lowest level of profitability (the MSF in particular) are highly sensitive to any price changes.

Aquaculture in the area is also developing rapidly. While high value activities such as tuna ranching are unlikely to expand further without major technological developments (e.g. through a breeding program)[16], other sectors – particularly shellfish – are expanding rapidly and offer greater potential for future expansion. Oysters and mussels are expected to increase annually by 10% and 20% respectively over the next decade (EconSearch 2014a), after the temporary shortfall in oyster production in 2017 and 2018 due to the shortage of spat is overcome. Much of this aquaculture activity is concentrated along the Eyre Peninsular (particularly around Port Lincoln) and the West Coast.

Recreational fishing participation has increased in recent years, diverging from the national trend that is seeing recreational fishing participation decreasing. Deriving appropriate values for the industry is difficult as relatively few studies have been undertaken in the State, and is potentially an area for further investigation.

5.1 Ongoing and future data needs

Social and economic conditions are not static. As seen in this report, aquaculture production is rising rapidly in some areas, while fisheries economic performance also varies considerably. As a result, ongoing monitoring of the economic and social conditions in the GAB will be required to ensure that baseline data is kept up to date.

The analysis also identified several deficiencies that should be considered for future data collection. Recreational fishing data are generally not regularly collected, while economic values associated with these activities are very sparse in the region. This is not an issue unique to the GAB – similar recreational fisheries data are deficient in most states, and appropriate economic value data are also scarce. Similarly, the behavioural response of recreational fishers to change is fairly poorly researched

[16] Although SBT quotas have increased marginally in recent years, catch has not increased suggesting a capacity constraint.

in Australia and elsewhere. How recreational fishers may respond to any development may affect the level of economic value generated.

For the commercial fisheries, SA fisheries are data rich in terms of economic information, but WA and, to a large extent, Commonwealth fisheries in the region are relatively data poor. For the Commonwealth fisheries, this partly reflects the relatively small number of operators fishing in the GAB, and issues around confidentiality of data. However, combined, the Commonwealth fisheries derive a substantial output (in terms of gross value of product) from the GAB, so a better understanding of the economic performance of these fleets is important to establish an appropriate benchmark.

Economic information on aquaculture production, other than gross value of production and employment, is also limited. Given the importance of these industries to the total production from the GAB, greater attention to the economic performance of these sectors would be beneficial in order to assess the impacts of any development in the region.

Social indicators are also relatively sparse. Collection of such indicators as part of the regular economic surveys of SA fisheries is relatively new, and is currently limited to only a few fisheries and a few indicators. Over time, these data will provide a more comprehensive overview of social aspects associated with the commercial fishing sector. More recently, social research has focused on community wellbeing associated with fisheries (Voyer *et al.* 2017). Such a framework may help further provide a useful benchmark of social conditions in the fisheries and fishing communities. In addition to this, a project has recently started to develop an evidence-based health and safety training program for Australian fishing families (FRDC Project number 2016-400), part of which involves determining the current health, wellbeing and stress levels in fisheries. Such information may also prove useful when establishing changes in social conditions following any offshore developments in the region.

Collection of consistent and appropriate data will require the development of a social and economic monitoring plan, which should include a strategy for liaising with key data collection agencies/organisations to ensure that historical data series continue to be collected into the future, and to develop a strategy for filling the identified data gaps/deficiencies. The development of such a monitoring plan and strategy is beyond the scope of this study. However, the current benchmarking study can provide a starting point as to which information is required to be collected and where the main information gaps exist.

APPENDIX: CPI and real values

Real values are used in the analysis to account for the effects of inflation on the value of money. Real values used in the study have been converted from their nominal values using the conversion factor given in Table 7. This in turn is given by

$$Conversion\ Factor = \frac{CPI_{2013-14}}{CPI_{year}}$$

For example, $100 in 2000-01 would be equivalent to $142.70 in 2013-14 in real terms.

CPI information was derived from the macroeconomic indicators published in the ABARES (2015a), Agricultural commodity statistics 2015. CC BY 3.0.

Table 7. Consumer price index and conversion factors

Year	CPI	Conversion to 2013/14
1997–98	67.0	1.569
1998–99	67.8	1.549
1999–00	69.4	1.513
2000–01	73.6	1.427
2001–02	75.7	1.387
2002–03	78.0	1.347
2003–04	79.9	1.315
2004–05	81.8	1.284
2005–06	84.4	1.244
2006–07	86.9	1.209
2007–08	89.8	1.169
2008–09	92.6	1.134
2009–10	94.8	1.108
2010–11	97.7	1.075
2011–12	100.0	1.051
2012–13	102.3	1.027
2013–14	105.0	1.000

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