Economic management guidance for Australian abalone fisheries

Klaas Hartmann, Eriko Hoshino, Caleb Gardner, Sarah Jennings, Stacey Patterson, Lisa Rippin, Julian Morison, Duncan Worthington

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Institute for Marine & Antarctic Studies
University of Tasmania, Private Bag 49, Hobart TAS 7001

EconSearch Pty Ltd
214 Kensington Rd, Marryatville SA 5068

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Office Mark Oliphant Building, Laffer Drive, Bedford Park SA 5042
Postal Box 26, Mark Oliphant Building, Laffer Drive, Bedford Park SA 5042
Tollfree 1300 732 213 Phone 08 8201 7650 Facsimile 08 8201 7659
Website www.seafoodcrc.com ABN 51 126 074 048

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Non-Technical Summary

Economic management guidance for Australian abalone fisheries, 2009/714.30

PRINCIPAL INVESTIGATOR: Klaas Hartmann

ADDRESS: Institute for Marine & Antarctic Studies
University of Tasmania, Private Bag 49, Hobart TAS 7001

PROJECT OBJECTIVES:

1. **Define baseline economic performance of participating abalone fisheries**

The project was discontinued after objective 1 was met, but before the following original objectives could be addressed:

2. ***Produce bio-economic analysis tools in abalone fisheries***
3. ***Determine optimal management strategies using stock and economic information including seasonal / size / catch combinations***
4. ***Promote and drive management change to capture opportunities identified at (3)***

ABSTRACT

Detailed economic surveys of Abalone fishers were conducted in Tasmania (37 respondents), NSW (17 respondents) and South Australia (18 respondents). These surveys provide a detailed economic assessment of the fisheries covering a broad range of aspects in a systematic and standardised manner. Analyses of abalone export prices from Australia and import prices into Hong Kong and Japan were conducted. These analyses characterised abalone beach price trends, explored different abalone product types and considered product substitution. This revealed a number of interesting characteristics, for example, in Japanese markets, Australian wild caught Abalone is substituted for wild South African abalone and farmed South Korean abalone. This information could be used to make marketing decisions and to highlight future potential price changes in response to increased supply of other product (e.g. growth in South Korean farmed Abalone supply).

The collected economic data provides information essential for making informed management decision in Abalone fisheries and was a pre-requisite for completing Objectives 2, 3 and 4. The project was discontinued prior to these objectives being addressed, however now that the economic data is available this data can be used to address a broad range of management issues. This report provides a summary of future work that was planned as a starting point for potential future projects.

OUTCOMES ACHIEVED

Rigorous and comprehensive economic surveys were conducted in South Australia, NSW and Tasmania. These provide the first economic baseline for Abalone fisheries in NSW and Tasmania.

Export and import price data for Abalone were considered to provide a characterisation of the supply demand characteristics and consider aspects such as product substitution.

Together these two components provide the economic information required for a broad range of economic management decisions.

A range of economic analyses that would use the economic data and were planned for this project are presented to provide suggestions for lines of enquiry for potential future Abalone projects.

LIST OF OUTPUTS PRODUCED

The following reports were funded by this project:

- Economic indicators for the NSW Abalone Fishery 2011/12

- Economic indicators for the Tasmanian Abalone Fishery 2011/12

Chapter 3 was published as the following journal article:

E. Hoshino, C. Gardner, S. Jennings, K. Hartmann. 2015. Examining the Long-Run Relationship between the Prices of Imported Abalone in Japan. *Marine Resource Economics*. 30 (2)

ACKNOWLEDGEMENTS

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We thank the Abalone Council of NSW and the Tasmanian Abalone Council Ltd for encouraging the development of this project and its funding, facilitating interviews with industry managers, helped develop the surveys, contributing historical summary data, and reviewed the economic indicator reports.

Malcolm Haddon and Fay Helidoniotis provided valuable advice in planning the modelling that was to be conducted prior to the cancellation of this project. They developed a workplan that would have provided valuable results.

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Chapter 1 : Summary of Economic Indicator Reports

Understanding the various economic aspects of a fishery is critical for making management decisions to improve the profitability of a fishery and for understanding the economic implications of management decisions made to address other issues. The economic implications of management decisions are often counter-intuitive and well intended decisions made without a sound economic basis can have negative or even disastrous consequences.

The first step in developing this economic understanding is to obtain economic data about the fishery. The findings from this part of the project are detailed in Chapters 1 – 4. The next step is combining this economic information with an understanding of the biology and fleet dynamics of the fishery. The work planned for this part of the project (which was not completed) is detailed in Chapter 5.

Economic Surveys

Standardized economic surveys were conducted in Tasmania (37 respondents), NSW (17 respondents) and South Australia (18 respondents). This chapter provides a summary of the economic performance of the abalone fisheries in the three surveyed states, based on the indicators obtained from these surveys. The key indicators reported here include catch and gross value of production (GVP); financial performance indicators; and economic rent (Appendix 1 and 2 for full details).

Catch and Gross Value of Production

While the annual catch of abalone in the three abalone states remains relatively stable over the past 5 years due to quota management, there are generally larger variations in GVPs as a result of price fluctuations.

Tasmania

The total catch of abalone in Tasmania has remained relatively steady since 2006 (Table 1). The overall stability is due to the quota management arrangements for the fishery that were introduced in the mid to late 1980s. The catch in 2012 (2,363 tonnes) was almost 6 per cent lower than that in 2006 (2,503 tonnes). Although the catch has remained relatively steady from 2006 onwards the value of the fishery has fluctuated over this period with most of the variance between years attributable to change in the Eastern Zone TAC. In 2010 the value of catch reached $104 million (27 per cent higher than the value in 2007 around $82m). This increase in gross value of production (GVP) was principally due to an increase in prices. In 2012 GVP was very similar to 2007 levels (around $82m).

Table 1: Catch and value of catch of the Tasmanian Abalone fishery, 2006 to 2012

Year	Total catch (tonnes)	GVP ($m)	Average price - nominal ($/kg)	TAC (tonnes)	% of TAC caught	Active boats (no.)
2006	2,503	n.a.	n.a.	2,503	100%	189
2007	2,433	82	$34	2,503	97%	191
2008	2,583	90	$35	2,594	100%	189
2009	2,607	93	$36	2,604	100%	172
2010	2,660	104	$39	2,660	100%	189
2011	2,548	85	$33	2,566	99%	181
2012	2,363	82	$35	2,366	100%	n.a.

Source: University of Tasmania and EconSearch analysis *NSW*

New South Wales

The total catch of abalone in NSW has declined significantly since 2000 (Table 2). The total catch in 2011/12 was less than 40 per cent of the total catch in 2000. This dramatic shift stems from a decline in fish stocks and catch rate, and subsequent cuts to the TAC to allow stocks to rebuild (NSW DPI 2006, 2012). Total catch reached its lowest levels in 2009/10 at 74.6 tonnes, but has increased in the last two years. The catch in 2011/12 (just under 110 tonnes) was on par with total catch in 2007/08. The beach price or per kg value of abalone in NSW has also declined significantly since 2000. The nominal price of abalone in 2011/12 was 38 per cent lower than in 2000 (this equates to a 66 per cent decrease in real terms). The combination of declining catch and declining per kg value of catch have resulted in a significant fall in GVP for the fishery. The nominal GVP for the NSW abalone fishery fell 64 per cent nominal terms between 2000 and 2011/12—this equates to a 74 per cent reduction in GVP in real terms. There was 38 per cent decrease in nominal price, equivalent to a 56 per cent real price decrease, between 2000 and 2011/12. This means that the value of the abalone catch in NSW in 2011/12 was 73 per cent lower in real terms than it was in 2000 (64 per cent lower in nominal terms as noted above). There are several likely reasons for the decline in beach price including SARS, which impacted market demand for abalone, the appreciation of the Australian dollar against Asian currencies and the development of aquaculture in South Korea (see section 4.1.3 of the full report for more detail).

Table 2: Catch and value of catch of the NSW Abalone fishery, 2000 to 2011/12

Year	(tonnes)	$ (m)
2000	304.80	15.85
2001	304.40	15.31
2002/03[a]	425.60	19.13
2003/04	242.00	7.99
2004/05	188.70	7.74
2005/06	129.00	5.50
2006/07	121.90	4.99
2007/08	109.40	3.67
2008/09	103.00	3.09
2009/10	74.60	1.94
2010/11	93.80	2.81
2011/12	109.81	3.51

[a] Eighteen month Period: January 2002- June 2003. The 2002 calendar year was combined with the 2002/03 financial year to allow a shift from management in management time periods.

Source: NSW DPI (2006, 2012)[1], Duncan Worthington pers. comm. and EconSearch analysis

[1] Data were taken from NSW DPI (2006, 2012). Where discrepancies between the two reports existed or where the units used in the reports were not clear (i.e. in the period 2002 and 2002/03), advice was taken from the NSW Abalone Council regarding the correct figures.

South Australia

The total catch of abalone in SA has remained relatively steady since 1990/91. This is largely due to the quota management arrangements for the fishery which were introduced in the mid to late 1980s. The catch in 2011/12 (822 tonnes) was almost 5 per cent lower than that in 1990/91 (863 tonnes). Although the catch has remained relatively steady from 1990/01 onwards at between 815 and 903 tonnes, the value of the fishery has fluctuated significantly over this period. Value of catch increased from $14.0m in 1990/91 to a peak of $40.0m in 2000/01. This is principally as a result of a substantial increase in price during the 1990s. Since 2000/01 value of catch has fallen and was $28.9m in 2011/12 (Table 3). The nominal value of the abalone catch in 2011/12 was only 8 per cent higher than that in 1997/98, despite a substantial increase between 1997/98 and 2000/01. Because total catch has remained relatively steady throughout the period, variations in gross value of production have closely followed changes in average price. The nominal price of abalone peaked at $46.15/kg in 2000/01 but declined to $35.16/kg in 2011/12.

Table 3: Catch and value of catch of the South Australian Abalone fishery, 1990/91 to 2011/12

	Southern Zone		Central Zone		Western Zone		South Australia	
Year	(tonnes)	($m)	(tonnes)	($m)	(tonnes)	($m)	(tonnes)	($m)
1990/91	121	2.0	187	3.0	555	9.1	863	14.0
1991/92	131	2.2	191	3.3	563	9.5	885	15.1
1992/93	176	4.0	168	4.9	525	14.9	869	23.7
1993/94	141	5.4	151	5.1	510	16.8	802	27.2
1994/95	154	4.4	205	5.5	492	12.8	851	22.8
1995/96	155	3.8	177	4.5	570	14.1	902	22.5
1996/97	146	3.8	195	5.7	562	15.7	903	25.2
1997/98	123	4.0	180	5.7	509	17.2	812	26.9
1998/99	171	4.7	170	5.0	592	17.4	933	27.2
1999/00	149	5.2	190	7.2	550	20.0	889	32.4
2000/01	145	6.7	188	9.1	534	24.1	867	40.0
2001/02	141	5.9	193	9.0	516	19.9	850	34.8
2002/03	146	5.8	171	8.0	573	22.5	890	36.3
2003/04	143	4.3	177	6.6	559	20.6	879	31.6
2004/05	157	5.9	180	7.4	565	20.5	902	33.8
2005/06	136	5.1	181	7.2	579	21.5	896	33.9
2006/07	164	6.1	168	6.2	511	19.2	883	31.4
2007/08	146	4.5	193	7.0	550	19.6	889	31.0
2008/09	151	4.8	151	5.7	535	22.1	837	32.5
2009/10	147	3.5	164	5.5	544	19.1	855	28.1
2010/11	152	4.4	155	5.7	508	17.9	815	28.0
2011/12	153	4.8	166	6.3	503	17.8	822	28.9

Source: SARDI Aquatic Sciences

Financial Performance Indicators

Financial performance indicators were obtained from licence holders and abalone divers based on survey responses (37 in TAS, 17 in NSW, and 18 in SA) for 2011/12.

Income

In Tasmania, average boat gross income for the surveyed fishing businesses was around $916,000, or $36.49/kg which is close to the average beach price for 2011/12 ($842,000 after deduction of the 8.25 per cent state government royalty). The average boat gross income received by surveyed divers was around $253,000 ($246,000 after deduction of the state royalty[2]) or $10.08/kg well over the average dive fee in the fishery, which anecdotally sits between $6/kg and $7/kg. The significant difference in income reflects the fact that the majority of divers surveyed own only a small amount of quota (on average around 11 per cent of the total quota fished), and are paid a portion of the beach price in a 'dive fee' to catch the quota for other quota holders. A large proportion of the survey participants indicated that they were in a better than average position for divers in the fishery, often due to their position in a family business, suggesting that the survey sample may be biased towards divers with a higher ownership of quota. Several divers also indicated that they were able to leverage the quota that they owned to receive a better dive fee than other divers could receive. Divers who own quota are also able to receive the full income for this quota (although they also incur the opportunity cost of capital).

The estimated average gross income per business surveyed in the NSW abalone fishery was approximately $171,000 in 2011/12. This is significantly higher than the average income per licenced diver[3] ($125,000), primarily because the fishing businesses surveyed fished more quota than the average entitlement holder. The fishing businesses surveyed owned an average of 81.6 shares and leased an additional 88.6 shares in from external licence holders, to fish an average of 170.2 shares per fishing business, compared to an average of 123.4 shares per diver across the whole fishery. The average income per share fished across the fishing businesses surveyed ($1,007/ share) is similar to the average income per share across the whole fishery ($1,017/ share).

The estimated average gross income per boat surveyed in the SA abalone fishery was approximately $819,000 in 2011/12, up from $791,000 per boat in the previous year). The average income for boats surveyed in the combined SZ and CZ was slightly lower ($792,000) than the average income for boats surveyed in the WZ ($850,000).

Costs

Variable costs represent a significantly greater proportion of total boat cash costs in TAS (83% for licence holder, 72% for divers) and NSW (78%) than fixed costs. For licence holders in TAS, the diver fee (calculated as income received by divers minus operating costs incurred by divers) as well as additional paid labour (i.e. deck hands), together represent the most significant operational cost for licence holders (55 per cent).

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2 The royalty was only deducted from the income that divers received for their own quota. Royalty was not deducted from the catch fee that were divers paid.

3 NSW Abalone fishery GVP divided by the number of divers is equal to around $125,000 per diver.

In NSW, the largest individual cost item was 'leasing quota', which accounted for around 39 per cent of total boats costs in 2011/12, followed by labour costs comprised of formal payments to crew as well as an imputed wage to licence owners and other family members who are not paid a wage directly by the business. For external shareholders (i.e. those who are not currently directly involved in the operation of a fishing business), variable costs represented a slightly smaller (45%) cost to shareholders than fixed costs (55%). The fixed costs make up a greater proportion of total costs for shareholders than for fishing businesses, because their main cost components are licence fees, interest and administration costs. The only significant variable cost they incur is the catch fee paid to divers, and this is less than half of their total costs.

In SA, variable costs represented a greater proportion (58%) of total boat cash costs than fixed costs (42%). Variable costs as a proportion of total costs have decreased over time, falling from 79% in 2001/02 to 58% in 2011/12. This appears to be largely due to an increase in the average interest paid, which increases the fixed costs. It was estimated that average total boat cash costs increased by more than 3 per cent between 2010/11 and 2011/12. Interest payments increased by 320 per cent between 2010/11 and 2011/12. This increase may be due in part to a change in the sample between this survey and the previous (2009) Abalone survey. The trend may also reflect an increase in the number of licence holders who have bought into the fishery as investors (compared to licence holders who have inherited their licences). Other increases in operating costs include fuel costs (29%) and repairs and maintenance (9%). Paid labour costs decreased (13%), as did total unpaid labour (48%). Communication costs, office and administration costs and cost of travel to meetings also decreased. Similar to other two states, the largest individual cost item in SA was labour, which accounted for around 47% of total boats costs in 2011/12.

Profits

Boat gross margin (total boat income less total boat variable costs) is a basic measure of profit, assuming that capital has no alternative use and that as fishing activity varies there is no change in capital or fixed costs. In a short run, boat gross margin should be above zero to stay in business.

In TAS, average boat gross margin for licence holders was around $681,000 and average boat gross margin for divers was around $144,000 in 2011/12. In NSW, average business gross margin for quota shareholder (internal and external shareholder combined) was around $110,000 in 2011/12.

In SA, there was an increase in boat gross margin in 2011/12 ($569,000) compared to previous year ($518,000) mainly due to the increase in boat gross income, in turn due to higher nominal abalone prices. Boat gross margin was slightly higher (4 per cent) in the combined Central and Southern Zones than in the Western Zone.

Gross operating surplus (GOS) was calculated by boat gross margin minus non-paid wages for operator and family members. The average GOS of licence holders in TAS was estimated to be around $649,000, and for divers was around $126,000. The average GOS in NSW was estimated to be around $60,000. In SA, the average GOS of all boats in 2011/12 was estimated to be around $398,000, approximately 1 %

higher than the previous year. This is largely due to the significant increase in fixed costs, in particular interest repayments.

Boat business profit (boat cash income minus depreciation, also known as accounting profit) gives an indication of the capacity of the operator to remain in the fishery in the short to medium term. In 2011/12, the average boat business profit for licence holders in TAS was around $621,000, and around $76,000 for divers. In NSW, the average boat business profit was around $19,000. In SA, the average boat business profit was around $344,000 in 2011/12, which was 4% higher than the previous year ($331,000). Boat business profit was higher (15%) in the combined Central and Southern Zones than in the Western Zone.

License values

In TAS, there was a large degree of variability in the licence holders estimates of licence value. Survey respondents estimates of licence value ranged from approximately $140,000 to $240,000 per quota unit. Some of the surveyed Tasmanian licence holders and divers fished parts of licences. Estimates of per boat licence value, based on part or multiple licence, varied from around $0.5 million to $16 million. A quota unit value of $87,000 (approximately 50 per cent below the licence value estimated for 2011/12) would mean an annual rate of return to the total asset of 18.5 per cent, while a quota unit value of $261,000 (approximately 50 per cent above the licence value estimated for 2011/12) would mean an annual rate of return to the total asset of 6.4 per cent.

Similarly, there was a large degree of variability in the respondents' estimates of licence value in NSW, ranging from around $32,000 to $95,000 per 10 units of share. This variability stemmed from variation in the estimates of the value of a licence unit, and also from variability in the number of licence units or shares owned by each business.

In SA, survey respondents estimates of licence value ranged from approximately $3.5 million to $10 million per licence. Since there have been limited transfers of licences in recent years and the current market value of licences is uncertain, a sensitivity analysis was undertaken to estimate the rate of return to capital for a range of licence values. Based on the costs and returns shown for the year 2011/, a licence value of $3.4 million (approximately 50% below the licence value estimated for 2011/12) would mean an annual return to the total asset of 11.4 per cent, while a licence value of $10.4 million (approximately 50% above the licence value estimated for 2011/12) would mean an annual return to the total asset of 4.0%.

Economic Rent

Economic rent is defined as the difference between the price of a good produced using a natural resource and the unit costs of turning that natural resource into the good. In this case the natural resource is the abalone fishery and the good produced is the landed abalone. What remains after the value of these inputs (labour, capital, materials, services) has been netted out is the value of the natural resource itself. The economic rent generated in the Tasmanian abalone fishery was estimated at $64.9 million in 2011/12, of which $6.9 million (or 10.6 per cent) was charged by the State

Government as a royalty. When an economic rent is generated in a fishery and there are transferable licences, the rent represents a return to the licences, which affects their value when traded in a market. The aggregate value of diving entitlements in TAS was estimated to be approximately $18 million (123 entitlements with an average value of $146 000 per entitlement) in 2011/12. The value of quota in the fishery was estimated to be $609 million (3,500 quota units with an average value of approximately $174,000 per unit). An annual economic rent of $62.8 million represents a rate of return of 10.0% to the capital value of the fishery (quota plus diving entitlement).

In NSW, the aggregate value of licences in 2011/12 was estimated to be approximately $22 million (3,454 licence units with an average value of approximately $6,371). An annual economic rent of the NSW abalone fishery was estimated to be $827,000, which equates a return of 3.8% to the capital value of the fishery.

The economic rent generated in the SA Abalone fishery was estimated to be $13.9 million in 2011/12. The aggregate value of licences in 2011/12 was estimated to be approximately $241.6 million (35 licences with an average value of approximately $6.9 million). An annual economic rent of $13.9 million represents a return of 5.8% to the capital value of the fishery.

Chapter 2 : Export prices of Australian abalone

Abalone is one of the most important export seafood items in Australia, accounting for 30 % of the total value of crustacean and mollusc exports (ABARES 2012). Here we summarises the trends in export prices of Australian abalone products. Export quantity and value data are supplied by the Australian Bureau of Statistics (ABS). The quantity data is reported on the basis of the net product weight (excluding packaging) exported according to source state or territory, not state or territory in which the product was caught or farmed. The products are valued on a free on board (fob) basis at the Australian port of export. The costs of freight, insurance and other distributive services beyond the Australian customs border are not included.

Australia wide export quantity and values

Tasmania, Victoria, and South Australia combined accounts for the majority of the abalone export (96%) in terms of both quantity and value. Since peaked in 2003 the export quantity of Australian abalone has declined from 5,266 tonnes to 3,417 tonnes in 2011 (Figure 1). The exported value peaked in 2001 (AU$256 million), but it has declined to AU$211 million in 2011 (Figure 1). This equates approximately 18% decline in exported value from its peak in nominal term, and 35% in real term[4].

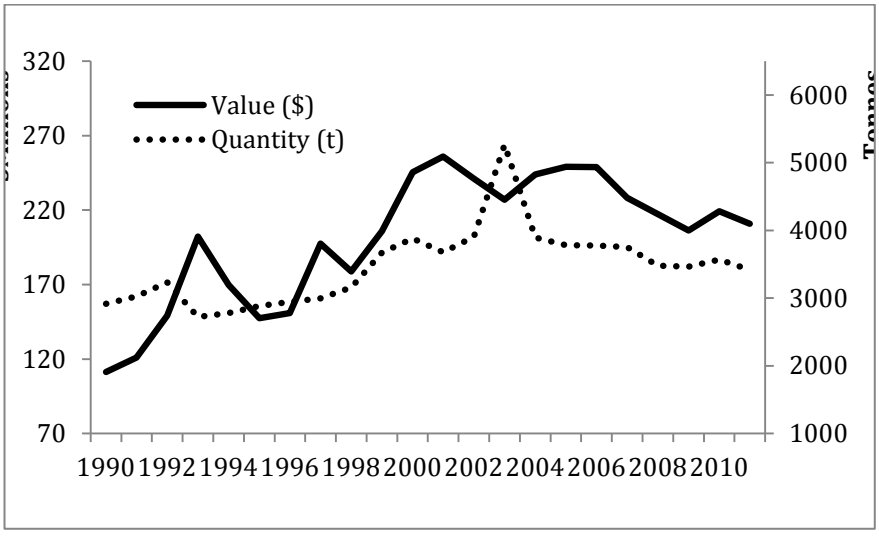

Figure 1: Quantity (tonnes) and value (AU$million) of Australian abalone export, 1990-2011. Source: Australian Bureau of Statistics (ABS)

A large proportion of abalone is exported to Hong Kong, China and Japan (Figure 2). Traditionally Japan was the dominant export nation, but this has changed since 1999 when Hong Kong took over Japan. The direct export to China was negligible until

[4] Australia Consumer Price Index (CPI) for Fish and other seafood. 2001 as a base year. Weighted average of eight capital cities.

1994, but it now accounts for 21% of total exported quantity, and 18% of exported value in 2011.

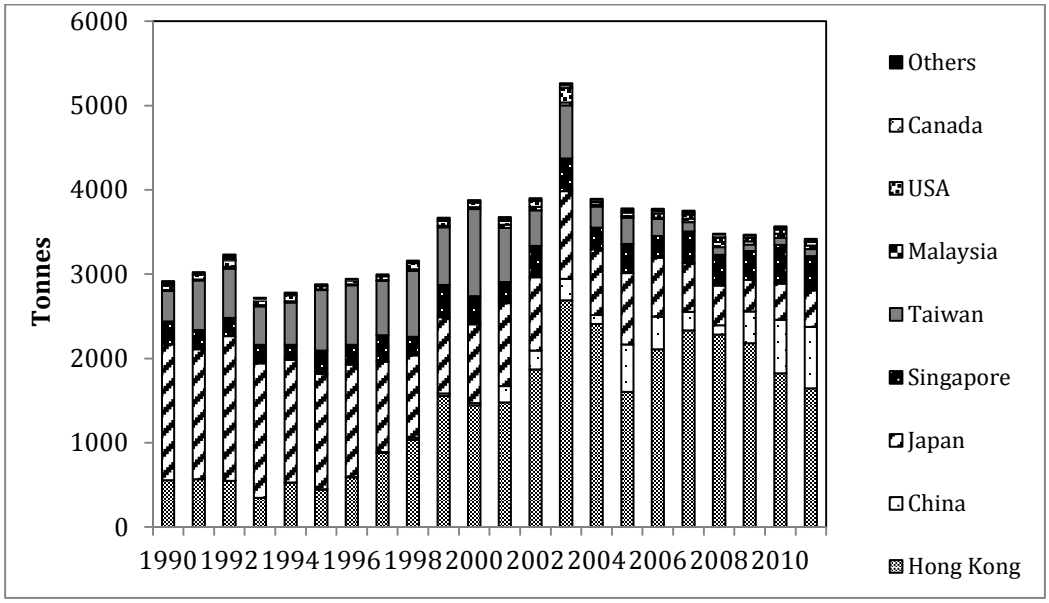

Figure 2: Top 8 export destination of Australian abalone by quantity, 1990-2011.

The majority (47.6%) of abalone is exported in the form of "live, fresh or chilled" (Figure 3). The share of the live abalone export has more than doubled since 1994 (16.2%). This is followed by "prepared or preserved" abalone (26.8%) which includes canned or bottled, and "frozen" abalone (11.2%) including both frozen meat and whole on shell. Dried and parboiled abalone accounts for only 0.2%, and 0.3% of total export quantity, respectively. The exported quantity of frozen abalone has been relatively stable during this period, while the quantity of prepared or preserved abalone export has declined by 48%.

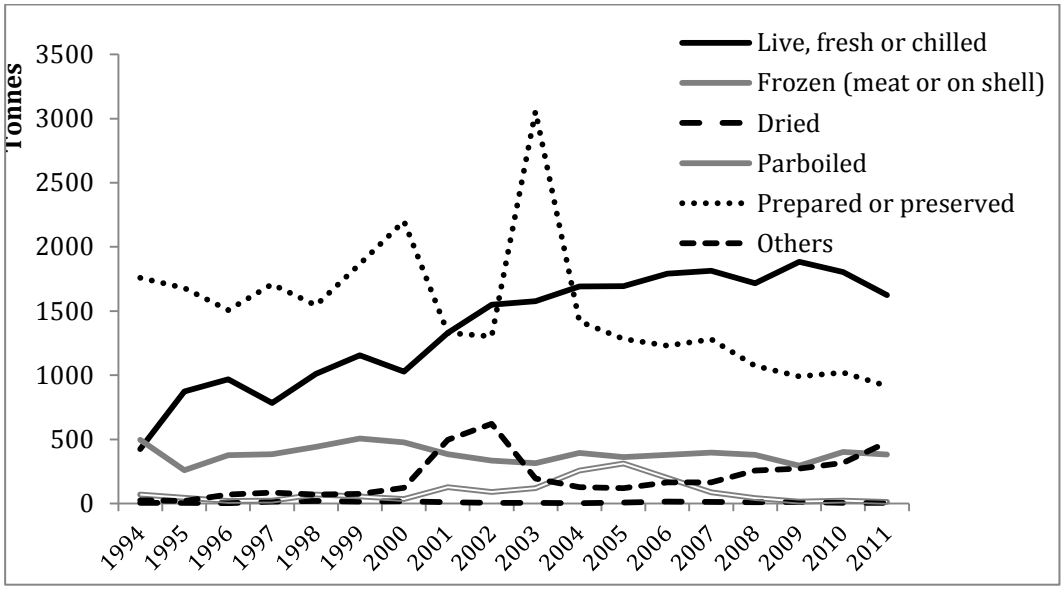

Figure 3: Export quantity of Australian abalone by commodities, 1994-2011.

Unit export price by commodity type

The average unit export price (AU$/kg/year) of abalone products in nominal term has generally declined over the past 10 years, with exception of the price of dried meat, which increased by 180% in nominal term between 2001 and 2011 (Figure 4). The decline was the largest for frozen whole on shell (-56.5%), followed by frozen meat (-23.3%), prepared or preserved (-10.6%), and live, fresh, or chilled (-9.4%).

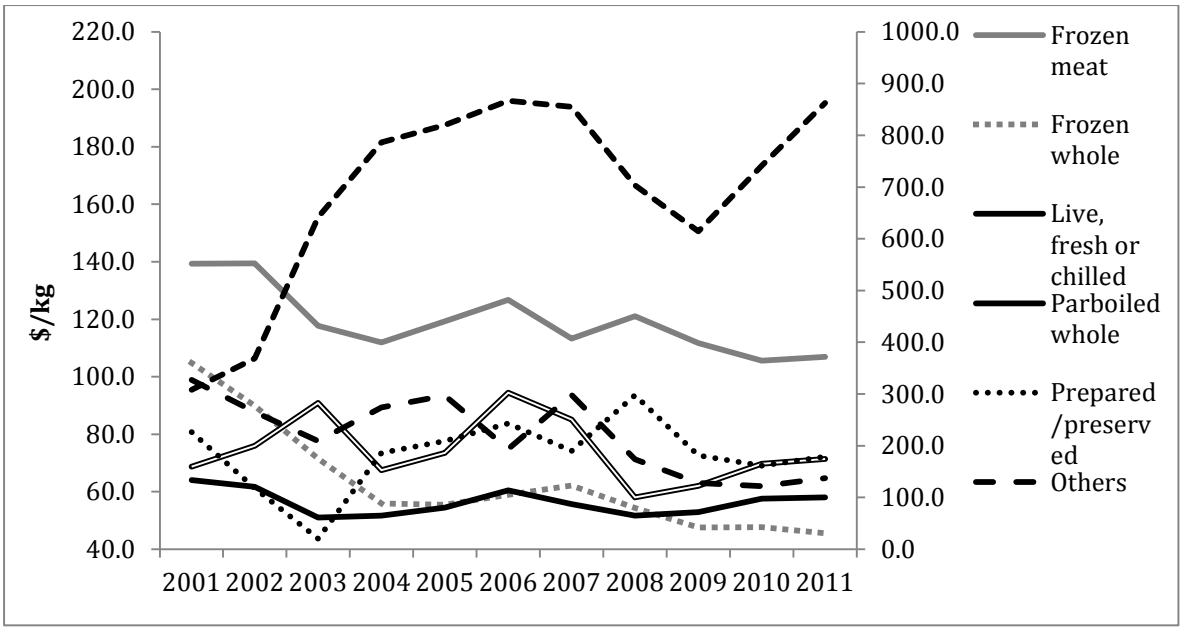

Figure 4: Nominal unit export prices ($/kg/year) of abalone commodities, 2001 and 2011.

The five-year average unit prices (2007-2011) of live, fresh or chilled abalone among the top export destination was the highest for Singapore ($61.2/kg), followed by Hong Kong ($58.3/kg), China and Japan ($50.8kg), Malaysia ($49.0kg), Taiwan ($47.1kg), and USA($46.5/kg) (Table 3.1a). On average across the major export countries, the unit price is the lowest in November ($49.2/kg), and highest in January ($55.1/kg) followed by September ($54.9/kg)(see Table 1). However, considerable variation was found at individual country level. For example, November yielded the second highest average unit price for live abalone in Japan and USA.

Similarly, the five-year average unit export prices for “prepared or preserved” abalone vary considerably across the months (Table 1b). The high export prices in November observed in China, Hong Kong and Japan may be explained by the high demand related to the end of the year banquet and New Year celebration (in Japan). Frozen meat export prices, on the other hand, appear to have less variation across the months in the majority of the countries. For example, the monthly average export prices of frozen meat in Hong Kong vary between $103/kg and $114/kg, or $9/kg difference, which equates approximately 9% gap between the highest and lowest. This is less than half of the variation of live, fresh and chilled abalone ($16.1/kg, or 35% gap), and prepared or preserved abalone ($59.5/kg or 50% gap).

Table 4: Average monthly export prices ($/kg) of abalone between 2007 and 2011 (nominal) by commodity type.

a)Live, fresh or chilled ($/kg)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
China	53.2	51.5	52.4	51.1	51.1	51.4	51.3	49.9	51.0	51.3	48.6	49.0
Hong Kong	62.9	61.4	61.4	64.7	55.3	48.6	63.7	51.4	62.0	57.6	54.0	54.8
Japan	50.9	49.8	49.9	49.7	48.2	48.6	48.3	48.1	61.3	49.7	57.1	50.5
Malaysia	51.3	51.9	54.7	43.7	46.9	48.3	46.8	50.7	53.4	46.7	38.4	45.6
Singapore	62.0	59.9	58.9	62.6	59.3	67.1	68.4	66.8	68.4	69.1	53.8	59.4
Taiwan	60.5	47.9	44.7	46.4	45.3	45.2	45.4	45.0	44.0	47.4	42.7	42.3
USA	44.6	55.4	52.1	46.7	46.0	45.1	46.9	45.3	44.5	47.4	49.8	52.5
Average	**55.1**	**54.0**	**53.4**	**52.1**	**50.3**	**50.6**	**53.0**	**51.0**	**54.9**	**52.7**	**49.2**	**50.6**

b)Prepared or preserved ($/kg)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
China	73.3	24.7		144		190	53.5	268	63.5	65.5	161	105
Hong Kong	66.2	71.0	115	65.5	73.2	72.6	71.2	88.3	101	82.6	125	79.7
Japan	74.8	71.9	71.8	67.8	68.4	71.7	80.5	71.4	77.3	68.0	152	87.5
Malaysia	62.6	78.6	65.7	63.4	58.9	57.5	67.0	62.5	69.3	64.1	58.8	76.3
Singapore	60.8	75.3	72.9	62.6	75.7	81.6	66.8	62.7	61.2	70.3	71.2	113
Taiwan	62.0	72.2	68.0	75.1	70.4	67.7	59.5	77.7	69.3	76.3	83.5	75.6
USA	71.8	72.5	69.2	69.0	62.6	60.2	61.5	65.6	64.7	72.2	69.5	65.8
Average	**67.4**	**66.6**	**77.0**	**78.2**	**68.2**	**85.9**	**65.7**	**99.5**	**73.6**	**71.3**	**103**	**86.1**

c)Frozen meat ($/kg)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
China	103	101	84	100	92.2	75.2	98.4	72.2	122	74.3	91.4	83.1
Hong Kong	112	107	108	110	103	114	110	110	112	109	111	114
Japan	112	133	124	109	139	111	120	122	124	115	127	123
Malaysia	105	135	100	129		122	69.2	123	107	122		120
Singapore	123	126	128	125	102	98.1	128	119	113	80.3	115	102
Taiwan		88.0	110	114	114			85.0		72.3	139	
USA	122	91.3	103	118	106	104	116	129	119	95.1	128	128
Average	**98.8**	**98.3**	**89.3**	**97.1**	**78.1**	**90.5**	**97.1**	**92.7**	**100**	**83.5**	**102**	**95.3**

Export characteristics by states

Tasmania is the largest abalone export state in Australia, accounting for 48.7% of the total exported quantity, and 40.6% of exported value in 2011. A large proportion of Tasmanian abalone is exported to two countries: Hong Kong (51%) and China (40%), totalling 91%, which is considerably higher than the national average of 69% for the two countries combined. This is largely because Tasmania has the largest share of live abalone export targeting the Chinese market. Live abalone export represents just under 6% of total Tasmanian abalone export in 1994, but it has expanded to 86% in

2009 (Figure 1), although it has declined since to 70% in 2011 due to the decline in quantity exported to Hong Kong.

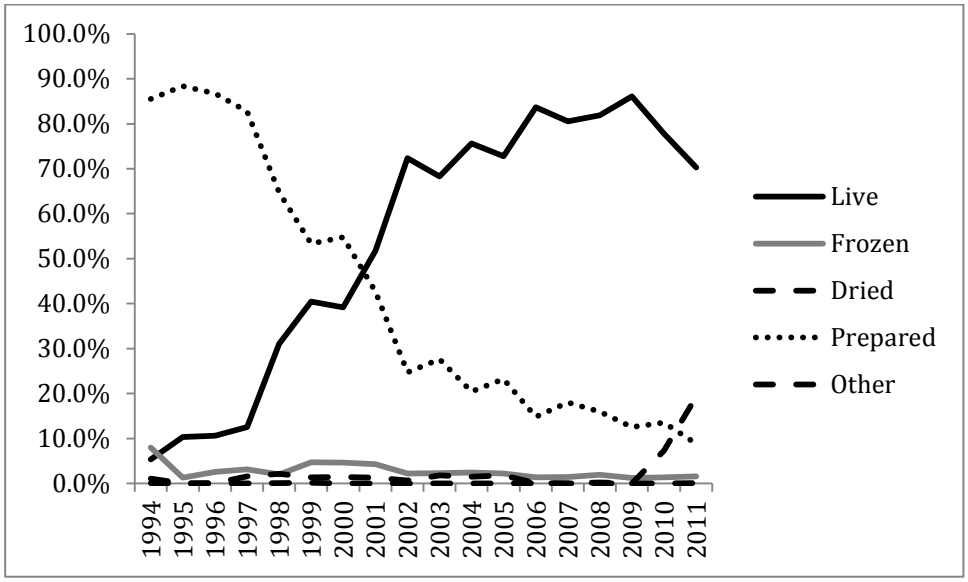

Figure 5: Tasmanian abalone commodities export quantity, 1994-2011

Table 5: Average unit export prices of Tasmanian abalone to Hong Kong (HK) and China (CN), 2007-2011.

Unit export price ($/kg)	2007		2008		2009		2010		2011	
	HK	CN	HK	CN	HK	CN	HK	CN	HK	CN
Live, fresh or chilled	52.2	52.8	49.0	48.8	50.3	49.7	57.2	57.5	48.6	49.4
Frozen meat	95.8		96.2	77.4	83.9	89.7	87.8	83.8	95.3	66.0
Frozen whole on shell	91.8	30.0	66.0	-	22.0		20.6	-	57.0	-
Dried meat	687.5	639.6	584.9	495.5	-	92.5	-	373.6	728.2	-
Prepared or preserved	68.5	65.5	73.2		62.6		62.4		64.8	164.0

The unit export prices of Tasmanian live abalone (annual average between 2007 and 2011) destined to China are very similar to those destined to Hong Kong (Table 5), suggesting the prices in the two markets are closely linked.

Victoria is the second largest abalone export state, accounting for 35.5% of the total abalone export in quantity, and 36.6% in value. Three top export destinations of Victorian abalone in in 2011 in terms of quantity were Hong Kong (33%), Japan (32%) and Singapore (21%). By type of commodities, "prepared or preserved" accounts for 37.1%, followed by "others"(24.7%), "live, fresh or chilled" (20.7%), and "frozen" (16.6%). Unlike Tasmania, an expansion of live export did not take

place (Figure 6). The export quantity of preserved or prepared abalone peaked in 2003, but it rapidly declined and is now below its 1994 level in quantity.

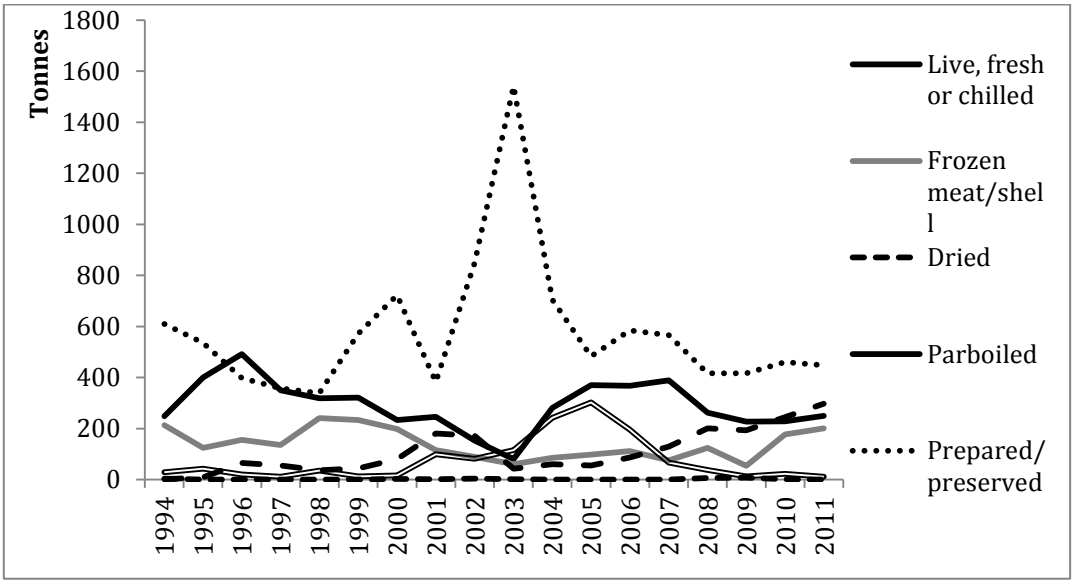

Figure 6: Victorian abalone commodities export quantity, 1994-2011

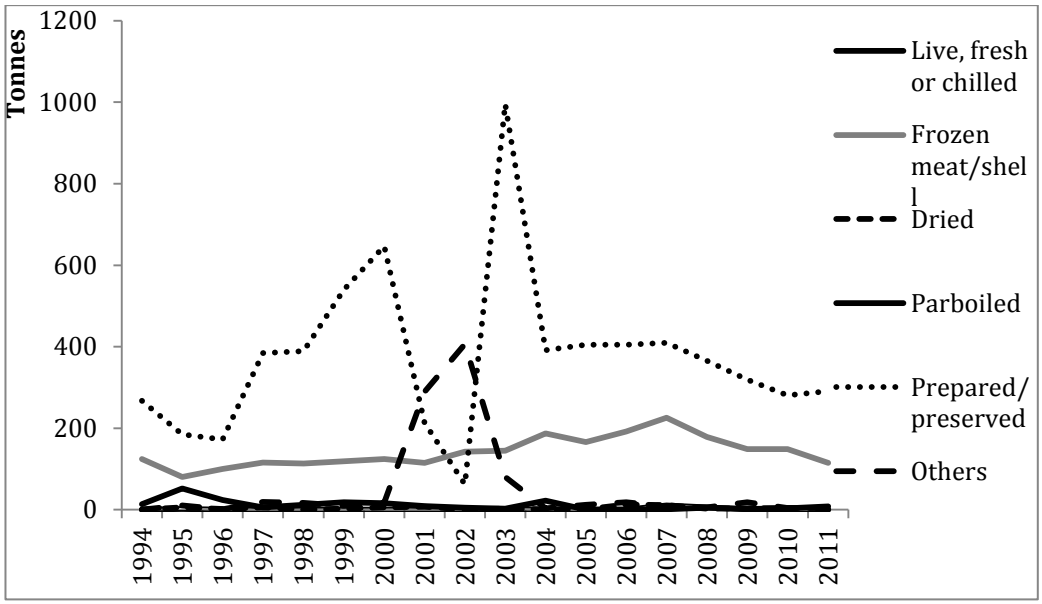

Figure 7: South Australian abalone commodities export quantity, 1994-2011.

South Australia accounts for about 12.3% of total Australian abalone export in quantity, 18.5% in value in 2011. The majority (84.2%) of the South Australian abalone is exported to Hong Kong, followed by Singapore (2.3%) and Japan (2.0%). Prepared or preserved abalone dominates (69.4%) the abalone commodities exported, followed by frozen abalone (27.5%, including both meat and whole on shell), and live, fresh, or chilled abalone (2.0%).

The annual export value of abalone by states (Figure 8) shows either flat or gradual decline for all states. The annual value of South Australian abalone export has been declining since 2001.

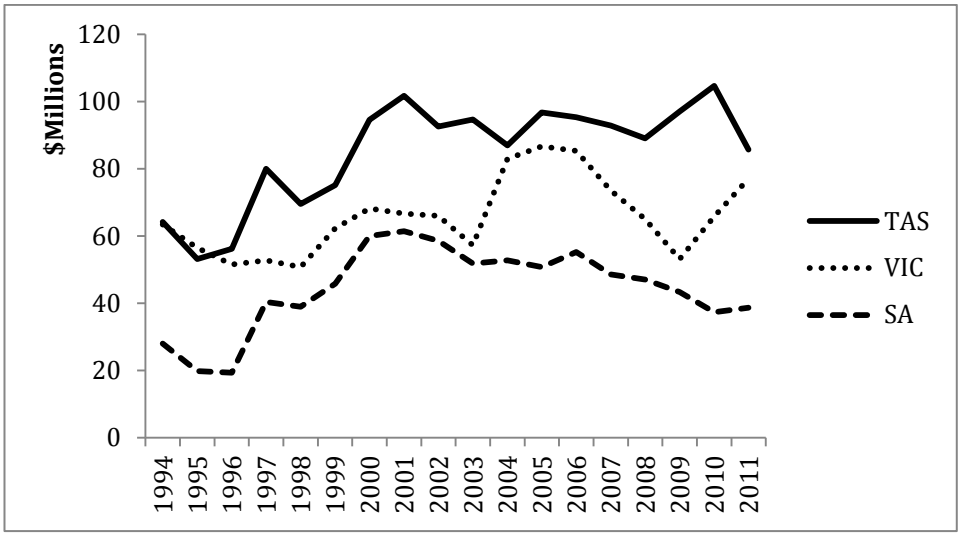

Figure 8: Export value (AU$million) of Australian abalone products by state

Chapter 3 : Prices of abalone products in the Japanese market

Wild harvest occurs in many countries but is dominated by Australian production, which accounts for around 50% of global wild fishery production with virtually all of this product exported into Asian markets (Cook and Gordon 2010). An issue of concern to producers is the trend in beach (ex-vessel) price, which has fallen by 47 per cent in real terms during the period 2000/01 to 2010/11 (ABARES 2012). The precise cause of this decline is not well understood although there are many possible factors including changes in market dynamics, exchange rates and supply, and market shocks such as the global financial crisis (Cook and Gordon 2010).

The change in supply of abalone is of particular interest because substantial shifts in production have occurred globally. Supply of wild harvested abalone has declined in many jurisdictions due to a range of factors including overfishing, disease, and poaching[5] (Jamieson and Campbell 1998, Gallardo-Fernández 2013). At the same time as wild harvest production has been in decline, global farmed abalone production has increased rapidly from around 2,500 tonnes in 2000 to more than 65,000 tonnes in 2010 (FAO 2012). This rapid increase in the production of farmed abalone products is of concern for wild abalone producers because of its direct contribution to the downward trend in price. Decreased price of wild product has been observed in some other seafood products such as salmon where supply has increased through aquaculture (Knapp, Roheim, and Anderson 2007, Nielsen *et al.* 2007, Nielsen *et al.* 2011). However wild and farmed abalone have many distinct market traits, including size and colour, so there is debate within the Australian wild harvest sector around the strength of the effect of increased aquaculture supply on price.

This research examined market integration between farmed and wild abalone using Japanese import price data in order to gain insights into the potential impact of aquaculture expansion on wild abalone prices, and associated implications for wild abalone producers. We tested the hypothesis of whether the prices of abalone products imported into Japan were integrated regardless of origin, species or production type (wild or farmed) using a cointegration analysis of import prices. We chose the Japanese import market as our case study, because Japan is one of the major markets for abalone together with China, Singapore, and Taiwan. It is also one of the most diversified import markets in which fish from all the major producing regions are present, and where both farmed and wild-caught abalone hold substantial market share. Detailed data on Japanese seafood imports are available which enabled the investigation of the nature and extent of the potential impact of farmed abalone imports on the price of wild abalone. Information on market integration provides insights to the substitution that occurs in the Japanese market between wild and farmed products and, hence, allows improved prediction of future price movements in response to changes in product supply. In the Australian context, a high level of global price integration suggests that changes in domestic wild abalone catch will not result in changes in beach prices, as is often assumed... Conversely, if wild abalone

[5] Including Mexico, California (USA), and South Africa. Outbreak of infectious Abalone Viral Ganglioneuritis (AVG) has also affected the wild abalone populations in Australia.

products are considered as a separate market segment differentiated by consumers in the import market, change in supply of farmed products would not affect the price of wild abalone products. In such cases, Australian fisheries managers must consider the implications of fisheries policy on the profitability of wild catch producers from both changes in harvest volumes and price.

A number of studies have investigated the market interaction between wild fisheries and seafood produced by aquaculture but for a limited number of species, including salmon (e.g. Asche, Bremnes, and Wessells 1999, Asche and Sebulonsen 1998, Jaffry *et al.* 2000, Asche *et al.* 2005, Tveteras and Asche 2008, Steen 1995), shrimp (Vinuya 2007, Asche *et al.* 2012), catfish and tilapia (e.g.Asche, Bjørndal, and Young 2001, Norman-Lopez and Asche 2008, Chidmi, Hanson, and Nguyen 2012). To date, no studies on abalone or other mollusc species have been undertaken. The evidence from the literature indicates low substitution between wild and farmed fish, unless they are closely related species. In the case of salmon, for example, farmed and wild caught product are found to be close substitutes, and increased production of farmed salmon has had a substantial impact on the market and prices for wild salmon species (Knapp, Roheim, and Anderson 2007, Nielsen *et al.* 2007, Nielsen *et al.* 2011). This paper follows these previous studies and others that identify interactions among seafood products on the market side (e.g. Gordon and Hannesson 1996, Jaffry, Pascoe, and Robinson 1999, Nielsen, Smit, and Guillen 2012, Singh, Dey, and Surathkal 2012), but we extend the cointegration analysis in this area by explicitly accounting for structural breaks. Despite the vast literature on the use of unit root tests in the presence of structural breaks, there are only a small number of multivariate cointegration analyses that address the issue of breaks in time series data. Disregarding breaks can lead to parameter inconsistency and may have severe consequences on inference if left undetected, i.e. it may mislead one to erroneously accept the null hypothesis of no cointegration or of a cointegration rank smaller than the true rank (Inoue 1999).

In our paper we used tested for abalone price integration using the Johansen cointegration test which allows for a structural break in the time series. Using this test we identified market integration , with fairly stable relative prices suggesting that Japanese consumers have a low level of differentiation of imported abalone product on the basis of product origin or production types.

The results of our analysis will be useful to exporters of abalone into the Japanese market and resource managers in the abalone producing countries, as they can better focus marketing strategies and other industry support to improve competitiveness, and design fisheries policy to ensure sustainability of wild stocks and support aquaculture development.

Abalone import market in Japan

Abalone is an expensive seafood in Japan, traditionally consumed for special occasions at luxury restaurants, or purchased as holiday gifts (NOAA 1989). Four native abalone species are found in Japanese waters; the Japanese abalone or Kuro awabi (*Haliotis discus discus*); a cold water species, the Pacific abalone or Ezo awabi (*Haliotis discus hannai*); the giant abalone or Medaka awabi (*Haliotis medaka*); and

Siebold's abalone or Mekai awabi (*Haliotis gigantea*). Until the late 1980s, abalone imports by Japan were negligible (54 tonnes in 1988), but the rapid economic growth of the 1980s, globalization, and the decline in domestic production of abalone species have increased the demand for and importation of abalone. The domestic production of Japanese abalone declined from approximately 4,580 tonnes in 1985 to 1,259 tonnes in 2011 (MAFF 2012), while import volume increased from negligible levels to 2,027 tonnes during the same period (MOF 2012). Imported product now accounts for more than 60% of the total abalone supply in Japan. In the past 5 years in particular, Japan experienced a large increase in fresh abalone imports from South Korea (Figure 9). This is largely attributed to the improvement in aquaculture technologies and expansion of aquaculture production for Ezo abwabi in the region (Yamakawa 2007). While Australian abalone used to dominate the Japanese import market, accounting for approximately 56.7% of fresh and frozen imports by quantity in 2000, supply from South Korea increased from 2006 so that by 2010 Australian abalone accounted for just 15.9 % of market share, while South Korean abalone dominated with 56.9% by quantity (Figure 9). At the same time, the unit import prices of abalone products have exhibited a downward trend in recent years (Ito 2012).

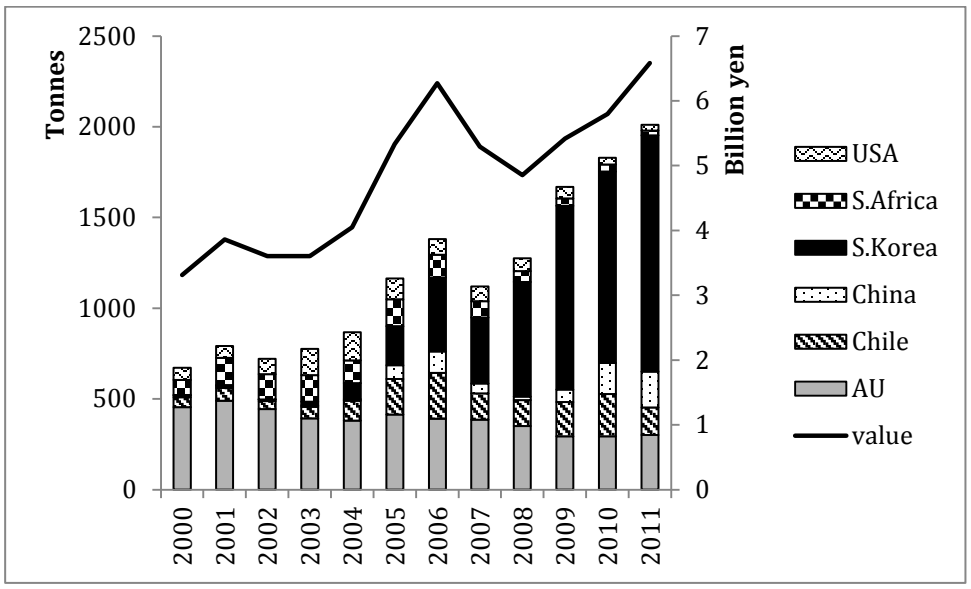

Figure 9: Import quantities (tonnes) of abalone to Japan by country of origin. Line indicates the total aggregated value of import (billion yen).

Data

Monthly data on the quantity and value of imports of the key fish species into Japan were available from Trade Statistics of Japan covering the period from 1984 to 2011[6]. From these, the monthly average import price (yen/kg) of abalone from different countries of origin between January 2002 and December 2011 was calculated as the value divided by quantity (Figure 10). We use the data on fresh, live or chilled form of abalone products (excluding frozen and dried forms), given that trade in these products accounts for the majority (approximately 70%) of imports. Fresh (including live and chilled) abalone from 6 countries represented approximately 98% of the fresh

[6] http://www.customs.go.jp/toukei/info/index_e.htm

abalone quantity imported. The available data do not distinguish between wild-caught and farmed abalone, however the distinction could be inferred by production patterns in the countries of origin. For instance, abalone aquaculture in Australia is still in its infancy, and the vast majority (approximately 97% in 2011, FAO 2012) of abalone from Australia is wild-caught, while the imports from South Korea (particularly since 2005) are predominantly farmed (Yamakawa 2007). Chile has no native abalone species[7] and therefore is 100% farmed. South Africa has been one of the major wild abalone producers in the world, but subsequent to the closure/drastic reduction of the commercial fishery since 2008, it is likely that the most recent production is dominated by farmed abalone (Gordon and Cook 2013). In the USA, most of the wild commercial stocks have been depleted (California Department of Fish and Game 2005) and increasing volume of farmed product has entered into the market in recent years, thus it was assumed that product from the USA was mainly farmed. There is little information about Chinese wild catch, but based on the production statistics reported to the Food and Agriculture Organization (FAO) of the United Nations, the production from China was also assumed to be mainly farmed (Gordon and Cook 2013).

The imported abalone include species that are non-native to Japan, including greenlip abalone (*H. laevigata*), blacklip abalone (*H.ruber*), red abalone (*H. rufescens*), and South African abalone (*H. midae*) (Table 3). The imports of minor species and similar large gastropods such as Chilean loco (*Concholepas concholepas*) are not included in the analysis since they are not classified as "awabi" (abalone) in the Japanese import statistics. Wild abalone produced domestically in Japan is out of the scope of this paper due to data limitation[8].

[7] There are several species of sea snails, known as Chilean loco, that are harvested in the wild and sold as abalone in some markets, but they are not included in the abalone import statistics in Japan. Moreover, loco species are mainly traded as frozen form, which is not the main product form considered in this paper.

[8] The traditional approach to investigate price sensitivity of demand and degree of substitution between potentially competing products is demand structure analysis, in particular, inverse demand systems for perishable products such as fish (Jaffry, Pascoe, and Robinson 1999, Anderson 1980), where the price of fish is assumed to vary in response to quantity landed. However, quantity information is not always available at high frequency as required for reliable econometric analyses.

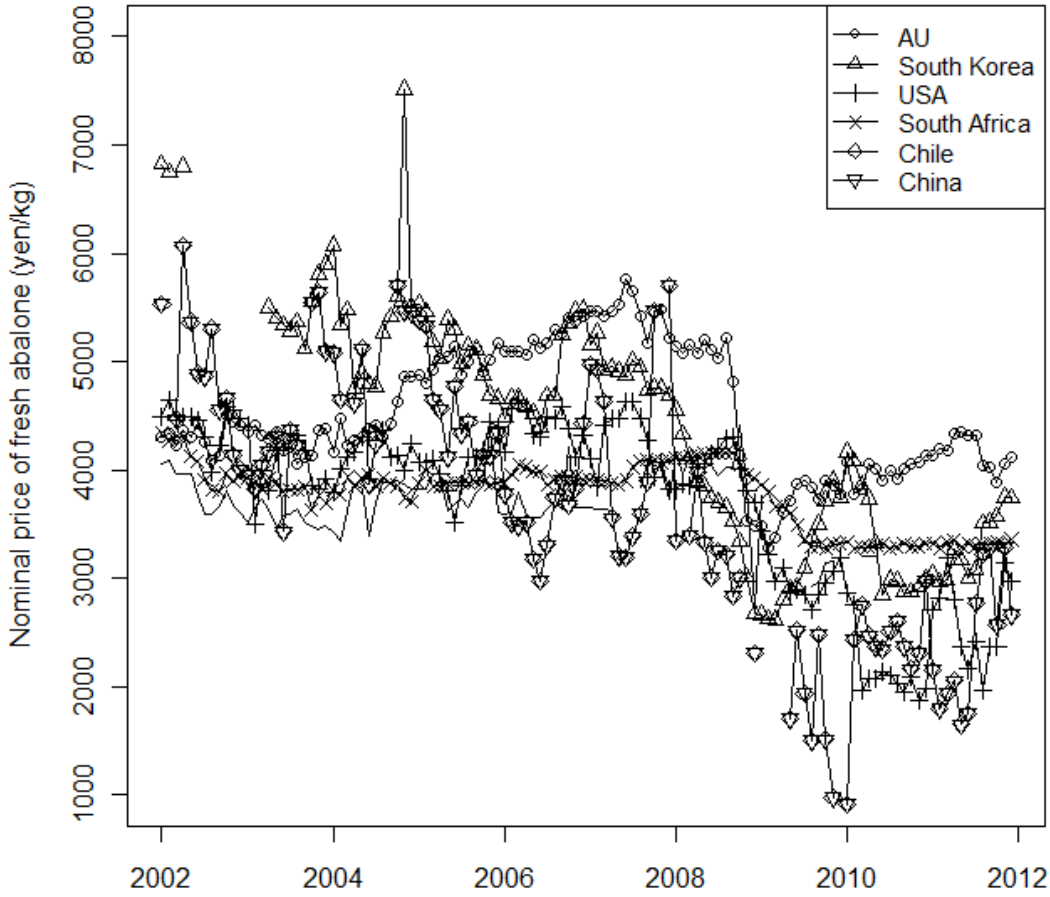

Figure 10: Nominal monthly import prices of fresh, lived and chilled abalone to Japan by country of origins, Jan 2002-December 2011.

Table 6: Fresh abalone import from six major countries.

Origins	Species	Production	Missing values[1]	Sample size (n)	Mean price (yen/kg)	Mean monthly import volume (tonnes)
Australia	*H. laevigata; H.ruber*	Wild	NA	120	4,529	17.7
Chile	*H. rufescens; H. discus hannai*	Farmed	Feb 09-Jul 09 May 10-Dec 11	89	3,711	1.1
China	*H. discus hannai*	Mainly farmed	Jan 09-Apr 09	107	3,666	3.2
South Africa	*H. midae*	Wild[2]	NA	120	3,778	7.5
South Korea	*H. discus hannai*	Farmed	May 02- Mar 03	108	4,400	39.9
USA	*H. rufescens*	Mainly farmed	NA	120	3,715	7.1

Data period is January 2002 to December 2011. Sample size indicates the number of observations of monthly price series.
1 Only major missing observations (where no trade occurred) are shown.
2 It is likely that some proportion of farmed products are present in recent years.

Methods

Unit root tests with unknown break

The plot of price series for imported fresh abalone (Figure 10) suggests that the individual series contain at least one structural break, centred around mid-2008. This is not surprising given the changes that impacted this market at this time including the global financial crisis, the expansion of aquaculture production and the closure of some wild abalone fisheries. Traditional unit root tests, such as the Augmented Dickey–Fuller test (ADF) (Dickey and Fuller 1981) and Phillips -Perron test (Phillips and Perron 1988), have been criticized because of their bias towards non-rejection of the null hypothesis of a unit root in the presence of structural breaks. A number of alternative methods exist that allow a unit root test with either known (Perron 1990) or unknown break date (e.g. Zivot and Andrews 1992), with some extended to accommodate the possibility of multiple break points (e.g.Clemente, Montañés, and Reyes 1998). Since the use of an incorrectly specified break date causes size distortions and power loss this paper adopted the method proposed by Kim and Perron (2009) [9] which allows for a break in the deterministic trend at an unknown time under both the null and alternative hypotheses. The break is limited to a single most significant period due to the relatively short length of the abalone import time series and the possible trade-off between power and additional information. The test for each series was performed in levels and first differences with a constant and, where necessary, a trend.

Cointegration test

The Johansen cointegration technique (Johansen 1996) provided a common framework within which it was possible to test whether there was a long-run price relationship in the presence of non-stationarity in the series. It is based on a vector autoregressive (VAR) system where y_t, a vector containing n price series to be tested for cointegration, is assumed to be generated by an unrestricted kth order vector autoregression in the levels of the variables:

$$y_t = \Pi_1 y_{t-1} + \cdots + \Pi_k y_{t-k} + \mu + \Omega D_t + \varepsilon_t \quad (1)$$

where $\Pi_i (i = 1, \ldots k)$ are the $(n \times n)$ matrices of the parameters, μ is a constant term, Ω is the coefficient matrix of potentially deterministic regressors, D_t is an $(n \times 1)$ column vector holding the appropriate deterministic regressors, such as trend and seasonal variables, and ε_t is an error term assumed to be normally distributed with mean zero. The system in equation (1) can be written in the vector error correlation form (VECM) as:

[9] Two types of possible structural breaks suggested by Kim and Perron (2009) are considered: Model A1, which permits an endogenous change in the level of the series; and Model A3, which allows both changes in the level and the rate of growth.

$$\Delta y_t = \Gamma_1 \Delta y_{t-1} + \ldots + \Gamma_{k-1} \Delta y_{t-k+1} + \Pi y_{t-k} + \mu + \psi D_t + \varepsilon_t \quad (2)$$

where $\Gamma_i = -(\mathrm{I} - \Pi_1 - \ldots \Pi_i)$ for i =1,… k-1, and $\Pi = -(\mathrm{I} - \Pi_1 - \ldots \Pi_k)$. Π is the long-run 'level' solution to equation (1). The Π matrix can be decomposed into the product of two ($n \times r$) matrices, α and β, i.e. $\Pi = \alpha\beta'$, where α is the matrix of speed of adjustment coefficients and β is the matrix of long-run coefficients. The rank of Π, r, determines how many linear combinations of the n price series in y_t are stationary. A trace test is used to test for the number of significant vectors in the system (Johansen and Juselius 1990). The alternative hypothesis in the trace test is that there exist more than r cointegration vectors.

Shifts in the cointegration relationships

Structural shifts bias the rejection frequency of standard cointegration tests (Gregory, Nason, and Watt 1996). To account for this we followed the approach by Lütkepohl, Saikkonen, and Trenkler (2004), which allows for a single shift in the level of the process at an unknown time. The unknown break point is estimated at the first step, followed by estimation and removal of the deterministic part of the process [10] including the shifts. A Johansen cointegration rank test is then performed on the adjusted series. The advantage of this method is that the asymptotic distribution of the test statistic under the null hypothesis is the same as in the case of a known break date, allowing the use of critical values readily available in the literature (Lütkepohl, Saikkonen, and Trenkler 2004).

Both pairwise and multivariate coinegration tests were first used without a structural break (base model) and then with a break to examine the influence of the break on cointegration ranks. Note that the sample sizes between the pairwise and group tests are different due to missing values (Table 3) with pairwise tests generally having larger sample sizes than the multivariate test. Price series data for Chile was not available after May 2010, so the multivariate test involving the five remaining series was run in addition to the test involving all six series. Where the series were found to be cointegrated, the law of one price (LOP) test was performed to determine the strength of the linkage. The LOP test is performed by imposing the restriction β' = (1, –1). The test statistic follows a chi-square distribution, χ^2 , with one degree of freedom.

Weak exogeneity and exclusion tests

Where the series were found to be cointegrated using the multivariate cointegration test, a further test was conducted to determine whether the price of a single country of origin drove prices for all imported fresh abalone in the long run (price leadership). For this analysis, a weak exogeneity test was carried out by imposing the restriction that all the parameters in the corresponding row in the α matrix are zero. The test statistics are distributed as χ^2 random variables with r (n - m) degrees of freedom for an ($n \times m$) matrix, with m equal to the columns of the restricting matrix. The test results are reported in Table 5.

It is possible that variables might be shown to cointegrate using the multivariate cointegration test even though one or more of the variables does not significantly

[10] The deterministic part of the data generating process may include a linear time trend in addition to shifts in the mean (Saikkonen and Lütkepohl 2000).

contribute to the long run relationship (Jaffry *et al.* 2000). To correct for this "weak" cointegration, exclusion tests (Jaffry *et al.* 2000) were undertaken, where null restrictions were imposed on the long-run parameters in $\hat{\beta}$ (the estimated cointegration vector β), and the resultant model was compared to the original model using the likelihood ratio test.

Results

The unit root test for each series was performed in levels and first differences with a constant and, where necessary, a trend. All data series were found to be non-stationary in levels, but were stationary in first differences (Table 4). For all pairwise cointegration tests of fresh imported abalone price, the null hypothesis of no cointegration vector with rank = 0 was rejected at the 5% level when a break is allowed (Table 5). On the other hand, the same tests of pairwise cointegration using the standard procedure (no break) failed to reject the null hypothesis of no-cointegration for some pairs of abalone import price series. This may be due to loss of power of the standard method in the presence of a structural break (Gregory, Nason, and Watt 1996).

Table 7: Kim and Perron unit root tests of logged abalone import prices (nominal) in Japan, January 2002 to December 2011.

Variables (log of prices)	Break	Levels	First differences
Australia	Aug.2008	-1.467(0)	-11.715(0)*
China	Jan. 2010	-0.721(2)	-10.837(1)*
Chile	Nov. 2008	-4.007(2)	-6.713(3)*
South Africa	Aug. 2002	-3.992(0)	-7.232(2)*
South Korea	Oct. 2004	-3.372(3)	-4.670(4)*
USA	Feb. 2010	-2.593(5)	-6.924(4)*

*indicates significance at the 5% level. The critical values were taken from Perron (1989). The values in brackets represent the number of lags which is chosen using the modified Akaike information criterion (MAIC) suggested by Ng and Perron (2001). Structural break in intercept (Model A1; crush model) or intercept and trend (Model A3) were used based on appearance of the break.

Table 8: Bivariate Johansen test for fresh imported abalone in the Japanese market. Trace test statistics at rank *r* = 0.

	Sample size (n)	Trace test	Trace test with shift	Break date	LOP (Chai-squared test)
Wild vs wild					
AU – S. Africa	120	24.80(1)**	21.08(1)**	Sep. 2008	0.35
Wild vs farmed					
AU – Chile	89	23.10(1)*	22.31(1)**	Sep. 2008	13.88**
AU – S. Korea	108	10.15(2)	17.68(2)**	Aug. 2008	0.63
S. Africa – Chile	89	39.40(1)**	27.01(2)**	Dec. 2008	0.64
S. Africa – S. Korea	108	20.92(2)*	30.54(2)**		4.55*
Wild vs mainly farmed					
AU – China	107	6.54(2)	27.31(1)**	Sep. 2008	3.79*
AU – USA	120	9.53(1)	29.74(1)**	Sep. 2008	1.77
S. Africa – China	107	11.35(1)	32.41(1)**	Dec. 2008	5.72**
S. Africa – USA	120	21.02(3)*	29.61(3)**	Jan. 2009	11.46**
Farmed vs farmed (mainly)					
Chile – S. Korea	77	16.22(1)	22.52(1)**	Dec. 2008	6.67**
Chile– China	81	19.99(5)*	17.61(5)**	Dec. 2008	15.81**
China– S. Korea	95	27.48(1)**	24.40(1)**	Jul. 2011	0.57
USA – S. Korea	108	11.31(1)	26.31(1)**	Jan. 2008	0.08

Critical value of MacKinnon *et al.* (1999) at 5%(*) and 1%(**). For LOP test, chi-square critical value at 5% was used. ( ) indicates optimal lag length based on AIC and SC selection criteria. When two criteria disagreed, a higher number of lag was selected.

Of particular interest is the hypothesis of whether the LOP holds in the long-run price linkage between wild (Australian and South African) and farmed (South Korean and Chilean) abalone. The LOP between Australian and Chilean abalone was rejected, while the pairwise tests between Australian and both South African and South Korean abalone were not rejected. This indicates that the price of Australian wild caught abalone is strongly linked to the price of wild product from South Africa and farmed product from South Korea, but not with the price of farmed product from Chile. The price of farmed Chilean abalone was found to be strongly linked with that of wild South African abalone, indicating that these products are close substitutes.

The multivariate cointegration tests indicated the existence of a long-run relationship between the variables (Table 6). Dickey *et al.* (1991) argued that cointegration vectors reflect the economic constraints imposed on the movements of variables in the system in the long run, and consequently a system is more stable when it has a higher number of cointegrating vectors, with the maximum possible being *n-1*. The results identify five cointegration vectors in the model including all six price series under the model specification including a constant term and a structural break, indicating strong interdependencies among the price series. The multivariate test involving five series (excluding Chile) yielded similar results (four cointegration vectors, Table 6), confirming the existence of a stable long-run relationship across the longer time period after accounting for a shift. The structural break in the cointegration relationship occurred most likely around October to December 2008 (Table 6). The rejection of the LOP tests, however, indicate that not all imported abalone products from different countries are seen as close substitutes, which is consistent with the bivariate test results.

Table 9: Multivariate Johansen test for fresh imported abalone

	6 countries (n=68)				5 countries excluding Chile (n=98)			
Rank	Trace	Trace with shift	Break date	LOP	Trace	Trace with shift	Break date	LOP
r <=0	146.26**	104.38**			121.73**	94.66**		
r <=1	98.17**	73.40**			73.61**	60.84**		
r <=2	60.17**	49.92**	Dec. 2008	13.01**	41.76**	35.25**	Oct. 2008	11.92**
r <=3	35.71*	31.47**			10.37	15.22*		
r <=4	13.31	14.77*			2.82	3.96		
r <=5	4.05	2.52			-	-		

*indicates significance at the 5% level; **indicates significance at the 1% level. Critical values from Osterwald-Lenum (1992) were used for non-adjusted series, and those from Trenkler (2003) were used for the shift adjusted series.

The exclusion tests for the multivariate model (base model with six countries) were rejected at the 5% significance level for all series, with the values of the likelihood ratio test statistics of 24.92 (Chile), 27.79 (China), 28.32 (USA), 29.14 (South Africa), and 30.14 (South Korea). The results provide support for the hypothesis that fresh abalone imported from six major countries significantly contribute to the long run relationship. In such cases, the price series generally move together in the long run, regardless of their origins or production process (farmed or wild-caught).

The null hypotheses of weak exogeneity were rejected for all imported fresh abalone prices, except for the Australian prices (Table 7). This indicated that the price of Australian abalone in Japan is determined outside of the system, and is therefore likely to be the leading price of imported fresh abalone in this market in the long run. Although farmed Pacific abalone from South Korea has become the single most important species by both volume and value over the past several years, no evidence was found to support the conjecture that farmed abalone from South Korea leads the prices for all imported abalone.

Table 10: Weak exogeneity and exclusion tests

	Weak exogeity test		Exclusion test	
Variable (r=4)	χ^2 statistics (4 d.f.)	P-value	χ^2 statistics (1 d.f.)	P-value
Australia	1.55	0.82		
Chile	9.74	0.04	24.92	>0.00
China	8.60	0.07	27.79	>0.00
South Africa	15.84	0.00	29.14	>0.00
South Korea	18.35	0.00	30.14	>0.00
USA	17.73	0.00	28.32	>0.00

The residual diagnoses suggest no evidence of serial correlation for the models considered, or heteroscedasticity. Although residuals appear to be symmetric and centered around zero, the multivariate normality test (JB-test) was rejected (e.g. χ^2 test =134 for model with 6 series) due to excess kurtosis (fat-tailed). Since cointegration results have been found quite robust to excess kurtosis (Gonzalo 1994, Hendry and Juselius 2000), the present model specification is viewed as acceptable.

Discussion and conclusions

The rapid increase in the production and trade of farmed abalone products is of concern for wild abalone producers because of the potential for price reduction, as experienced in the wild salmon industry (Asche, Bremnes, and Wessells 1999). This concern is grounded in the belief that consumers do not differentiate between products from different sources. Using the Japanese import market as a case study, this paper explored the existence of a long-run relationship among the prices of imported abalone products within a cointegration framework. We placed particular focus on the relationship between Australian wild abalone and farmed abalone from South Korea and Chile. Our test results support the existence of stable long-run relationships between abalone prices from the six major abalone producing countries considered. Interestingly, the price of Australian wild-catch abalone was closely linked with the price of both South African abalone (wild) and South Korean abalone (farmed), suggesting that they are close substitutes in the Japanese market. The rejection of the LOP from the multivariate test further supports the lack of market segmentation between farmed and wild products in the Japanese abalone import market. This led to the general conclusion that consumers in the Japanese market consider imported fresh abalone of different origins, species, or production types (wild vs. farmed) as substitutable commodities, although they are not perfect substitutes with each other.

The presence of market integration between farmed and wild abalone implies possible conservation benefits of aquaculture development as increased supply of farmed product reduces reliance on wild product, although this finding is only valid in the very few abalone fisheries where catch is not constrained by regulation. It potentially occurs where poaching is significant, such as in South Africa, although even in these fisheries the price is well above that where effort would respond (Gordon and Cook 2013).

All of the Australian commercial abalone fisheries are managed with total allowable catches (TAC), which are divided into individual transferrable quotas or ITQs (Mayfield *et al.* 2012). The use of ITQs affects economic yield from fisheries in several ways including: control of the tonnage and thus revenue; by promoting of the fleet through trading of quota; and through control of biomass which affects catch rates and costs of fishing (Costello and Deacon 2007). The constraint of supply that occurs with ITQ systems can also increase price (Dewees 1989, Nielsen, Smit, and Guillen 2009), however, our results suggest that constraint of supply in these ITQ fisheries is unlikely to yield higher prices because of product substitution. Controlling catch with ITQs may well have benefits in terms of biomass and cost of fishing but revenue will likely decrease with lower catch as price will not respond to changes in supply.

These results show that wild abalone producers face a challenge in differentiating their product from farm-grown alternatives in the marketplace, and this is likely to be required to maintain economic yield in these industries with supply from aquaculture projected to continue to grow. This product differentiation could take several forms including through third party certification of sustainability, improved traceability to guarantee the origin or place of provenance, and development of value-added products. The key message is that it is vital to consider the impacts of future aquaculture expansion, both domestically and internationally, in the formation of domestic wild abalone fishery management policy, given the potential economic risks for abalone capture fisheries. Since Maximum Economic Yield (MEY) has become the primary target for fisheries management across Australia and elsewhere (Dichmont *et al.* 2010), price is such a key factor that a better understanding of its dynamics will arguably result in a stronger knowledge basis for implementing current and future fisheries management policies.

The analyses did not include the price relationship between imported abalone and domestically produced wild abalone in Japan due to data limitations. Access to more detailed data would allow us to estimate the price elasticity of supply for domestic and imported abalone, as well as to identify factors driving changes in demand for abalone. Another research avenue would be to use a survey-based choice modelling approach to reveal consumer preferences, for a broader range of abalone attributes. For example, consumer preferences might be such that larger abalone command a price premium. If this was the case, we might expect to observe less tightly integrated prices in the market as wild caught and farmed abalone have different size frequency distributions. Re-evaluation of market integration and the LOP accounting for such differences in actual or perceived product characteristics will be useful when detailed size and other information becomes available in the future. Currently the largest market for abalone in the world is China. It is also the largest farmed abalone producer. As farmed abalone replaces wild caught abalone in the Japanese market, it would be worthwhile to investigate whether such changes also occur on the Chinese market where the majority of Australian abalone is exported.

Chapter 4 Prices of abalone products in the Hong Kong market

Hong Kong import statistics for abalone products are available for three commodity types: live, fresh or chilled abalone; frozen abalone; and dried, salted or in brine abalone. Data were obtained from the Hong Kong Census and Statistical Department and cover the period from January 2002 to May 2012. The import quantity by commodity groups are shown in Figure 3.9. In 2011, live, fresh or chilled and frozen abalone products combined account for 85% of the total import by quantity, but only 31% in exported value. Although the import quantity of dried, salted or in brine abalone remains relaively stable since 2002, the total value has more than doubled for the same period, and they account for 68% of total import value in 2011.

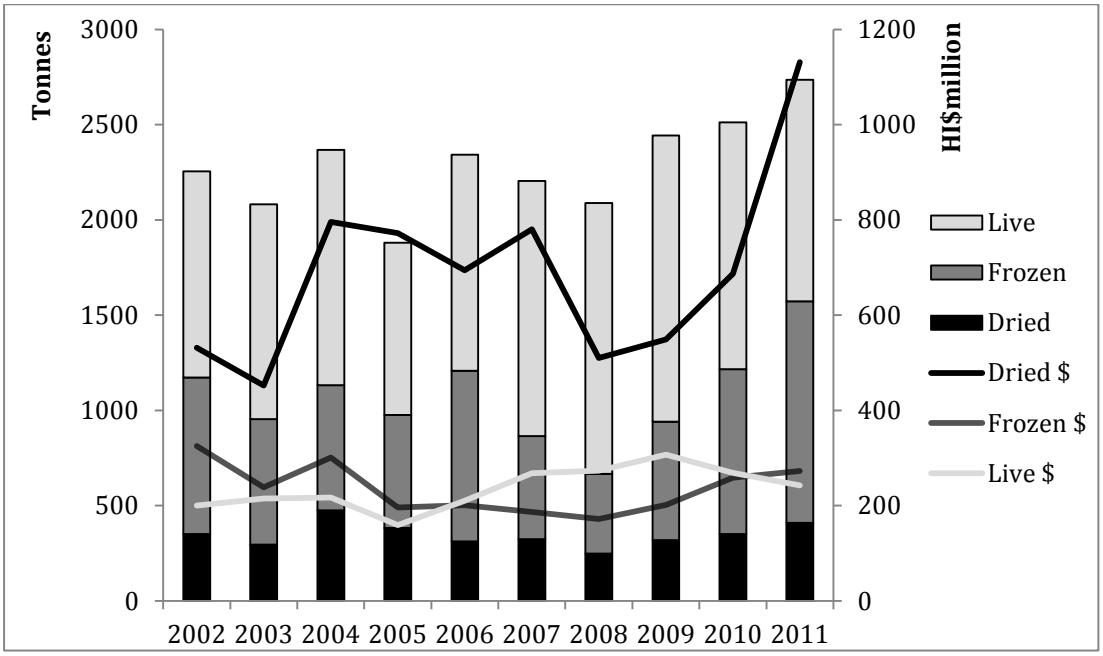

Figure 3.9. Abalone import quantity (tonnes) and value (HK$million) in Hong Kong, 2002-2011. Note that "Dried" in the legend includes dried, salted and in brine abalone, and "Live" includes live, fresh or chilled abalone.

Unit import price (HK$/kg) for dried, salted and in brine abalone in nominal term increased from HK$1,515/kg in 2002 to HK$2,755/kg in 2011 (approxilatemy AU$156/kg to 339/kg, with exchange rate in March 2013). The unit prices of frozen, and live, fresh and chilled abalone remains relatively flat for the same period (Figure 3.10). The high level of aggregation in the abalone import statistics in Hong Kong makes it difficult to identify exactly which product type is responsible for this price increase. However, given that the unit export price for dried Australian abalone incrased by 180% while canned abalone declined by 56% over the past 10 years (see previous section 3.1), it is reasonable to assume that the incrased import price of "dried" abalone is ofsetting the decline for "in brine" (or canned) abalone, resulting over 80% increase in unit price for "dried, salted or in brine" abalone products.

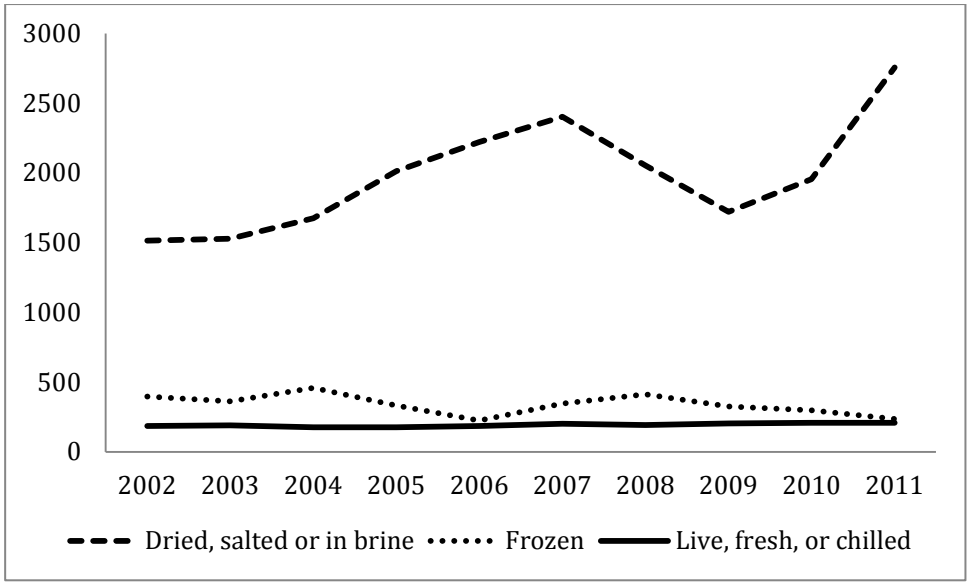

Figure 3.10. Unit import price (HK$/kg) of abalone prodocts by commodity type

The country of origins for each commody type are shown in Figure 3.11. For live, fresh or chilled abalone, Australia and South Africa dominate the import quantity (98%). Australia, South Africa and Phillipines used to dominate the frozen abalone import market, but the import of frozen abalone from China has increased since 2009, now representing 37.8% of frozen abalone import into Hong Kong in 2011 (Figure 3.11b). This is most likely due to increased production of farmed abalone in the region. Various countrie make up the import quantity of dried, salted and in brine abalone products (Figure 3.11c). Notable change is a declining import from South Africa, and increasing import from Mozambique since 2008. South African abalone (*Haliotis midae*) was listed as the Appendix III of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which comes into effect on 3 May 2007. Appendix III listing requires all international trade consignments of South African abalone to be accompanied by CITES documentation. Although South Africa withdrew the CITES listing on 25 May 2010, such trade regulation imposed in 2007 may have contributed to the subsequent decline in South African abalone import into Hong Kong in 2008, while import quantity from neighbouring countries such as Mozambique, Namibia, Swaziland and Zimbabwe, has increased at the same time. Since these countries either do not have *H. midae* in their waters or are landlocked countries, there is an assertion that the all abalone exported from these countries into Hong Kong were illegally harvested in South Africa waters and landed through neighbouring countries, from where they re-exported to Hong Kong (Raemaekers et al, 2011). Another factor which may have contributed to the general decline in South African export to Hong Kong is the closure of the commercial abalone fishery in February 2008, although the fishery was re-opened in 2010 after the new appointment of the South African president (Hauck and Fernández 2013).

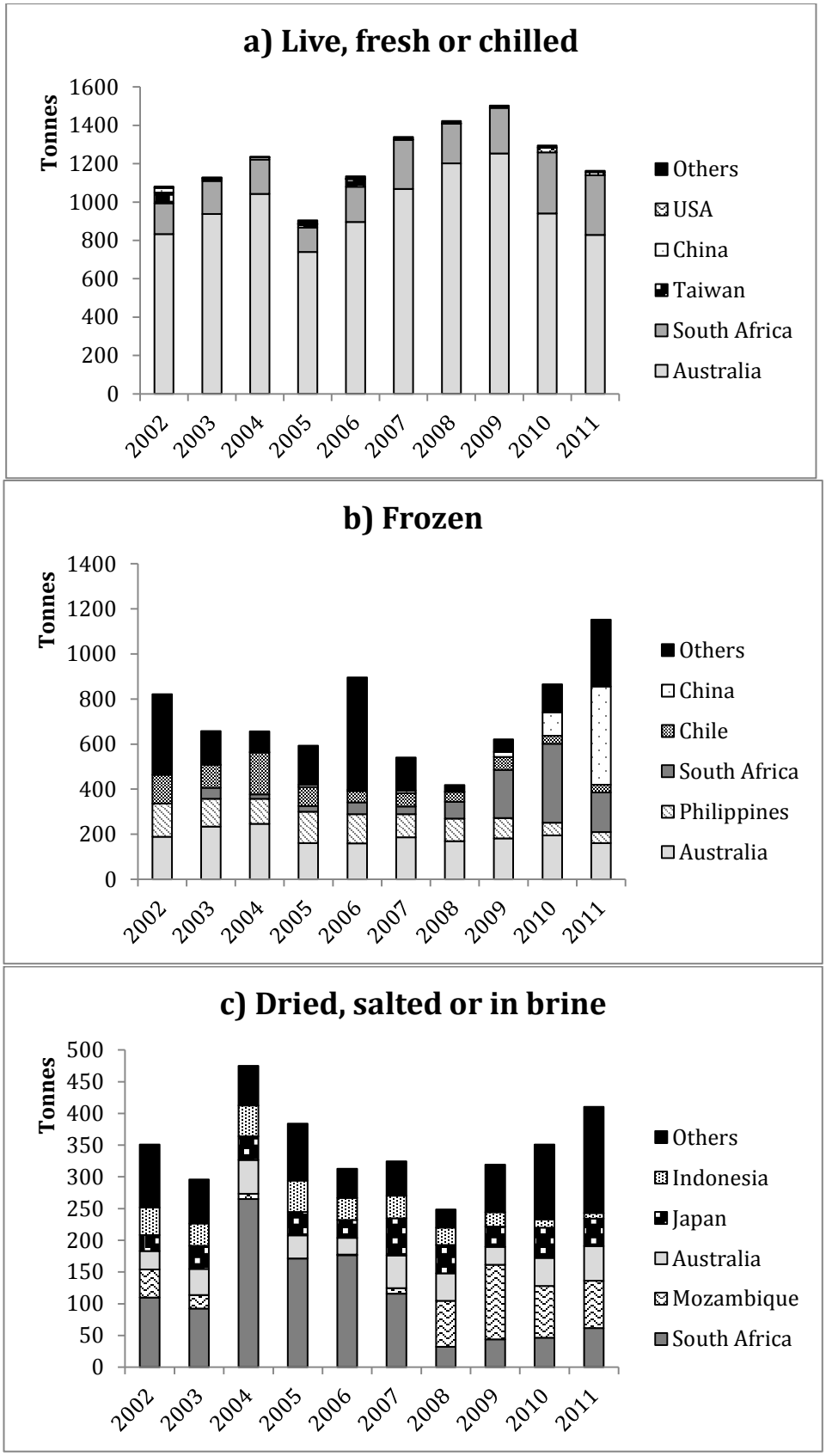

Figure 3.11. Import of origins for abalone products entering in Hong Kong, 2002-2011.

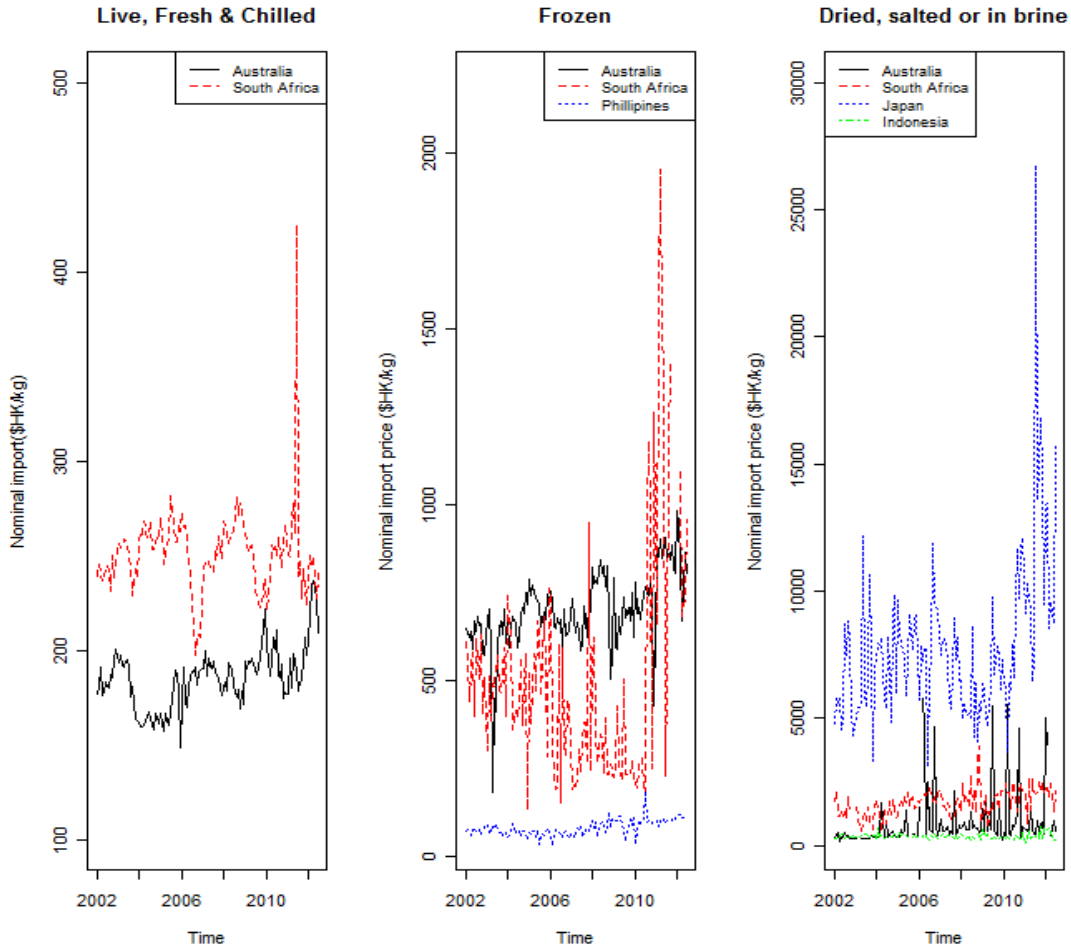

Figure 3.12. Unit import prices of abalone products (HK$/kg) for major countries, 2002-2011.

Chapter 5 : Planned Work

For a range of reasons the project was terminated before the economic data could be used to conduct modelling and provide management advice for Australian abalone fisheries. This chapter describes the work that was planned and which could still be readily conducted by future projects using the detailed economic data collected by this project.

This project is part of a series of similar bioeconomic projects in the CRC, the others being on prawn and lobster species. A review of CRC performance showed that these projects had the greatest return on investment of the CRC projects, which suggests similar substantial gains may be obtained by this approach in Abalone fisheries. Abalone have some different challenges to other species however. The main issue is that stock modeling is less well developed so there is less existing capacity that can be leveraged. For this reason the project intended to deliver industry outcomes at three different levels:

1) Economic status reporting. These provide a basic benefit across the entire range.
2) Stand alone analyses. These require the use of economic survey data can be applied to some modest specific industry issues.
3) Model based analyses. This is where the project can deliver substantial benefits but it's data intensive and not possible to do in all fisheries. Model based analyses can be transformational for industries. This is where the largest return on investment is delivered.

Economic surveys

What's the industry outcome?
- A standardized survey initiated in all areas so that we can report economic status in the future as per stock status. Reporting both economic and biological performance of the fishery side-by-side has led to better decision making in other fisheries. - The ability to report economic flows from the industry to the wider community. This is a powerful tool politically. It becomes possible to quantify the impact on the community from changes in the fishery – for example what's the community impact from a change in catch because of disease, or different export controls, or restrictions in air transport? This gives the capacity to champion the fishery in the same way that tourism and mining define their benefit in terms of employment across the community, not just tonnes of product or GVP. - We need to be clear this is a basic outcome. It's useful and likely to deliver some gains but won't have the impact of the following two sections. However it does deliver a benefit in all parts of the fishery, including where more sophisticated analyses are not possible.

Economic surveys have been conducted in Tasmania (37 respondents), NSW (17 respondents) and South Australia (18 respondents). Surveys were scheduled for WA, but this has been halted at the request of the ACA. Surveys were being planned for Victoria, but difficulties gaining industry co-operation repeatedly delayed .

The conducted surveys provide substantial insight into the Abalone industry. In addition a range of processor and export prices have been obtained from a broad range of sources. **The collected economic information is a prerequisite for most of the analysis that were planned for this project and will be extremely valuable for future projects in this area.**

Stand alone analyses

What's the industry outcome?
- Greater understanding of abalone markets, allowing improved targeting of marketing and providing insight into future risks associated with competing products. - Understanding the economic importance of different regions of the fishery, which can be used to inform decisions on management changes related to competing uses such as MPAs. - A guideline including basic 'rules of thumb' for reducing stress related mortalities in transport. - A clear understanding of which sectors (divers, quota owners, processors or the public) will benefit from various management changes.

Price/Markets

Abalone is a major export commodity and both export & import prices in the major Asian market have strong influence on abalone beach prices in Australia. Data on export prices as well as import prices in Hong Kong and Japan have been collected. The data will be used to provide a summary of market trends and to investigate demand structure for Australian abalone. Import price data in Japan, for example, has been used to investigate the potential competition among live abalone products originated from different countries and different production forms (wild vs. farmed) in the Japanese market. Similar analysis were planned to investigate long-run price relationships of various Australian abalone products destined to the Hong Kong market. Such analyses will provide insights into future price movement (which reflects market demand) and basis for discussion on potential interventions, such as marketing, and third party certifications etc.

Spatial analysis

The economic data was planned to be combined with the existing industry based GPS data in Tasmania. This would allow fishing costs and values to be calculated at a fine spatial resolution. This quantifies the importance of different blocks to industry beyond that indicated by catch alone. The impact on the Abalone industry of issues such as MPA introductions, boat ramp access and changing catch caps are often poorly understood. This analysis would help quantify these impacts to inform decisions.

Stress mitigation

Factors influencing transport stress resulting in mortalities and quality reduction resulting in product suitable only for canning were to be investigated. This would consider factors such as SST, swell, travel distance and air temperature. Guidelines for avoiding peak stress could be provided. For example this may provide maximum travel distance for different air temperatures to avoid stress issues.

Beneficiaries of management change

In most quota fisheries the roles of quota ownership and catching fish are separable. Over time this results in a small proportion of fishers owning quota. Fishers leasing quota generally make limited profit above their salaries and operating costs (including capital depreciation). Most management changes that make the fishery more profitable are beneficial to quota owners and ultimately make little difference to fisher profits (although they may decrease the number of fishers employed in the fishery). We intended to explore this dynamic in the context of the Abalone fishery with its particular complications (such as diver licenses in addition to quota). This would provide industry with an understanding of the implications of management change and will allow informed debate between industry sectors.

Model based analyses

What's the industry outcome?

- Management strategies that will improve the economic yield were to be determined. This would produce a range of management strategies with similar economic outcomes that can be evaluated by industry in light of other practical fishing concerns.
- The trade-off between regional catch caps, size limits and the spatial scale of management was to be investigated. This would allow industry to improve management rules, with consideration of both biological and economic effects. For example, it may be possible to achieve higher net revenue and equivalent biological outcomes with a lower catch cap in conjunction with a larger size limit.
- This stage is where best gains have been made with other species. Ideally the process operates by industry proposing rule changes (change in size limits, zone boundaries, etc), these are evaluated by the model and results presented to industry, refinements made by working back and forth…then rule changes made. This process happens already in abalone fisheries to some extent but economic information is only included in the process by opinion.

The Abalone stock assessment model produced by Malcolm Haddon was planned to be extended to include the economic information collected by this project. This would allow the economic impacts of a broad range of potential management changes to be considered. This information can be used both to inform debate about proposed changes and secondly propose changes that are anticipated to substantially improve industry profitability. The particular changes that were going to be explored are discussed below.

Maximum Sustainable Yield (MSY) versus Maximum Economic Yield (MEY)

Abalone fisheries in Australia generally target maximum sustainable yield, that is maximising the catch that is caught each year. In other fisheries it has been shown that reducing catches below MSY can result in increased profits due to increased catch rates, lower operating costs, and reduced fluctuations in annual catches. Unlike many other fisheries, catch rates in Abalone respond highly non-linearly to biomass. This complicates the calculation of MEY, nevertheless catches below MSY would increase the long-term profitability from the fishery.

This project was going to compare current management strategies against MSY and MEY targets. It would have determined MEY targets and proxies thereof that could be applied if industry wished to increase profitability.

Size limits and catch caps

A broad range of combinations of catch caps and size limits were going to be explored. Best management practices for different competing targets (economic yield, reduced inter-annual variability etc.) were to be developed. This would allow industry to set size limits that provide the desired trade-off between these attributes. An anticipated outcome was that a catch cap in an area could be increased for a given year if the size limit is increased by some amount. Alternatively the size limit could be reduced if the catch cap is reduced.

Spatial Management Scale

Hypothetically finer spatial scale setting of catch caps and size limits would increase the value of the Abalone fishery. In practice, data availability, management costs and fishing practicalities determine the optimal spatial management scale. This project was going to re-evaluate this trade-off. This would inform industry on the potential economic gains obtainable by changing the spatial management .

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Appendix 1: Economic indicators for the NSW Abalone Fishery 2011/12

Economic Indicators for the NSW Abalone Fishery 2011/12

A report prepared for

Seafood CRC

Prepared by

econsearch

21 October 2013

EconSearch Pty Ltd
214 Kensington Road
Marryatville SA 5068
Tel: (08) 8431 5533
Fax: (08) 8431 7710
www.econsearch.com.au

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Abbreviations

ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences
ABS	Australian Bureau of Statistics
CPI	consumer price index
FRDC	Fisheries Research and Development Corporation
fte	full time equivalent
GRP	gross regional product
GSP	gross state product
GVP	gross value of production
NSW	New South Wales
NSW DPI	New South Wales Department of Primary Industries
RBA	Reserve Bank of Australia
R&M	repairs and maintenance
UTAS	University of Tasmania

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Executive Summary

Catch and Gross Value of Production…

The NSW Share managed abalone fishery commenced in February 2000. Total catch of Abalone in NSW declined significantly in the period 2000 to 2009/10. Since 2009/10 the catch has increased slightly each season. Since 2009/10 more than 99 per cent of the TAC has been caught each season. Since 2005/06 more than 97 per cent of catch has been caught each season.

The value of catch in the fishery decreased significantly between 2000 and 2009/10, but has followed an increasing trend in subsequent years. Variation in GVP has been affected by changes in total catch and by the change in price for abalone. The nominal beach price of abalone peaked at more than $50/kg, but has followed a declining trend since 2000. The annual average beach price was $31.00/kg in 2011/12. Between 2000 and 2011/12, the 38 per cent decrease in nominal price was equivalent to a 66 per cent decline in real price (i.e. CPI adjusted price).

The coefficient of correlation between the exchange rate (USD) and the nominal price for abalone for the period 2000 to 2011/12 is –0.79, indicating that there is a moderately strong inverse relationship between the two variables. The relationship between the (HKD) and the nominal price of abalone is similar (a co efficient correlation of -0.81). There is also a moderate inverse relationship between the JPY exchange rate and the nominal price of NSW abalone over this period (-0.40). Thus, when the Australian dollar appreciates, as it did between 2001/02 and 2007/08 and again in 2009/10 and 2011/12, there is, generally, a corresponding decline in the average price of Abalone.

Management Costs…

Management Charges (as defined by section 76 of the FMA, and as distinct from other fees and charges required in the fishery) as a percentage of GVP increased from 6 per cent in 2000 to 16per cent in 2005/06, primarily as the result of falling GVP over this period. Management Charges as a percentage of GVP remained around this level until 2008/09 when they fell to 4per cent as a result of a significant reduction in management fees charged, and management services provided by DPI. Management Charges as a percentage of GVP have remained relatively low since then, due to continued lower service provision, and associated fees. Total management fees increased in 2012-13.

In addition to Management Charges, a community contribution was paid between 2002 and 2004/05, but since then the amount payable has been calculated to be zero by a regulated formula for its calculation based on beach price, TAC and GVP.

Financial Performance Indicators…

Financial performance indicators were calculated for two groups in the fishery before being combined to provide a representation of the economic performance of the fishery. The first set of financial performance indicators was calculated for fishing businesses with an

endorsement to dive. Where fishing businesses were paid to dive an external[11] shareholder's entitlement to quota, the difference between the beach price and the per kg dive fee was treated as a leasing cost. The second set of financial indicators was calculated for shareholders. The dive fee was treated as a payment. The combined analysis removed the transfers between the two parties and combined all other costs.

Economic Rent…

The economic rent generated in the Abalone fishery was estimated at $827,000 in 2011/12. Given that the aggregate value of licences in 2011/12 was estimated to be approximately $22 million (3,454 licence units with an average value of approximately $6,371), economic rent of $827,000 represents a rate of return of 3.8 per cent.

11 For the purposes of this analysis, shareholders were defined as 'external' to a fishing operation if they were not involved in the day to day running and management of the fishing operation, and if they did not own fishing equipment or gear used in the day to day running and management of the fishing operation.

1. Introduction

The NSW Abalone fishery operates in accordance with the *Fisheries Management Act 1994*. The primary objective of the Act includes the need to ensure management is ecologically sustainable.

This report was prepared as part of a research study being conducted by University of Tasmania, Institute for Marine and Antarctic Studies (IMAS). It is part of a project that was proposed and developed by Abalone Council Australia Ltd. (ACA), using funds from the Australian Seafood CRC. Appendix 1 summarises some key trends in each of the fisheries so far surveyed as part of the project (NSW, Tasmania, South Australia).

The objective of this report, *Economic Indicators for the New South Wales Abalone Fishery 2011/12*, is to present a set of economic performance indicators for the fishery. This information is used to investigate whether the abalone fishery in NSW is generating economic wealth, and how changes in economic variables, such as prices of fish and fuel costs, may affect profitability of the fishers and industry as a whole. The economic indicators detailed in this report include:

- gross value of production (catch and beach price);
- the cost of management of the fishery;
- financial performance indicators (income, costs, profit and return on investment);
- economic rent; and
- external factors influencing the economic condition of the fishery.

2. Method of Analysis and Definition of Terms

2.1 Survey of Share and Endorsement Holders in the Fishery, 2011/12

The questionnaire for the 2011/12 survey was based on the South Australian surveys conducted for 1997/98, 2000/01, 2004/05 and 2011/12.[12] It was drafted in consultation with the Abalone Council of NSW and the University of Tasmania project staff.

Economic data collected in the survey will also be used in a Seafood CRC funded project to develop bioeconomic models for Southern Abalone fisheries. EconSearch has been included in a consortium of research organisations (including CSIRO and University of Tasmania) to undertake this project. In these models biological and economic data are combined to enable stakeholders to make decisions about their fishery with the goal of enhancing profitability. Economic data will also be provided to the Abalone Council of NSW for ongoing research purposes.

In February 2013 an EconSearch consultant travelled to the South Coast of NSW to attend the Abalone Council of NSW meeting and to conduct face to face surveys with licence holders and divers. The Abalone Council of NSW provided contact details for some shareholders and endorsement holders within the fishery, and facilitated interviews. Licence holders who did not participate in face to face interviews were then contacted to arrange over the phone surveys. While only 10 surveys were planned, it was possible to complete 17 surveys. These 17 surveys represent 12 fishing businesses. The majority of the remaining licence holders and divers were either not contactable or were unwilling to participate in the survey due to complex business arrangements, time constraints or concerns about privacy. Of the 17 survey participants, nine who participated in the survey in person were able to provide documentation (usually in the form of a profit loss statement or a tax return) to aid in the collection of financial data.

2.2 Definition of Terms[13]

Total Boat Income (TBI): refers to the cash receipts received by an individual firm and is expressed in dollar terms. Total boat income is calculated as catch (kg) multiplied by 'beach price' ($/kg). Total boat income is the contribution of an individual licence holder to the GVP of a fishing sector or fishery.

Total Boat Variable Costs: are costs which are dependent upon the level of catch or, more commonly, the amount of time spent fishing. As catch or fishing time increases, variable costs also increase. Variable costs are measured in current dollar terms and include the following individual cost items:

- fuel, oil and grease for the boat (net of diesel fuel rebate)
- ice
- provisions

12 EconSearch (2013a).

13 Where possible definitions have been kept consistent with those used by Brown (1997) in ABARE's *Australian Fisheries Survey Report*.

- crew payments
- fishing equipment, purchase and repairs
- repairs & maintenance: ongoing (slipping, painting, motor)

Boat Gross Margin: is defined as *Total Boat Income* less *Total Boat Variable Costs*. This is a basic measure of profit which assumes that capital has no alternative use and that as fishing activity (days fished) varies there is no change in capital or fixed costs.

Total Boat Fixed Costs: are costs that remain fixed regardless of the level of catch or the amount of time spent fishing. As such these costs, measured in current dollar terms, are likely to remain relatively constant from one year to the next. Examples of fixed cost include:

- insurance
- licence and industry fees
- office & business administration (communication, stationery, accountancy fees)
- interest on loan repayments and overdraft
- leasing

Total Boat Cash Costs (TBCC): defined as *Total Boat Variable Costs* plus *Total Boat Fixed Costs*

Gross Operating Surplus: (GOS) is defined as *Total Boat Income* less *Total Boat Cash Costs* and is expressed in current dollar terms. GOS may be used interchangeably with the term Gross Boat Profit. A GOS value of zero represents a breakeven position for the business, where TBCC equals TBI. If GOS is a negative value the firm is operating at a cash loss and if positive the firm is making a cash profit. GOS does not include a value for owner/operator wages, unpaid family work, or depreciation.

Owner-operator and Unpaid Family Labour: in many fishing businesses there is a component of labour that does not draw a direct wage or salary from the business. This will generally include owner/operator labour and often also include some unpaid family labour. The value of this labour needs to be accounted for which involves imputing a labour cost based on the amount of time and equivalent wages rate. In the above calculations this labour cost can be included simply as another cost so that Gross Operating Surplus takes account of this cost. Alternatively, it can be deducted from GOS to give a separate indicator called Boat Cash Income. Owner-operator and unpaid family labour is separated into variable labour (fishing and repairs and maintenance) and overhead labour (management and administration).

Boat Cash Income: is defined as *Gross Operating Surplus* less *imputed wages for owner- operator and unpaid family labour*.

Boat Capital: includes capital items that are required by the licence holder to earn the boat income. It includes boat hull, engine, electronics and other permanent fixtures and tender boats. Other capital items such as motor vehicles, sheds, cold-rooms, and jetty/moorings can be included to the extent that they are used in the fishing business. The fishing licence/permit value is included in total boat capital.

Depreciation: Depreciation refers to the annual reduction in the value of boat capital due to general wear and tear or the reduction in value of an item over time.

Boat Business Profit: is defined as *GOS* less *Depreciation* less *Owner-operator and Unpaid Family Labour*. Boat Business Profit represents a more complete picture of the actual financial status of an individual firm, compared with GOS, which represents the cash in-cash out situation only.

Profit at Full Equity: is calculated as *Boat Business Profit* plus *rent, interest and lease* payments. Profit at Full Equity represents the profitability of an individual licence holder, assuming the licence holder has full equity in the operation, i.e. there is no outstanding debt associated with the investment in boat capital. Profit at Full Equity is a useful absolute measure of the economic performance of fishing firms.

Rate of Return to Capital: is calculated as *Profit at Full Equity* divided by *Boat Capital* multiplied by *100*. This measure is expressed in percentage terms and is calculated for an individual licence holder. It refers to the economic return to the total investment in capital items, and is a useful relative measure of the performance of individual firms. Rate of return to capital is useful to compare the performance of various licence holders, and to compare the performance of other types of operators, and with other industries.

Gross value of production (GVP): refers to the value of the total annual catch for individual fisheries, fishing sectors or the fishing industry as a whole, and is measured in dollar terms. GVP, generally reported on an annual basis, is the quantity of catch for the year multiplied by the average monthly landed beach prices.

Beach price: refers to the price received by commercial fishers for their catch, and is generally expressed in terms of $/kg. Processing costs are not included in the beach price, as processing operations are assumed to occur further along the value chain. The use of beach prices also removes the effect of transfer pricing by the firm if it is vertically integrated into the value chain.

Cost of management services: in a commercial fishery management services will generally include stock assessment monitoring and reporting; policy, regulation and legislation development; compliance and enforcement services; licensing services; and research. Where a commercial fishery operates under full cost recovery, licence fees will be set to cover the cost of managing the fishery or at least the commercial sector's share of the resource.

In fisheries where there is full cost recovery, it can be assumed that the cost of providing these management services to the commercial sector will be equal to the gross receipts from licence fees in the fishery. With information on licence fee receipts, GVP, catch and the number of commercial fishers in the fishery, the following indicators can be readily calculated:

- aggregate shareholding fee receipts for the fishery ($)
- shareholding fee/GVP (%)
- shareholding fee/catch ($/kg)
- shareholding fee/shareholder ($/share)

2.3 Previous Economic Indicator collection and reporting 2001/02

Dominion consulting conducted an economic and social indicator survey of the NSW Abalone fishery in 2001 (Dominion Consulting 2005). While some of the indicators collected were similar to those collected by EconSearch, variation in the methods used as well as the long time lapse between the two surveys limit the value of a detailed comparison between the two studies.

At the time of the last survey, the fishery GVP was significantly greater than in 2011/12. A brief comparison of the results of the two studies highlights some changes which have been supported anecdotally in the survey process.

- Average investment in fishing gear is less than in 2001
- Employment in the industry has significantly declined since 2001
- Profit at full equity has significantly reduced since 2001

While caution should be used in comparing the results of the two studies for the reasons outlined above, these changes are not unexpected given the significant reduction in catch and GVP over the ten year period. When interpreting these results it is important to acknowledge that the high levels of catch in 2001 were not biologically sustainable (NSW DPI 2006), and that the price of Abalone in 2001 was unusually high. Hence it is unlikely that the high levels of turnover, profit and capital investment which occurred in 2001 were sustainable for this fishery.

3. Economic Indicators for the NSW Abalone Fishery

3.1 Catch and Gross Value of Production

The data in Table 3.1 indicate that the total catch of abalone in NSW has declined significantly since 2000. The total catch in 2011/12 was less than 40 per cent of the total catch in 2000. This dramatic shift stems from a decline in fish stocks and catch rate, and subsequent cuts to the TAC to allow stocks to rebuild (NSW DPI 2006, 2012). Total catch reached its lowest levels in 2009/10 at 74.6 tonnes, but has increased in the last two years. The catch in 2011/12 (just under 110 tonnes) was on par with total catch in 2007/08. The beach price or per kg value of abalone in NSW has also declined significantly since 2000. The nominal price of abalone in 2011/12 was 38 per cent lower than in 2000 (this equates to a 66 per cent decrease in real terms). The combination of declining catch and declining per kg value of catch have resulted in a significant fall in gross value of production (GVP) for the fishery. The nominal GVP for the NSW abalone fishery fell 64 per cent nominal terms between 2000 and 2011/12 (this equates to a 74 per cent reduction in GVP in real terms).

Table 3.1Catch and value of catch of the NSW Abalone fishery, 2000 to 2011/12

Year	(tonnes)	$ (m)	beach price ($/kg)
2000	304.80	15.85	52.00
2001	304.40	15.31	50.28
2002/03[a]	425.60	19.13	44.95
2003/04	242.00	7.99	33.00
2004/05	188.70	7.74	41.00
2005/06	129.00	5.50	42.62
2006/07	121.90	4.99	40.90
2007/08	109.40	3.67	33.52
2008/09	103.00	3.09	30.00
2009/10	74.60	1.94	26.00
2010/11	93.80	2.81	30.00
2011/12	109.81	3.51	32.00

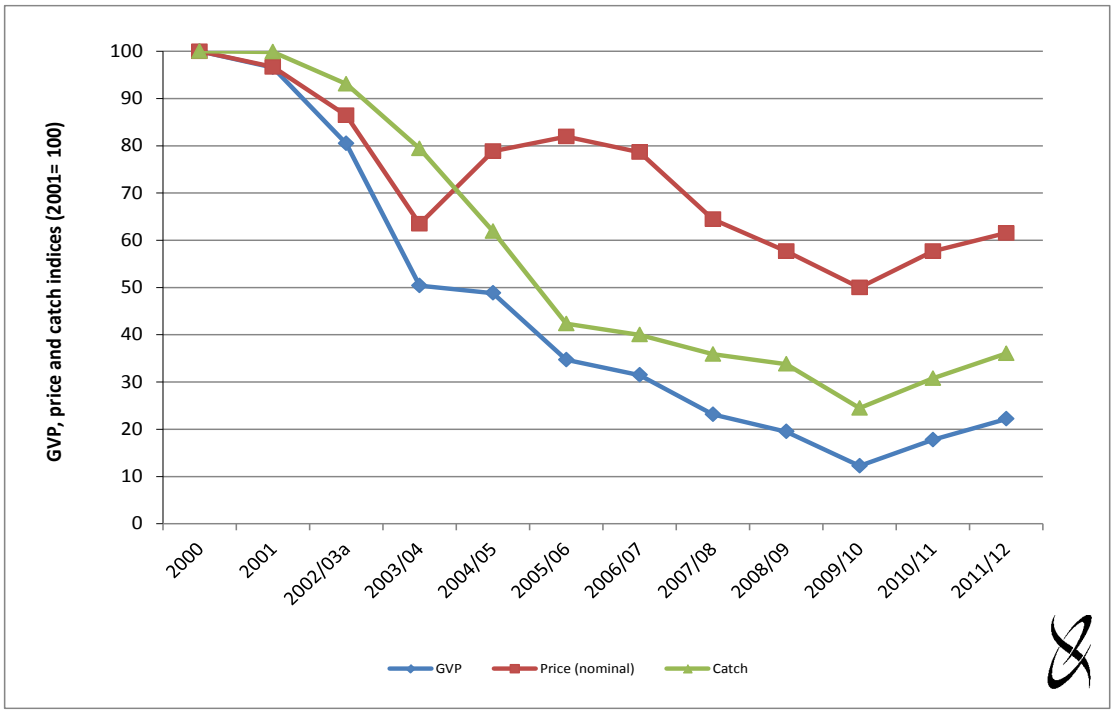
[a] Eighteen month Period: January 2002- June 2003. The 2002 calendar year was combined with the 2002/03 financial year to allow a shift from management in management time periods.

Source: NSW DPI (2006, 2012)[14], Duncan Worthington pers. comm. and EconSearch analysis

Figure 3.1 and Figure 3.2 illustrate the trends in price, catch and GVP over time.

[14] Data were taken from NSW DPI (2006, 2012). Where discrepancies between the two reports existed or where the units used in the reports were not clear (i.e. in the period 2002 and 2002/03), advice was taken from the NSW Abalone Council regarding the correct figures.

Figure 3.1 GVP, price and catch indices for the NSW Abalone fishery (2000=100)



[a] January 2002- June 2003. The catch and GVP figures for the January 2002 to June 2003 period (Table 3.1) have been normalised in this graph to better represent the trend over time.

Source: NSW DPI data and EconSearch Analysis

Figure 3.2 Price indices for the NSW Abalone fishery (2000=100) [a]

[a] Nominal price refers to the beach price in the current year's dollars. Real price is the nominal price adjusted for the purchasing power of money. The Sydney CPI (consumer price index) has been used to make this adjustment (ABS 2012a). It enables meaningful comparison of prices between years.

[b] January 2002- June 2003.

Source: Source: NSW DPI data, ABS (2012a) and EconSearch analysis

Figure 3.2 shows that the 38 per cent decrease in nominal price was equivalent to a 56 per cent real price decrease between 2000 and 2011/12. This means that the value of the abalone catch in NSW in 2011/12 was 73 per cent lower in real terms than it was in 2000 (64 per cent lower in nominal terms as noted above). There are several likely reasons for the decline in beach price including SARS which impacted market demand for abalone, the appreciation of the Australian dollar against Asian currencies and the development of aquaculture in South Korea.

3.2 Cost of Management

Management charges levied by NSW DPI to the NSW Abalone industry remained relatively steady against a back drop of falling GVP between 2000 and 2007/08. In 2008/09 licence fees fell dramatically following the build up of outstanding management charges payable to NSW DPI and a vote of shareholders arranged by NSW DPI about the level of service provision. For several years following 2003/04 concerns about the efficacy of management, and the proportionally increasing costs associated with management led to refusal to pay management charges by some shareholders. Outstanding management fees were not waived but a repayment schedule (based on fishery profitability) was negotiated between licence holders and the DPI. Outstanding management charges were around $900,000 in mid 2011 (NSW DPI 2012) and were reduced to $800,000 by mid 2012 (NSW Abalone Council pers. comm.).

Between 2002 and 2004/05 there was also a community contribution or royalty fee charged per share. The regulated formula used to calculate the royalty was changed in 2005/06. Between 2005/06 and 2011/12 fishery beach price, TAC and GVP has been too low to warrant a royalty according to the new formula (NSW DPI data). Details of the formula are available in section 34B of the Abalone Share Management Plan (NSW Consolidated Regulation Accessed 2013).

There were also additional costs levied by NSW DPI on Shareholders in 2004-5 for the completion of an FMS and EIS (Ab Mac 2003). The total cost of establishing the FMS and EIS was $459,000 (Ab Mac 2003). A portion of the funding for the levy ($106,000 or 23 per cent) was reassigned from general management costs for the fishery. The remainder was paid as an additional fee in instalments over 2003 and 2004.

Management charges as a percentage of GVP increased between 2001 (6.0 per cent) and 2007/08 (15.9 per cent), largely due to a fall in fishery GVP. In 2008/09 management charges fell dramatically and as a result management charges as a percentage of GVP fell to 4.0 per cent despite a further decrease in fishery GVP. Since 2008/09 management charges have remained stable. In 2011/12 management charges as a percentage of GVP (3.5 per cent) were lower than in any previous year, although provisional data for 2012/13 suggests that this percentage is set to increase again (Table 3.2).

The cost of management charges per kilogram of landed Abalone rose from $3.04 in 2001 to reach a peak of $6.79 in 2005/06. Since then the cost of management charges per kg has fallen almost every year. In 2011/12 the management charge per kg was the lowest for the fishery since 2001 at only $0.82/kg. Total management fees increased between 2011/12 and 2012/13.

Table 3.2 Cost of management in the NSW Abalone fishery 2000 to 2012/13

Year	No. of shares	Management charge ($/share)[a]	Community Contribution[b] ($/share)	Management Charge ($'000)	Community Contribution ($'000)	Total GVP ($'000) / period	Management Charge as % of GVP	Community contribution[b] % of GVP	catch (tonnes)	Management Charge ($/kg)	Community contribution $/kg
2000	3,700	242	$0	$895	$0	$15,850	6%	0%	305	$2.94	$0.00
2001	3,700	250	$0	$925	$0	$15,305	6%	0%	304	$3.04	$0.00
2002/03[c]	3,700	347	$76	$1,282	$281	$19,130	5%	1%	426	$3.01	$0.66
2003/04[d]	3,654	242	$140	$884	$510	$7,986	11%	6%	242	$3.65	$2.11
2004/05	3,654	247	$129	$903	$471	$7,737	12%	6%	189	$4.78	$2.49
2005/06	3,654	240	$0	$875	$0	$5,498	16%	0%	129	$6.79	$0.00
2006/07	3,654	200	$0	$730	$0	$4,986	15%	0%	122	$5.99	$0.00
2007/08	3,454	168	$0	$582	$0	$3,667	16%	0%	109	$5.32	$0.00
2008/09	3,454	36	$0	$123	$0	$3,090	4%	0%	103	$1.19	$0.00
2009/10	3,454	40	$0	$138	$0	$1,940	7%	0%	75	$1.85	$0.00
2010/11	3,454	30	$0	$105	$0	$2,814	4%	0%	94	$1.12	$0.00
2011/12	3,454	26	$0	$90	$0	$3,514	3%	0%	110	$0.82	$0.00
2012/13[e]	3,454	77	$0	$267	$0	$3,840	7%	0%	120	$2.22	$0.00

[a] Full cost of management for the fishery is generally higher than the fees charged to the fishery.

[b] Community contribution was calculated as a percentage of the previous year's GVP (2 per cent, 4 per cent and 6 per cent for 2001, 2002/03 and 2003/04 respectively). The management charge as % of GVP is calculated as a percentage of the year in which it was paid.

[c] January 2002- June 2003. Includes total Management charges and Community contributions for the eighteen month period.

[d] Additional charges of $66.76 per share were charged to Abalone shareholders for the establishment of a Fishery Management Scheme (FMS) and Environmental Impact Statement (EIS). The charges to the fishery for the FMS and EIS represent around 23 per cent of the total cost of the establishment of the programs (Ab MAC 2003).

[e] Provisional data provided by the NSW Abalone Council pers. comm. As the 2012/13 fishing season is not yet complete, the catch figure is equal to the quota for the 2012/13 period. Given historically high catch rates as a proportion of total quota, it is highly likely that the catch for 2012/13 will be very close to the quota.

Source: NSW DPI (2006, 2012)[15], Duncan Worthington pers. comm. and EconSearch analysis

[15] Data were taken from NSW DPI (2006,2012). Where discrepancies in the two reports exist, or where the units used in the reports were not clear (i.e. in the period 2002 and 2002/03) advice was taken from the NSW Abalone Council regarding the correct figures.

3.3 Objectives of the NSW Abalone Fishery

The management objectives of the NSW Abalone fishery are dictated by the Fisheries Management Act of NSW (NSW Government 1994) and the Abalone Fishery Share Management Plan (NSW Consolidated Regulations 2013). The primary objectives of the Fisheries management act are set out in part 1 section 3 of the act, and are presented below. Because the objects of the act specifically refer to 'viable commercial fishing', data regarding financial performance of fishing business were collected and analysed and presented in Section 3.4. In 2007 the NSW DPI also developed a fishery management plan strategy (The Ecology Lab 2007)

(1)The objects of this Act are to conserve, develop and share the fishery resources of the State for the benefit of present and future generations.

(2) In particular, the objects of this Act include:
- (a) to conserve fish stocks and key fish habitats, and
- (b) to conserve threatened species, populations and ecological communities of fish and marine vegetation, and
- (c) to promote ecologically sustainable development, including the conservation of biological diversity,

and, consistently with those objects:
- (d) to promote viable commercial fishing and aquaculture industries, and
- (e) to promote quality recreational fishing opportunities, and
- (f) to appropriately share fisheries resources between the users of those resources, and
- (g) to provide social and economic benefits for the wider community of New South Wales, and
- (h) to recognise the spiritual, social and customary significance to Aboriginal persons of fisheries resources and to protect, and promote the continuation of, Aboriginal cultural fishing.

3.4 Financial Performance Indicators- Fishing businesses

The major measures of the financial performance of the surveyed fishing businesses in the NSW Abalone fishery are shown in Table 3.3 for 2011/12. In this analysis quota owned by someone currently active within the fishing business or someone who holds physical capital used in that fishing business is treated as 'internal' quota. Internal quota is usually held by the diver or a family member. Quota owned by someone who is not involved in the day-to-day operation of the fishing business and who does not hold capital used in the fishing operation is treated as 'external' quota. Many 'external' quota holders are still involved in fisheries management. This analysis presents the income and costs from the perspective of a fishing business. It does not include costs to external shareholders; instead the income external shareholders receive from the fishing business is included in this analysis as a 'leasing cost'. Costs borne by internal shareholders (i.e. owner operators or family businesses) were not included in this component of the analysis. Estimates of the value of shares in the fishery are based on the average responses from all 17 survey participants who provided an estimate of the share value in the fishery.

Income…

The total boat gross income presented in Table 3.3 is an average of the total boat gross income for surveyed fishing businesses. The calculation of this figure was based on total catch per business and the average beach price received. In cases where the operator of the fishing business fishes quota for another shareholder, a portion of the sale price for the abalone often goes directly to the shareholder. In this analysis, the portion of income which goes directly to the shareholder is treated as a 'leasing cost' (Table 3.3).

The estimated average gross income per business surveyed in the NSW Abalone fishery was approximately $171,000 in 2011/12. This is significantly higher than the average income per licenced diver[16] ($125,000), primarily because the fishing businesses surveyed fished more quota than the average entitlement holder. The fishing businesses surveyed owned an average of 81.6 shares and leased an additional 88.6 shares in from external licence holders, to fish an average of 170.2 shares per fishing business, compared to an average of 123.4 shares per diver across the whole fishery. The average income per share fished across the fishing businesses surveyed ($1,007/ share) is similar to the average income per share across the whole fishery ($1,017/ share)

Costs…

Table 3.3 shows total costs separated into variable and fixed costs. Variable costs (78 per cent of total boat cash costs in 2011/12) represented a significantly greater proportion of total boat cash costs than fixed costs (22 per cent). The treatment of payments to external shareholders as a variable cost may slightly overstate the relative weight of variable costs, as fixed costs borne by the shareholders to whom these payments are made or not included in this part of the analysis.

The largest individual cost item was 'leasing quota', which accounted for around 39 per cent of total boats costs in 2011/12. The majority of businesses involved in the survey fish quota in addition to their own quota (in some cases the businesses do not own any quota, and fish entirely for other shareholders). The majority of fishing businesses which do this are paid a per kilo dive fee, or they purchase the right to fish quota outright for a lump sum. The payment received by external licence holders was calculated and included as a leasing cost.

The next most significant cost was labour. The labour costs reported in Table 3.3 are comprised of formal payments to crew as well as an imputed wage to licence owners and other family members who are not paid a wage directly by the business. Imputed unpaid labour (on average $11,223 per boat for 2011/12) was divided into variable (fishing and repairs and maintenance) and fixed (management and administration) components based on the survey responses.

Similar to other abalone fisheries, other significant cash costs were interest (10 per cent), licence fees (3 per cent), repairs and maintenance (3 per cent) and fuel (4 per cent) (Table 3.3). It is likely that this analysis understates the costs of interest and licence fee payments, as a significant proportion of these costs are borne by external shareholders. Payments to external shareholders are reported as leasing costs in Table 3.3.

16 NSW Abalone fishery GVP divided by the number of divers is equal to around $125,000 per diver.

Table 3.3 Financial performance in the NSW Abalone fishery, 2011/12 (average per fishing business)

		Average per fishing business	Average per 100 shares[a]	Share of TBCC[b]
(1)	Total Boat Gross Income	**$171,370**	**$100,632**	
	Variable Costs			
	Fuel	$5,818	$3,416	4%
	Repairs & Maintenance [c]	$4,770	$2,801	3%
	Ice	$0	$0	0%
	Provisions	$825	$484	1%
	Leasing quota	$56,185	$32,993	39%
	Labour - paid	$13,895	$8,160	10%
(2)	- unpaid [d]	$6,554	$3,849	5%
	Other	$23,097	$13,563	16%
(3)	**Total Variable Costs**	**$111,145**	**$65,267**	**78%**
	Fixed Costs			
	Licence Fee	$4,572	$2,685	3%
	Insurance	$2,102	$1,234	1%
(4)	Interest	$14,316	$8,406	10%
(5)	Labour - unpaid [d]	$4,669	$2,742	3%
	Legal & Accounting	$1,939	$1,141	1%
	Telephone etc.	$1,513	$890	1%
	Slipping & Mooring	$171	$100	0%
	Travel	$736	$433	1%
	Office & Admin	$1,890	$1,111	1%
(6)	**Total Fixed Costs**	**$31,907**	**$18,769**	**22%**
(7)	**Total Boat Cash Costs (3 + 6)**	**$143,051**	**$84,148**	**100%**
	Boat Gross Margin (1 - 3)	**$60,225**	**$35,427**	
(8)	**Total Unpaid Labour (2 + 5)**	**$11,223**	**$6,602**	
	Gross Operating Surplus (1 - 7 + 8)	**$39,542**	**$23,260**	
(9)	**Boat Cash Income (1 - 7)**	**$28,319**	**$16,658**	
(10)	**Depreciation**	**$16,916**	**$9,951**	
(11)	**Boat Business Profit (9 - 10)**	**$11,403**	**$6,707**	
(12)	**Profit at Full Equity (11 + 4)**	**$25,718**	**$15,128**	
	Boat Capital			
(13)	Fishing Gear & Equip	$80,268	$47,217	
	Licence Value	$544,719	$320,423	
(14)	**Total Boat Capital**	**$624,987**	**$367,640**	
	Rate of Return on Fishing Gear & Equip (12 / 13 * 100)	**32.0%**	**32.0%**	
	Rate of Return on Total Boat Capital (12 / 14 * 100)	**4.1%**	**4.1%**	

[a] Average results from the survey have been scaled down to 100 shares (traditional full quota) at the request of the Abalone Council of NSW to make the analysis more comprehensible for some stakeholders. This column does not represent any additional analysis based on smaller fishing operations.

[b] Total boat cash costs. In this case total boat cash costs refer to total business cash costs. Some businesses have more than one boat used to fish in different areas or conditions.

[c] Repairs and maintenance costs have been classified as a variable cost although it is noted that some of these costs may be fixed (e.g. regulated maintenance).

[d] Unpaid labour was divided between variable (time spent fishing and on repairs and maintenance) and fixed (management and administrative duties) based on survey responses.

Source: EconSearch analysis

Cash Income and Profit…

The separation of variable and fixed costs from total cash costs enables the calculation of boat gross margin (total boat income less total boat variable costs) as a basic measure

of profit (assuming that capital has no alternative use and that as fishing activity varies there is no change in capital or fixed costs). Average business gross margin in 2011/12 was $60,225.

Gross operating surplus (GOS) was calculated excluding imputed wages for operator and family members as a cost item. The average GOS of all boats in 2011/12 was estimated to be around $39,542.

Boat cash income is measured as gross operating surplus with imputed wages (unpaid labour) included as cash costs. The estimated average boat cash income in 2011/12 was approximately $28,319 per business.

Gross operating surplus and boat business profit give an indication of the capacity of the operator to remain in the fishery in the short to medium term. In 2011/12, the average boat business profit was around $11,403.

Profit at full equity is a measure of the profitability of an individual licence holder, assuming the licence holder has full equity in the operation. It is a useful absolute measure of the economic performance of fishing firms. Profit at full equity in 2011/12 was over $25,718, indicating that interest repayments are a significant cost for some fishing businesses in this fishery.

Return on Investment…

There are a number of interpretations of the concept of return on investment. For the purpose of this analysis it is appropriate to consider the investment as the capital employed by an average fishing business in the fishery. Capital includes boats, licence/quota, fishing gear, sheds, vehicles and other capital items used as part of the fishing enterprise. It does not include working capital or capital associated with other businesses operated by the licence holder. The return on investment has been calculated as the profit at full equity as a percentage of the total capital employed.

The average total investment in fishing gear and licence in the Abalone fishery in 2011/12 was estimated to be almost $625,000 per fishing business. This included the licence holders' estimate of the value of their licence (almost $545,000) and estimated investment in boats and fishing gear (around $80,000 per business).

The rate of return to boat capital (i.e. fishing gear and equipment) was 32 per cent in 2011/12. The rate of return to total capital is much lower, estimated to be 4.1 per cent. While it is not possible to compare this estimated rate of return to previous years, anecdotally there is some optimism that the fishery has been becoming more profitable over the last few years, as the health and robustness of fish stocks improves.

Licence values…

The value of licences represents a significant proportion of the capital used by each fishing business in the fishery. The reported licence value for 2011/12 in Table 3.3 represents the licence holders' estimate of the value of their licence based on the 2013 survey responses. There was a large degree of variability in the licence holders' estimates of licence value. Part of this variability came from the differences in shareholdings between fishing businesses. There was also variability in estimates of the

value of a licence unit. The table below calculates the sensitivity of the rate of return to changes in the estimate of the value of a licence unit, holding the size of the shareholdings constant.

Table 3.4Sensitivity of rate of return to changes in licence value, 2011/12 [a]

Share Value (10 units per share)	$31,856	$63,712	$95,568
Rate of Return to Total Capital (%)	7.3%	4.1%	2.9%

[a] Based on the licence value estimated for 2011/12 and values 50 per cent above and below this estimate.

Source: EconSearch analysis

Based on the costs and returns shown for the year 2011/12 in Table 3.3, a per share value of $32,000 (approximately 50 per cent below the average share value estimated for 2011/12) would mean an annual return to the total asset of 7.3 per cent, while a per share value of $96,000 (approximately 50 per cent above the per share value estimated for 2011/12) would mean an annual return to the total asset of 2.9 per cent (Table 3.4). The price of shares in the Abalone fishery has varied significantly over time. The timing of share purchase affects the return on investment for individual licence holders.

3.5 Financial Performance Indicators - External Shareholders

External shareholders (i.e. those who are not currently directly involved in the operation of a fishing business) are an important component of the NSW fishery. As the fishery has adjusted to lower quota limits, the number of divers (endorsement holders) and active fishing operations have reduced, while the number of shareholders has remained relatively constant. There are almost twice as many shareholders as divers in the fishery, so many fishing businesses lease in additional quota. Many external shareholders have historical connections with the fishery and attempt to remain active in management of the fishery and industry. Some shareholders are retaining boat capital as an option to start diving again should it become viable financially.

This analysis presents income and costs from the point of view of an external shareholder, based on an average of the shareholders surveyed. Estimates of the value of shares in the fishery are based on the responses from all shareholders.

Table 3.5 Financial performance in the NSW Abalone fishery, 2011/12 (average per shareholder)[a]

		Average per shareholder	Average per 100 shares[a]	Share of TBCC[b]
(1)	Total Boat Gross Income	**$78,597**	**$61,755**	
	Variable Costs			
	Fuel	$0	$0	0%
	Repairs & Maintenance [c]	$1,058	$831	2%
	Ice	$0	$0	0%
	Provisions	$0	$0	0%
	Leasing quota			
	Labour - paid	$23,085	$18,138	36%
(2)	- unpaid [d]	$1,158	$910	2%
	Other	$3,217	$2,528	5%
(3)	**Total Variable Costs**	**$28,518**	**$22,407**	**45%**
	Fixed Costs			
	Licence Fee	$5,003	$3,931	8%
	Insurance	$178	$140	0%
(4)	Interest	$14,362	$11,285	23%
(5)	Labour - unpaid [d]	$7,998	$6,284	13%
	Legal & Accounting	$2,048	$1,609	3%
	Telephone etc.	$861	$676	1%
	Slipping & Mooring	$0	$0	0%
	Travel	$1,586	$1,246	2%
	Office & Admin	$2,987	$2,347	5%
(6)	**Total Fixed Costs**	**$35,024**	**$27,519**	**55%**
(7)	**Total Boat Cash Costs (3 + 6)**	**$63,542**	**$49,926**	**100%**
	Boat Gross Margin (1 - 3)	**$50,079**	**$39,348**	
(8)	**Total Unpaid Labour (2 + 5)**	**$9,156**	**$7,194**	
	Gross Operating Surplus (1 - 7 + 8)	**$24,210**	**$19,022**	
(9)	**Boat Cash Income (1 - 7)**	**$15,055**	**$11,829**	
(10)	**Depreciation**	**$2,467**	**$1,938**	
(11)	**Boat Business Profit (9 - 10)**	**$12,588**	**$9,890**	
(12)	**Profit at Full Equity (11 + 4)**	**$26,950**	**$21,175**	
	Boat Capital			
(13)	Fishing Gear & Equip	$11,693	$9,187	
	Licence Value	$498,845	$391,950	
(14)	**Total Boat Capital**	**$510,538**	**$401,137**	
	Rate of Return on Fishing Gear & Equip (12 / 13 * 100)[e]	**n/a**	**n/a**	
	Rate of Return on Total Boat Capital (12 / 14 * 100)	**5.3%**	**5.3%**	

[a] Average results from the survey have been scaled up to 100 shares (traditional full quota) at the request of the Abalone Council of NSW to make the analysis more comprehensible for some stakeholders. This column does not represent any additional analysis based on smaller fishing operations.

[b] Total boat cash costs: in this case TBCC actually refers to total cash costs per shareholder.

[c] Repairs and maintenance costs have been classified as a variable cost although it is noted that some of these costs may be fixed (e.g. regulated maintenance).

[d] Unpaid labour was divided between variable (time spent fishing and on repairs and maintenance) and fixed (management and administrative duties) based on survey responses.

[e] While some shareholders to own fishing gear and equipment, in most cases it is not actively used in the fishery and its calculated rate of return is meaningless in these circumstances.

Source: EconSearch analysis

Income…

The total boat gross income presented in Table 3.5 is an average of the total boat gross income for surveyed fishing businesses. The income figure presented is the average beach price multiplied by the weight of abalone caught using that shareholding. Payments to divers and fishing business responsible for catching abalone are represented as a cost in this analysis. Average income for the shareholders surveyed is almost $79,000. This is similar to the fishery's average income per shareholder of $74,765[17].

Costs…

Table 3.5 shows average shareholder costs separated into variable and fixed costs. Variable costs (45 per cent of total boat cash costs in 2011/12) represented a slightly smaller cost to shareholders than fixed costs (55 per cent). The fixed costs make up a greater proportion of total costs for shareholders than for fishing businesses, because their main cost components are licence fees, interest and administration costs. The only significant variable cost they incur is the catch fee paid to divers, and this is less than half of their total costs.

Labour was the most significant cost item. The labour costs reported in Table 3.5 are comprised of payments to divers and fishing businesses, as well as imputed unpaid labour provided by the shareholders or their families. Imputed unpaid labour (on average $9,156 per shareholder for 2011/12) was divided into variable (fishing and repairs and maintenance) and fixed (management and administration) components based on the 2013 licence holder survey. While not directly involved in the fishing businesses which catch their quota, some shareholders spent time maintaining their own fishing gear (hence the proportion of unpaid labour allocated to variable costs). This equipment is not currently being used in the fishery, but is being maintained for the option value of returning to abalone diving. A significant amount of time is spent by shareholders on fishery and industry management and administration activities.

Interest is the next most significant cost for shareholders on average (23 per cent). Other significant costs to shareholders include office and administration (5 per cent), and accounting (3 per cent) and travel (i.e. for fishery and industry related meetings) (2 per cent). This last item, and the large amount of time spent by shareholders on management and administration activities highlight the desire of many shareholders to be heavily involved in fishery and industry management.

Cash Income and Profit…

The separation of variable and fixed costs from total cash costs enables the calculation of gross margin (total boat income less total boat variable costs) as a basic measure of profit (assuming that capital has no alternative use and that as fishing activity varies there is no change in capital or fixed costs). Average gross margin per shareholder in 2011/12 was $50,079.

[17] Total fishery GVP for 2011/12 divided by the number of shareholders for 2011/12 is equal to $74,765.

Gross operating surplus (GOS) was calculated excluding imputed wages for shareholders and family members as a cost item. The average GOS of all boats in 2011/12 was estimated to be around $24,210.

Boat cash income is measured as gross operating surplus with imputed wages (unpaid labour) included as cash costs. The estimated average boat cash income in 2011/12 was approximately $15,055 per shareholder.
Gross operating surplus and boat business profit give an indication of the capacity of the operator to remain in the fishery in the short to medium term. In 2011/12, the average boat business profit was around $13,000.

Profit at full equity is a measure of the profitability of an individual shareholder, assuming the shareholder has full equity in the operation. It is a useful absolute measure of the economic performance of fishing firms. Profit at full equity in 2011/12 was over $27,000, indicating that interest repayments are significant cost item for some shareholders in this fishery.

Return on Investment…

The average total investment in fishing gear and licence in the Abalone fishery in 2011/12 was estimated to be almost $511,000 per fishing business. This included the licence holder's estimate of the value of their licence (almost $499,000) and estimated investment in physical capital (around $12,000 per business).

The rate of return to boat capital (i.e. fishing gear and equipment) was not calculated, because the physical capital used to conduct shareholder operations is of negligible importance compared to ownership of the shares. The rate of return to total capital was calculated to be 5.3 per cent which is higher than the rate of return to total capital calculated for fishing businesses (4.1 per cent)

Licence Values…
The value of licences represents a significant proportion of the capital used by each fishing business in the fishery. The reported licence value for 2011/12 in Table 3.3 represents the licence holders' estimate of the value of their licence based on the 2013 survey responses.

There was a large degree of variability in the licence holders' estimates of licence value. This variability stemmed from variation in the estimates of the value of a licence unit, and also from variability in the number of licence units or shares owned by each business.

Table 3.6 Sensitivity of rate of return to changes in licence value, 2011/12 [a]

Share Value (10 units per share)	$31,856	$63,712	$95,568
Rate of Return to Total Capital (%)	10.3%	5.3%	3.5%

[a] Based on the licence share value estimated for 2011/12 and values 50 per cent above and below this estimate.
Source: EconSearch analysis

Based on the costs and returns shown for the year 2011/12 in Table 3.6, a per share value of $32,000 (approximately 50 per cent below the average share value estimated for 2011/12) would mean an annual return to the total asset of 10.3 per cent, while a per share value of $96,000 (approximately 50 per cent above the per share value estimated for 2011/12) would mean an annual return to the total asset of 3.5 per cent (Table 3.4). The price of shares in the Abalone fishery has varied significantly over time. Some shareholders obtained licences early when they first became available for a nominal fee. Other licence holders will have paid significantly more (anecdotally around twice as much as the survey estimate) for their share in the fishery. The timing of share purchase affects the return on investment for individual licence holders. The financial position of licence holders, in particular interest repayments, is also likely to be related to the timing of the share purchase.

3.6 Financial Performance Indicators- Combined results

In order to assess the economic performance of the fishery as a whole, the two sets of indicators described above have been combined. The leasing costs (payments from fishing businesses to shareholders) have been removed, as have payments from shareholders to divers.

The average number of quota units owned by the sample shareholders was calculated (on average 78.6 per shareholder in the sample). The average number of quota units leased in by the sample of fishing businesses was also calculated (on average 88.6). Using these average figures the shareholder costs were adjusted[18] and added to the fishing business costs. Calculating the costs in this way allows the creation of a set of economic indicators that represents the whole fishery and not just one component of it. The cost of leasing quota was removed entirely, as was the cost of payments from licence holders to divers, as these represent a transfer within the fishing unit rather than a cost incurred to it.

Income…

The total boat gross income presented in Table 3.7 is an average of the total boat gross income for aggregated fishing units ($171,370). This figure includes the income from all abalone caught, regardless of who owns the quota, and is the same as the average boat gross income calculated in Table 3.3.

Costs…

Table 3.7 shows costs to the fishery separated into variable and fixed costs. Variable costs (46 per cent of total boat cash costs in 2011/12) represented a slightly smaller cost to shareholders than fixed costs (54 per cent). Proportionately high imputed administrative labour, interest repayments and licence fee costs contribute to the unusually high proportion of fixed costs.

Labour was the most significant cost item. The labour costs reported in Table 3.7 are comprised of payments to crew, as well as imputed unpaid labour provided by the fishing business operators, shareholders or their families. Imputed unpaid labour (on average $21,551 in 2011/12) was divided into variable (fishing and repairs and maintenance) and fixed (management and administration) components.

[18] Average shareholder costs presented in Table 3.5 were multiplied by (88.6/78.6) and added to the fishing operation costs presented in Table 3.3.

Interest is the next most significant cost at 23 per cent. Other significant costs include licence fees (8 per cent), fuel (4 per cent), repairs and maintenance (5 per cent), office and administration (4 per cent), legal and accounting (3 per cent) and travel (i.e. for fisheries related meetings) (2 per cent).

Table 3.7 Financial performance in the NSW Abalone fishery, 2011/12 (average per aggregated fishing unit), 2011/12

		Average per aggregated fishing unit	Average per 100 shares[a]	Share of TBCC[b]
(1)	Total Boat Gross Income	**$171,370**	**$100,632**	
	Variable Costs			
	Fuel	$5,818	$3,416	4%
	Repairs & Maintenance [c]	$5,964	$3,502	5%
	Ice	$0	$0	0%
	Provisions	$825	$484	1%
	Leasing quota		$0	0%
	Labour - paid	$13,895	$8,160	10%
(2)	- unpaid [d]	$7,860	$4,616	6%
	Other	$26,726	$15,694	20%
(3)	**Total Variable Costs**	**$61,088**	**$35,872**	**46%**
	Fixed Costs			
	Licence Fee	$10,215	$5,999	8%
	Insurance	$2,303	$1,352	2%
(4)	Interest	$30,516	$17,920	23%
(5)	Labour - unpaid [d]	$13,691	$8,040	10%
	Legal & Accounting	$4,249	$2,500	3%
	Telephone etc.	$2,484	$1,461	2%
	Slipping & Mooring	$171	$100	0%
	Travel	$2,525	$1,485	2%
	Office & Admin	$5,259	$3,094	4%
(6)	**Total Fixed Costs**	**$71,413**	**$42,008**	**54%**
(7)	**Total Boat Cash Costs (3 + 6)**	**$132,501**	**$77,942**	**100%**
	Boat Gross Margin (1 - 3)	**$110,282**	**$64,872**	
(8)	**Total Unpaid Labour (2 + 5)**	**$21,551**	**$12,677**	
	Gross Operating Surplus (1 - 7 + 8)	**$60,420**	**$35,541**	
(9)	**Boat Cash Income (1 - 7)**	**$38,869**	**$22,864**	
(10)	**Depreciation**	**$19,699**	**$11,587**	
(11)	**Boat Business Profit (9 - 10)**	**$19,171**	**$11,277**	
(12)	**Profit at Full Equity (11 + 4)**	**$49,687**	**$29,227**	
	Boat Capital			
(13)	Fishing Gear & Equip	$93,458	$54,975	
	Licence Value	$1,107,403	$651,414	
(14)	**Total Boat Capital**	**$1,200,861**	**$706,389**	
	Rate of Return on Fishing Gear & Equip (12 / 13 * 100)	**53.2%**	**53.2%**	
	Rate of Return on Total Boat Capital (12 / 14 * 100)	**4.1%**	**4.1%**	

[a] Average results from the survey have been scaled down to 100 shares (traditional full quota) at the request of the Abalone Council of NSW to make the analysis more comprehensible for some stakeholders. This column does not represent any additional analysis based on smaller fishing operations.

[b] Total boat cash costs: in this case TBCC actually refers to total cash costs per aggregated fishing unit.

[c] Repairs and maintenance costs have been classified as a variable cost although it is noted that some of these costs may be fixed (e.g. regulated maintenance).

[d] Unpaid labour was divided between variable (time spent fishing and on repairs and maintenance) and fixed (management and administrative duties) based on survey responses.

Source: EconSearch analysis

Cash Income and Profit…

The separation of variable and fixed costs from total cash costs enables the calculation of gross margin (total boat income less total boat variable costs) as a basic measure of profit (assuming that capital has no alternative use and that as fishing activity varies there is no change in capital or fixed costs). Average gross margin per aggregated fishing unit in 2011/12 was around $110,000.

Gross operating surplus (GOS) was calculated excluding imputed wages for shareholders and family members as a cost item. The average GOS of all boats in 2011/12 was estimated to be around $60,000.

Boat cash income is measured as gross operating surplus with imputed wages (unpaid labour) included as cash costs. The estimated average boat cash income in 2011/12 was approximately $39,000 per aggregated fishing unit.

Gross operating surplus and boat business profit give an indication of the capacity of the operator to remain in the fishery in the short to medium term. In 2011/12, the average boat business profit was around $19,000.

Profit at full equity is a measure of the profitability of an aggregated fishing unit, assuming the full equity in the operation. It is a useful absolute measure of the economic performance of fishing firms. Profit at full equity in 2011/12 was almost $50,000, indicating that interest repayments are a significant cost for some fishing operations.

Return on Investment…

The average total investment in fishing gear and licence in the Abalone fishery in 2011/12 was estimated to be more than $1.2 million per aggregated fishing unit. This included the licence holder's estimate of the value of their licence for all licences used by each aggregated fishing unit (more than $1.1 million) and estimated investment in physical capital (more than $93,000 per business).

The rate of return to boat capital (i.e. fishing gear and equipment) was significantly higher than the rate of return to total boat capital for fishing businesses in isolation (53.2 per cent). This is because the removal of leasing costs from the fishing model, and replacement with the cost to licence holders caused the calculation of Profit at Full Equity to almost double. As you would expect licence holders had limited boat capital, so total boat capital did not change significantly by combining the two groups. In contrast, the rate of return to total capital was only marginally (0.02 per cent) higher than the rate of return calculated for fishing businesses in isolation. Removal of the transfer costs between licence holders and divers, and replacement with the scaled costs of licence holders resulted in the Profit at Full equity measure almost doubling. Because the addition of the scaled capital value of licence holders almost doubled the total boat capital of fishing operations, the rate of return to total boat capital remained very similar.

Licence Values…

The value of licences represents a significant proportion of the capital used by each aggregated fishing unit in the fishery. The reported licence value for 2011/12 in Table 3.7 represents the licence holders' estimate of the value of their licence based on the 2013 survey responses.

There was a large degree of variability in the respondents' estimates of licence value. This variability stemmed from variation in the estimates of the value of a licence unit, and also from variability in the number of licence units or shares owned by each business.

Table 3.8 Sensitivity of rate of return to changes in licence value, 2011/12 [a]

Share Value (10 units per share)	$31,856	$63,712	$95,568
Rate of Return to Total Capital (%)	7.7%	4.1%	2.8%

[a] Based on the licence value estimated for 2011/12 and values 50 per cent above and below this estimate.

Source: EconSearch analysis

Based on the costs and returns shown for the year 2011/12 in Table 3.6, a per share value of $32,000 (approximately 50 per cent below the average share value estimated for 2011/12) would mean an annual return to the total asset of 7.7 per cent, while a per share value of $96,000 (approximately 50 per cent above the per share value estimated for 2011/12) would mean an annual return to the total asset of 2.8 per cent (Table 3.8). As noted earlier, the price of shares in the Abalone fishery has varied significantly over time. Some shareholders obtained licences early when they first became available for a nominal fee. Other licence holders will have paid significantly more (anecdotally around twice as much as the survey estimate) for their share in the fishery. The timing of share purchase affects the return on investment for individual licence holders. The financial position of licence holders, in particular interest repayments, is also likely to be related to the timing of the share purchase.

3.7 Financial Performance Indicators- Large and Small Boats

There is significant variation in the amount of quota each fishing business operates with. In order to explore the possibility of structural differences between smaller operations and larger operations, the sample of twelve fishing businesses was divided in half based on catch. Finer subdivision (i.e. into quartiles) was not possible due to privacy considerations. Because the sample size of each half is quite small, (6 out of 28 operational boats in the fishery) care should be taken interpreting the results presented below. It is worth noting that the small boat category presented here still fishes on average more than 100 shares. In the NSW Abalone fishery there are several businesses which fish only 70 shares (the minimum required to maintain a diving entitlement). There may be some structural differences between the smallest fishing businesses in the fishery (few of which participated in the survey) and the six smaller fishing businesses from the survey sample, which are presented in the table below.

Table 3.9 Financial performance in the NSW Abalone fishery, 2011/12 (average per aggregated fishing unit)

		Average per aggregated fishing unit (lower catch)	Share of TBCC[b]	Average per aggregated fishing unit (higher catch)	Share of TBCC[b]
(1)	**Total Boat Gross Income**	**$129,492**		**$213,248**	
	Variable Costs				
	Fuel	$4,094	4%	$7,543	4%
	Repairs & Maintenance [c]	$2,145	2%	$7,395	4%
	Ice	$0	0%	$0	0%
	Provisions	$0	0%	$1,650	1%
	Leasing quota	$47,851	46%	$64,520	36%
	Labour - paid	$9,553	9%	$18,237	10%
(2)	- unpaid [d]	$4,853	5%	$8,255	5%
	Other	$17,869	17%	$28,325	16%
(3)	**Total Variable Costs**	**$86,365**	**83%**	**$135,925**	**75%**
	Fixed Costs				
	Licence Fee	$2,538	2%	$6,605	4%
	Insurance	$2,355	2%	$1,849	1%
(4)	Interest	$8,752	8%	$19,880	11%
(5)	Labour - unpaid [d]	$1,192	1%	$8,147	4%
	Legal & Accounting	$1,569	1%	$2,309	1%
	Telephone etc.	$1,000	1%	$2,026	1%
	Slipping & Mooring	$185	0%	$157	0%
	Travel	$27	0%	$1,446	1%
	Office & Admin	$671	1%	$3,108	2%
(6)	**Total Fixed Costs**	**$18,288**	**17%**	**$45,526**	**25%**
(7)	**Total Boat Cash Costs (3 + 6)**	**$104,652**	**100%**	**$181,450**	**100%**
	Boat Gross Margin (1 - 3)	**$43,127**		**$77,324**	
(8)	**Total Unpaid Labour (2 + 5)**	**$6,045**		**$16,402**	
	Gross Operating Surplus (1 - 7 + 8)	**$30,884**		**$48,200**	
(9)	**Boat Cash Income (1 - 7)**	**$24,839**		**$31,798**	
(10)	**Depreciation**	**$11,063**		**$22,769**	
(11)	**Boat Business Profit (9 - 10)**	**$13,776**		**$9,029**	
(12)	**Profit at Full Equity (11 + 4)**	**$22,528**		**$28,909**	
	Boat Capital				
(13)	Fishing Gear & Equip	$51,200		$109,337	
	Licence Value	$400,833		$688,605	
(14)	**Total Boat Capital**	**$452,033**		**$797,942**	
	Rate of Return on Fishing Gear & Equip (12 / 13 * 100)	**44.0%**		**26.4%**	
	Rate of Return on Total Boat Capital (12 / 14 * 100)	**5.0%**		**3.6%**	

[a] Average results from the survey have been scaled down to 100 shares (traditional full quota) at the request of the Abalone Council of NSW to make the analysis more comprehensible for some stakeholders. This column does not represent any additional analysis based on smaller fishing operations.

[b] Total boat cash costs: in this case TBCC actually refers to total cash costs per aggregated fishing unit.

[c] Repairs and maintenance costs have been classified as a variable cost although it is noted that some of these costs may be fixed (e.g. regulated maintenance).

[d] Unpaid labour was divided between variable (time spent fishing and on repairs and maintenance) and fixed (management and administrative duties) based on survey responses.

Source: EconSearch analysis

Income…

The income generated by larger fishing businesses (those which fish more quota) is almost double that of the smaller fishing business. This indicates significant variation within the sample of 12 fishing businesses.

Costs…

The main cost items are similar for large and small fishing businesses. Costs for large fishing businesses are close to double the cost for smaller businesses. For the most part the relative importance of each cost in the overall cost profile is similar. There are a few differences, for instance unpaid administrative labour is more than four times as high for large businesses as for small ones.

Cash Income and Profit…

The separation of variable and fixed costs from total cash costs enables the calculation of gross margin (total boat income less total boat variable costs) as a basic measure of profit (assuming that capital has no alternative use and that as fishing activity varies there is no change in capital or fixed costs). Average gross margin per fishing business in 2011/12 was $43,712 for the smaller businesses and $77,324 for the larger businesses.

Gross operating surplus (GOS) was calculated excluding imputed wages for shareholders and family members as a cost item. The average GOS of all boats in 2011/12 was estimated to be around $30,884 for smaller business and $48,200 for larger businesses.

Boat cash income is measured as gross operating surplus with imputed wages (unpaid labour) included as cash costs. The estimated average boat cash income in 2011/12 was approximately $24,839 per smaller business and $31,789 per larger fishing business.

Gross operating surplus and boat business profit give an indication of the capacity of the operator to remain in the fishery in the short to medium term. In 2011/12, the average boat business profit was around $13,776 for smaller businesses, and $9,029 for larger businesses. The higher boat business profit for the smaller businesses is caused by the significantly greater depreciation costs for the larger businesses.

Profit at full equity is a measure of the profitability of an aggregated fishing unit, assuming the full equity in the operation. It is a useful absolute measure of the economic performance of fishing firms. Profit at full equity in 2011/12 was over $30,000, indicating that interest repayments are a significant cost for some fishing operations.

Return on Investment

The average total investment in fishing gear and licence in the Abalone fishery in 2011/12 was estimated to be just over $452,000 for smaller fishing businesses, and just under $798,000 for larger fishing businesses. This included the licence holder's estimate of the value of their licence (around $400,000 for smaller businesses, and around $688,000 for larger fishing businesses). Physical capital was estimated to be on average around $50,000 for smaller businesses, and on average more than $109,000 per fishing business.

The rate of return to boat capital (i.e. fishing gear and equipment) was fairly high (33.6 per cent). The rate of return to total capital was much lower, calculated to be 2.6 per cent. As expected, this rate of return to total capital falls between the rates calculated for fishing businesses and shareholders separately.

Licence Values…

The value of licences represents a significant proportion of the capital used by each fishing business in the fishery. The reported licence value for 2011/12 in Table 3.9 represents the licence holders' estimate of the value of their licence based on the 2012 survey responses. There was a large degree of variability in the licence holders' estimates of licence value. Part of this variability came from the differences in shareholdings between fishing businesses. There was also variability in estimates of the value of a licence unit. The table below calculates the sensitivity of the rate of return to changes in the estimate of the value of a licence unit, holding the size of the shareholdings constant.

Table 3.10 Sensitivity of rate of return to changes in licence value, 2011/12 [a] smaller fishing businesses

Share Value (10 units per share)	$31,856	$63,712	$95,568
Rate of Return to Total Capital (%)	9.0%	5.0%	3.4%

[a] Based on the licence value estimated for 2011/12 and values 50 per cent above and below this estimate.
Source: EconSearch analysis

Table 3.11 Sensitivity of rate of return to changes in licence value, 2011/12 [a] larger fishing businesses

Share Value (10 units per share)	$31,856	$63,712	$95,568
Rate of Return to Total Capital (%)	6.4%	3.6%	2.5%

[a] Based on the licence value estimated for 2011/12 and values 50 per cent above and below this estimate.
Source: EconSearch analysis

On average, the smaller fishing businesses which participated in the survey have a higher rate of return than the larger fishing businesses, despite the larger fishing businesses generating higher profits. This result is due to the lower capital investment made by the smaller businesses.

3.8 Economic Rent

Economic rent[19] is defined as the difference between the price of a good produced using a natural resource and the unit costs of turning that natural resource into the good. In

[19] Economic rent is comprised of three types of rent: entrepreneurial rent, quasi-rent and resource rent. As in any business some operators are more skilful than others and will therefore earn more profit. These profits, which are one component of economic rent, are *entrepreneurial rents*. In the short-term fishers may earn large surpluses over costs, which may provide prima facie evidence of substantial resource rents. However, there are some circumstances where such surpluses can occur but they are not true rents. These are referred to as *quasi-rents*. One example is where a fishery is developing or recovering and there may be under-investment in the fishery. Another example is where there is a short-term but unsustainable increase in price due to, for example, exchange rate fluctuations. However, some profits will be obtained because the natural resource being used (i.e. the fishery) has a value. These profits are described as *resource rents* and are also a component of economic rent.

this case the natural resource is the Abalone fishery and the good produced is the landed Abalone.

The unit costs or long term costs all need to be covered if the licence holder is to remain in the fishery. These long-term costs include direct operating costs such as fuel, labour (including the opportunity cost of a self employed fisher's own labour), ice, overheads such as administration and licences and the cost of capital invested in the boat and gear (excluding licence). Capital cost includes depreciation and the opportunity cost of the capital applied to the fishery. The opportunity cost is equivalent to what the fisher's investment could have earned in the next best alternative use.

Determining the opportunity cost of capital involves an assessment of the degree of financial risk involved in the activity. For a risk-free operation, an appropriate opportunity cost of capital might be the long-term real rate of return on government bonds. The greater the risks involved, the greater is the necessary return on capital to justify the investment in that particular activity. For this analysis the long term (10 year) real rate of return on government (treasury) bonds of 5 per cent has been used and a risk premium of 5 per cent has been applied.

Given the relatively high-risk nature of the industry (weak property rights therefore short time horizons, exposure to exchange rate fluctuations, general price volatility, potential problems of resource sustainability and political risk in export countries) an argument could be made for a higher required rate of return.

What remains after the value of these inputs (labour, capital, materials, services) has been netted out is the value of the natural resource itself. The economic rent generated in the NSW Abalone fishery was estimated to be around $827,000 in 2011/12.

When an economic rent is generated in a fishery and there are transferable licences, the rent represents a return to the value of the licences. The aggregate value of licences in 2011/12 was estimated to be approximately $22 million (3,454 licence units with an average value of approximately $6,371). An annual economic rent of $827,000 represents a return of 3.8 per cent.

4. Other Economic Indicators

4.1 Factors Influencing the Economic Condition of the Abalone Fishery

There are a number of factors in 2011/12 that have impacted on the economic performance of the fishery. Most of these are likely to continue to affect economic outcomes in the future.

4.1.1 Illegal, unregulated and unreported Abalone fishing activity

Illegal, unregulated and unreported Abalone fishing activity is an ongoing problem that has the potential to cost the industry millions of dollars in lost income. It undermines the existing management systems that are in place to ensure the sustainability of the resource. This practice also undercuts the economic benefits received by legitimate Abalone fishers.

Because it is difficult to determine the actual level of illegal, unregulated or unreported catch of Abalone in NSW, it is difficult to make management decisions relating to this issue.

4.1.2 Exchange rates

A large proportion of the Australian Abalone is exported overseas. Accordingly, the value of the Australian dollar can have a significant impact on the economic performance of the fishery. The value of the Australian dollar influences the price of Australian exports overseas. Significant changes in the value of the Australian dollar have the potential to influence the demand for Australian Abalone exports. The Australian dollar generally remained high in 2011/12, typically valued above or very close to parity with the US Dollar.

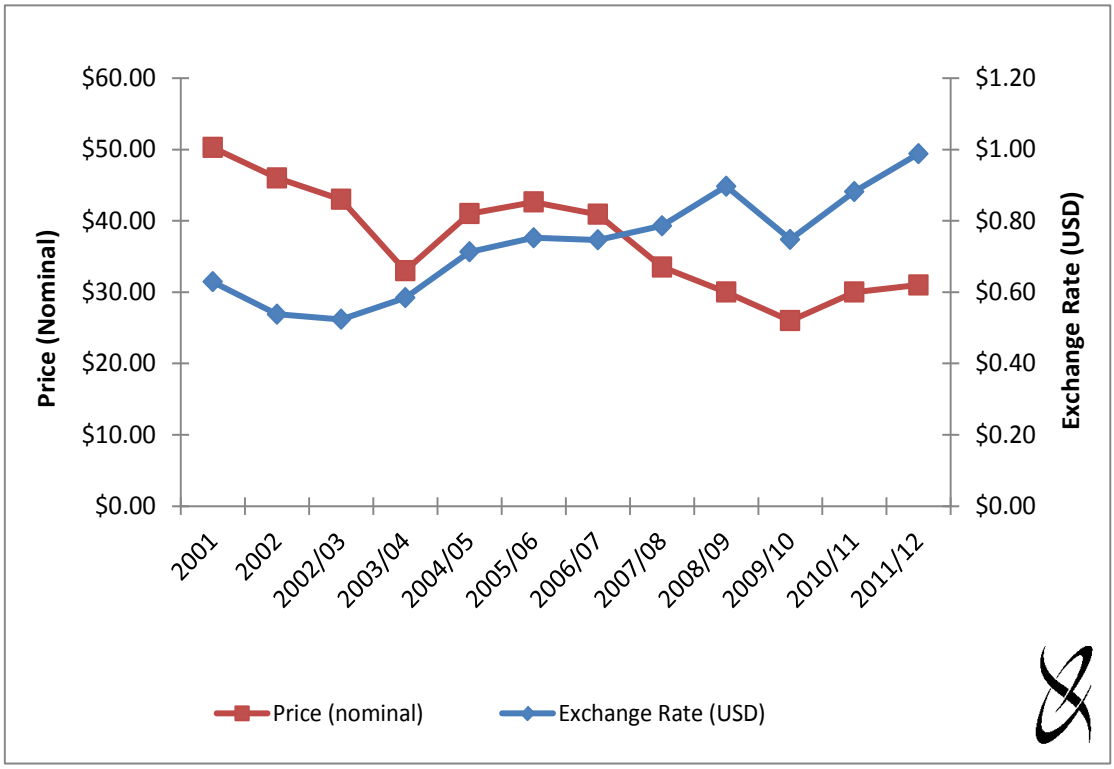
The average exchange rate in 2011/12 was US $1.04, an increase of 5 per cent compared to the average for the previous year (Figure 4.1). Other things held equal, a rise in the value of the currency would have the effect of decreasing the price of Abalone received by Australian exporters between 2010/11 and 2011/12.

The most significant export destination for Australian Abalone in 2009/10 was Hong Kong (ABS unpublished data). Thus it may be useful to compare the value of the Australian dollar with the Hong Kong dollar (HKD). The average rate of exchange in 2010/11 was 7.68 HKD increasing to 8.05 (HKD) in 2011/12 (Figure 4.2). The most significant destination for NSW Abalone in 2011/12 was Japan (Duncan Worthington pers. comm.).

The relationship between the price of Abalone and the exchange rate between 2001 and 2011/12 can be readily observed in Figure 4.1, Figure 4.2 and Figure 4.3. A widely used measure of the relationship between two variables, such as price and exchange rate, is the coefficient of correlation. The coefficient of correlation can range in value

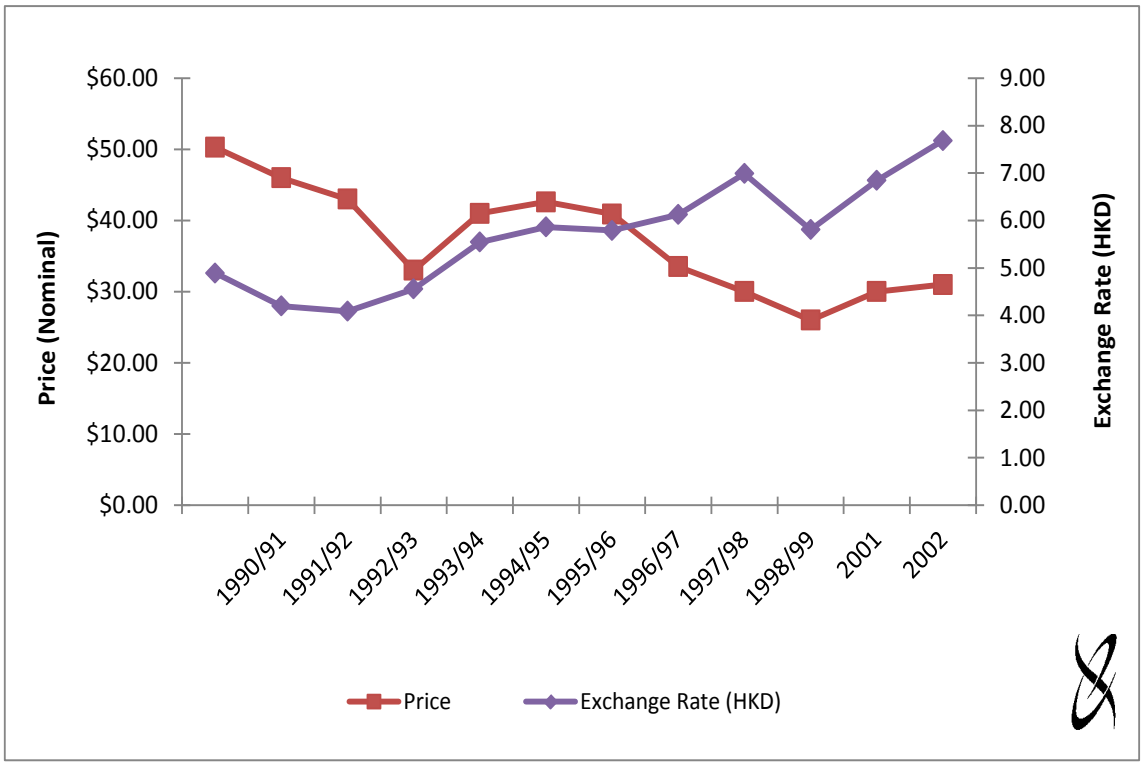
from +1.0 for a perfect positive correlation to –1.0 for a perfect inverse correlation. The coefficient of correlation between the exchange rate (USD) and the price for NSW Abalone for the period 2001 to 2011/12 is –0.64. This indicates that there is a moderately strong inverse relationship between the two variables. Thus, when the Australian dollar appreciates, as it did between 2010/11 and 2011/12, there is, generally, a corresponding decline in the average price of NSW Abalone. The coefficient of correlation between the exchange rate (HKD) and the price for NSW Abalone for the period 2001 to 2011/12 is also –0.64, as the HKD and USD were highly correlated over the same period. There was a moderate negative relationship between the JPY exchange rate and the nominal price of Abalone between 2000 and 2011/12 (the coefficient of correlation was -0.40).

Figure 4.1 Exchange rate (USD) and price for NSW Abalone, 2001 to 2011/12



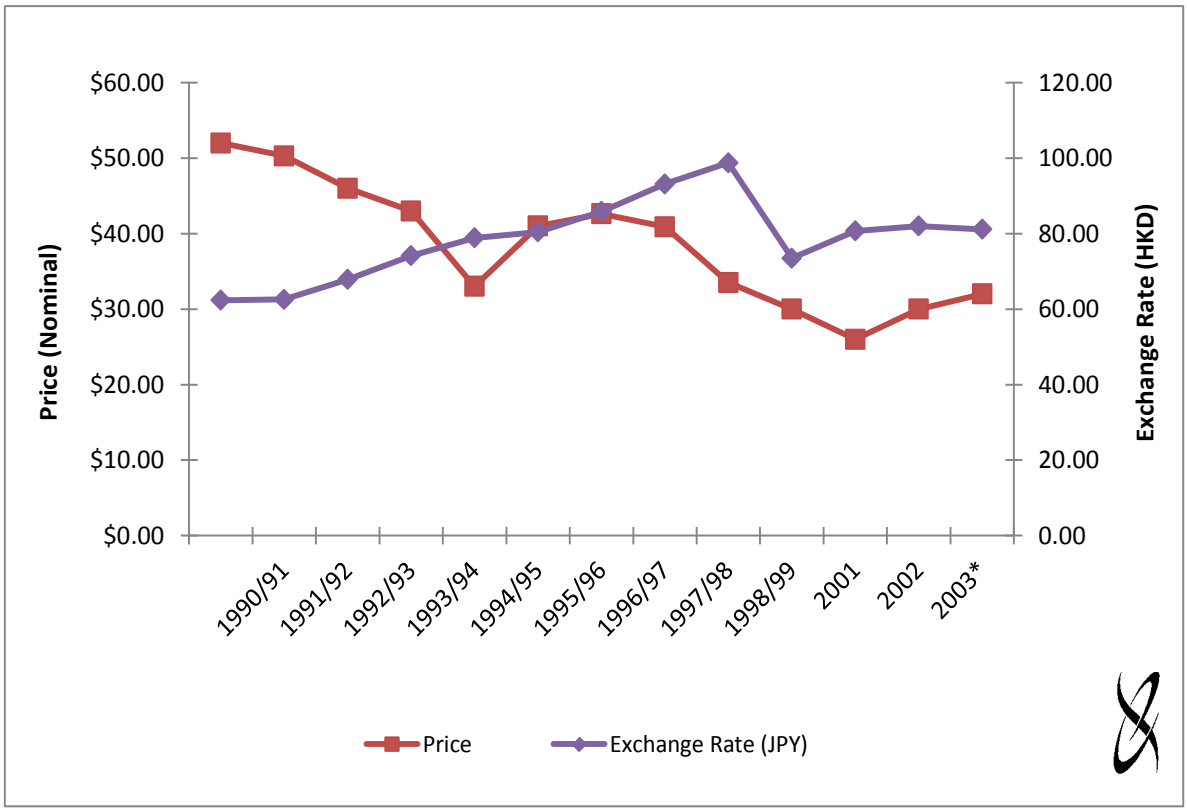
Source: NSW DPI and RBA (2012b and previous issues)

Figure 4.2 Exchange rate (HKD) and price for NSW Abalone, 2001 to 2011/12



Source: NSW DPI and RBA (2012b and previous issues)

Figure 4.3 Exchange rate (JPY) and price for NSW Abalone, 2000 to 2011/12



Source: NSW DPI and RBA (2012b and previous issues)

4.2 Shareholder and Diver Comments

In the 2013 survey shareholders and divers highlighted some key issues that have the potential to affect the economic performance of the fishery. These comments were made through the course of the survey, and as a response to an open ended question at the end of the survey. The comments below do not represent the opinions of EconSearch, but are a summary of the key economic issues raised with EconSearch by survey participants. It is important to note that not all shareholders and divers were involved in the survey process, and the comments below represent only the views of those shareholders and divers who were able to participate.

Theft
Theft of the resource impacts is a direct economic loss and reduces the productivity of the resource. As such, ongoing poaching in the fishery is of concern to fishery stakeholders.

Processing
The capacity of local processing plants to take Abalone was identified as a key constraint by many divers. Many divers identified their ability to sell Abalone to processors as the key limiting factor in their business operations, and decisions regarding which days to fish (as opposed to weather or quota). The size of the NSW industry and irregularity in demand from overseas were identified as key reasons for the processors' caps on abalone intake.

Management Charges
Many survey participants indicated that management fees in the past few years had fallen to much more reasonable levels than in previous years. However, the majority of survey participants commented that licence fees are still too high, both as a proportion of total income, and in terms of the services provided. Management charges and other fees must be affordable and used efficiently to manage the resource.

TAC
Several licence holders and divers commented that the return to fishing effort was better than it had been in many years, and attributed this to the recovery of fish stocks as a result of the cut in TAC. A number of survey participants emphasised the importance of avoiding another crash in fish stocks. The survey did not explicitly ask participants to comment on TAC, and as mentioned above, only a portion of fishery stakeholders were involved in the survey. Noting this, the majority of participants who volunteered a comment on TAC during the survey suggested that it should be increased slightly, or held constant.

Fishery Management
Many survey participants highlighted the need for a clearer strategy, more certainty and increased transparency in decision making at all levels of fishery management. A need for greater respect of stakeholder opinions and increased stewardship was also highlighted. It was suggested that there could be a greater role for Industry in the efficient and effective management of the resource. In particular, there could be significant advantages from involving divers in research, and taking more account of the insights that divers could provide into ocean floor ecology. A few survey participants suggested that more flexible arrangements for transfer of quota between shareholders and to divers would be useful.

Size limits
Some survey participants drew attention to the natural variation in Abalone sizes in different areas, and made mention of the need to vary the size limit spatially to allow efficient distribution of effort and resources. Concern was raised by a few survey participants regarding the effects of size limit increases, shifting fishing effort away from areas with robust fish stocks, but naturally smaller sized of Abalone.

Spatial catch distribution
Some concerns were raised about localised over fishing in southern fishing grounds. There was concern that the areas with the fastest recovery (i.e. northern areas) were not being sufficiently utilised, and areas which were slower to recovery were being underutilised.

Markets and exchange rates
A number of shareholders identified the high Australian dollar as a significant factor in the depressed prices for NSW Abalone. Others identified irregularity of demand from overseas markets as an issue of concern for the industry. Improving industry access to larger or local markets was seen as a key priority for the future of the industry by some participants.

External impacts
The need to reduce the potential for negative external impacts on the fishery was highlighted. For example, past marine park impacts and past Perkinsus disease impacts have had negative impacts on the performance of the fishery.

Health Effects
The potential negative effects of long duration or deep diving on the brain were brought up by several survey participants, although it was noted that the risk of nitrogen poisoning had been reduced as an indirect result of reduced quota allocations and improved catch rates.

5. Continued Collection of Economic Indicators.

The 2012/13 TAC Committee report (TACC 2012) highlights the need for improvements to the availability of economic data for the fishery. Given the small (relative to other states) size of the fishery, it is particularly imperative that collection of this data occurs in a cost effective way.

In South Australia, in order to keep costs of economic indicator reporting down, surveys such as the one undertaken in this project are undertaken periodically (every three to four years) in order to capture structural changes to the fisheries. In the interim economic indicators, cost and income data, are updated based on ABS and fishery data. Variable costs are adjusted according to changes in fishing effort and changes in relevant price indices. For example, labour costs are inflated using the labour price index and fuel costs are inflated using the cost index for petrol. Average income is adjusted based on fishery GVP[20]. A similar approach may be useful for NSW.

[20] For more details refer to EconSearch 2012

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Appendix 1. Summary Indicators - Southern Abalone Fisheries

Appendix Table 1 illustrates trends in catch, GVP and price in the South Australian, Tasmanian and NSW Abalone Fisheries over time[21]. Notable trends include the significant decline in the NSW Abalone fishery catch over the last ten years, and the relative stability of catch in the South Australian Abalone Fishery. Prices across the three fisheries have been similar for the last five years. Both NSW and South Australia experience high prices for Abalone in the early 2000s. This price increase was more distinctive and more prolonged in the NSW fishery. Data for Tasmania over this period is not available.

Appendix Table 1 Catch, GVP and nominal price in selected Southern Abalone Fisheries, 1999/00 to 2011/12

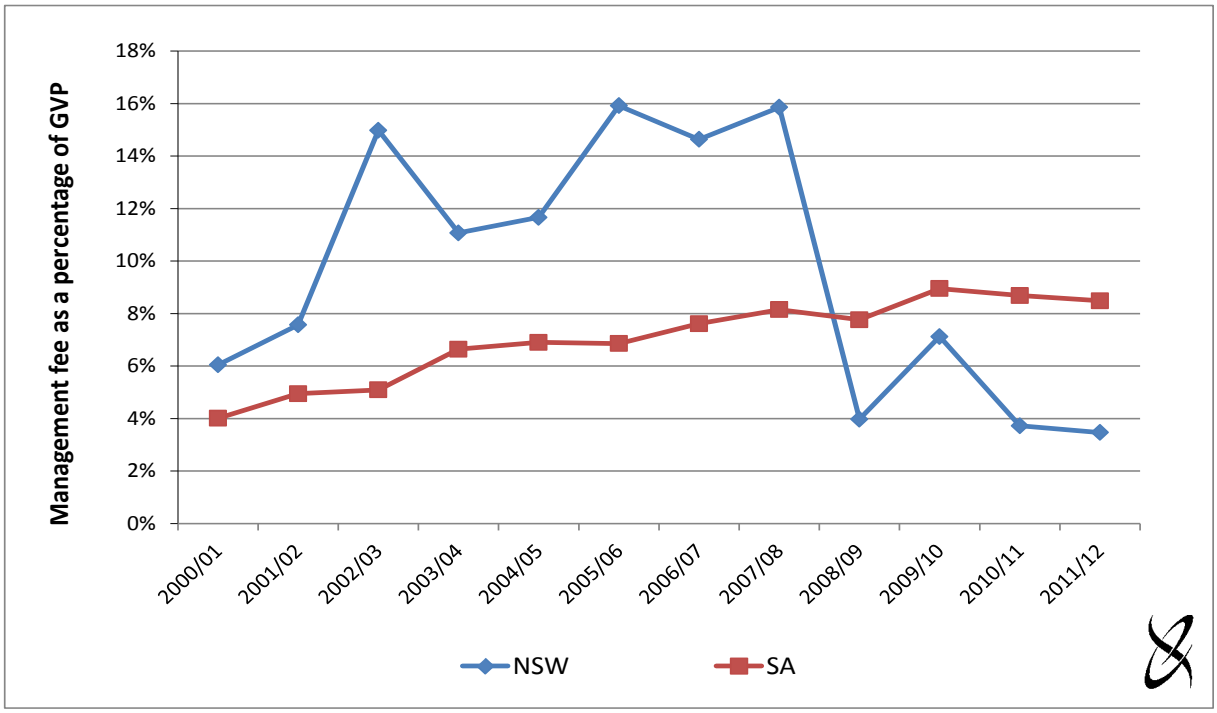
Year	South Australia			Tasmania			New South Wales		
	(tonnes)	($m)	($/kg)	(tonnes)	($m)	($/kg)	(tonnes)	($m)	($/kg)
1999/00	889	$32	$36.44	n.a	n.a	n.a	304.8	$16	$52.00
2000/01	867	$40	$46.15	n.a	n.a	n.a	304.4	$15	$50.28
2001/02	850	$35	$40.89	n.a	n.a	n.a	276.3	$13	$46.00
2002/03	890	$36	$40.77	n.a	n.a	n.a	149	$6	$43.00
2003/04	879	$32	$35.93	n.a	n.a	n.a	242	$8	$33.00
2004/05	902	$34	$37.50	n.a	n.a	n.a	189	$8	$41.00
2005/06	896	$34	$37.79	2,503	n.a	n.a	129	$5	$42.62
2006/07	883	$31	$35.58	2,433	$82	$33.70	122	$5	$40.90
2007/08	889	$31	$34.92	2,583	$90	$34.84	109	$4	$33.52
2008/09	837	$33	$38.85	2,607	$93	$35.67	103	$3	$30.00
2009/10	855	$28	$32.83	2,660	$104	$39.11	75	$2	$26.00
2010/11	815	$28	$34.35	2,548	$85	$33.28	94	$3	$30.00
2011/12	822	$29	$35.16	2,363	$82	$34.88	110	$4	$32.00

Source: EconSearch 2013a, EconSearch 2013b, NSW Abalone council, pers. comm.

Appendix Figure 1 illustrates how licence fees as a percentage of GVP change over time in the South Australian and NSW Abalone fisheries. Similar information is not available for the Tasmanian fishery. As the figure illustrates licence fees have increased slightly over the last ten years in SA (as a result of both a slight decrease in GVP, and increase in licence fees). Licence fees as a percentage of GVP have fluctuated significantly over the last thirteen years. Between 2002/03 and 2007/08 licence fees as a percentage of GVP remained well above 10 per cent as a result of a significant decrease in catch and GVP, and a simultaneous increase in licence fees. Since then negotiations between industry and government have resulted in a reduction in licence fees. Licence fees as a percentage of GVP have remained relatively stable for the last four years.

[21] These three fisheries have so far been surveyed by EconSearch as part of the Abalone Bioeconomic Indicators Project.

Appendix Figure 1 Licence Fees as a percentage of GVP in selected Southern Abalone Fisheries



Source: EconSearch 2013a, NSW Abalone council, pers. comm, EconSearch Analysis

Appendix Table 2 summarises the Economic Rent for each of the fisheries. Calculations of rent are based on the 2012 and 2013 surveys of southern Abalone fisheries.

Appendix Table 2 Economic Rent in Selected Southern Abalone Fisheries, 2011/12

	SA	NSW	Tas
Gross Income	$28,671	$3,514	$85,200
Less Labour	$7,094	$727	$9,922
Less Cash Costs	$5,232	$1,364	$5,450
Less Depreciation	$1,448	$404	$2,607
Less Opportunity Cost of Capital (@10%)	$968	$192	$2,301
Economic Rent	$13,930	$827	$64,919

Source: EconSearch 2013a, EconSearch 2013b, 2013 NSW Abalone survey and EconSearch Analysis.

Appendix Table 3 provides a summary of key financial performance indicators in each of the three southern Abalone fisheries which has so far been surveyed in the Bio Economic Modelling project. Care should be taken when comparing results between fisheries as there are structural differences between the three fisheries which may affect the interpretation of the results. For example, comparing licence fees between the three fisheries might suggest that Tasmania pays much lower licence fees per kg than the other state, but it should be taken into account that there is a royalty charged by the Tasmanian State Government on Abalone caught in their fishery.

The costs and income presented here are based on the closest available estimate of the income and costs of a 'complete' fishing business: that is a business model which incorporates both shareholder and diver components of the fishing operation. Due to differences in survey process and fishery structure, the estimates of income and costs were calculated differently for each fishery. In SA, where licences are still primarily linked to the diver, the estimates presented above relate to a holistic fishing business. In NSW, a number of licence holders who still remain active in the fishery were interviewed. The information presented above relates to a composite of licence holder costs and diver costs (see details in Section 3.6 of this report). In Tasmania, many divers lease the majority of their quota. The operating costs are based on surveys with divers only some of whom own their own quota. Income and licence value of 'external shareholders were imputed based on average beach price and estimates of quota value (see EconSearch 2013b) for details. Because of these differences in calculation methods, particular care should be taken when comparing labour costs (both paid and unpaid) between the fisheries.

Appendix Table 3 Financial performance indicators for southern Abalone fisheries[a]

		Tasmania			NSW			South Australia		
		Average per fishing business (Licence Holder)	average per kg	Share of TBCC[b]	Average per aggregated fishing unit	average per kg	Share of TBCC[b]	Average per fishing business	average per kg	Share of TBCC[b]
	Total Boat Gross Income (before Royalty)	$916,446	$36.49		$171,370	$31.65		$819,183	$33.83	
	Royalty	$74,461	$3		n/a			n/a		
(1)	**Total Boat Gross Income (after Royalty)**	**$841,984**	**$33.52**		**$171,370**	**$31.65**		**$819,183**	**$31.65**	
	Variable Costs									
	Fuel	$26,203	$1.04	14%	$5,818	$1.07	4%	$19,649	$0.81	5%
	Mothership fees	$7,562	$0.30	4%	n/a	n/a	n/a	n/a	n/a	n/a
	Repairs & Maintenance [c]	$11,923	$0.47	6%	$5,964	$1.10	5%	$25,206	$1.04	6%
	Ice	$73	$0.00	0%	$825	$0.15	1%	$438	$0.02	0%
	Provisions	$1,726	$0.07	1%	$0	$0.00	0%	$742	$0.03	0%
	Labour - paid	$106,727	$4.25	55%	$13,895	$2.57	10%	$190,941	$7.88	44%
(2)	- unpaid [d]	$0	$0.00	0%	$7,860	$1.45	6%	$4,386	$0.18	1%
	Other	$6,455	$0.26	3%	$26,726	$4.94	20%	$8,933	$0.37	2%
(3)	**Total Variable Costs**	**$160,668**	**$6.40**	**83%**	**$61,088**	**$11.28**	**46%**	**$250,295**	**$10.33**	**58%**
	Fixed Costs									
	Licence Fee	$2,249	$0.09	1%	$10,215	$1.89	8%	$63,035	$2.60	15%
	Insurance	$6,099	$0.24	3%	$2,303	$0.43	2%	$5,234	$0.22	1%
(4)	Interest	$8,840	$0.35	5%	$30,516	$5.64	23%	$81,215	$3.35	19%
(5)	Labour - unpaid [d]	$0	$0.00	0%	$13,691	$2.53	10%	$7,348	$0.30	2%
	Legal & Accounting	$2,909	$0.12	2%	$4,249	$0.78	3%	$8,499	$0.35	2%
	Telephone etc.	$2,146	$0.09	1%	$2,484	$0.46	2%	$2,404	$0.10	1%
	Slipping & Mooring	$2,899	$0.12	1%	$171	$0.03	0%	$2,812	$0.12	1%
	Travel	$2,748	$0.11	1%	$2,525	$0.47	2%	$3,150	$0.13	1%
	Office & Admin	$1,733	$0.07	1%	$5,259	$0.97	4%	$7,428	$0.31	2%
	Leasing	$3,105	$0.12	2%	n/a	n/a	n/a	$1,964	$0.08	0%
(6)	**Total Fixed Costs**	**$32,727**	**$1.30**	**17%**	**$71,413**	**$13.19**	**54%**	**$183,089**	**$7.56**	**42%**
(7)	**Total Boat Cash Costs (3 + 6)**	**$193,395**	**$7.70**	**100%**	**$132,501**	**$24.47**	**100%**	**$433,384**	**$17.89**	**100%**
	Boat Gross Margin (1 - 3)	**$681,316**	**$27.13**		**$110,282**	**$20.37**		**$568,888**	**$23.49**	
(8)	**Total Unpaid Labour (2 + 5)**	**$0**	**$0.00**		**$21,551**	**$3.98**		**$11,734**	**$0.48**	
	Gross Operating Surplus (1 - 7 + 8)	**$648,589**	**$25.82**		**$60,420**	**$11.16**		**$397,533**	**$16.41**	
(9)	**Boat Cash Income (1 - 7)**	**$648,589**	**$25.82**		**$38,869**	**$7.18**		**$385,799**	**$15.93**	
(10)	**Depreciation**	**$28,047**	**$1.12**		**$19,699**	**$3.64**		**$41,678**	**$1.72**	
(11)	**Boat Business Profit (9 - 10)**	**$620,543**	**$24.71**		**$19,171**	**$3.54**		**$344,122**	**$14.21**	
(12)	**Profit at Full Equity (11 + 4)**	**$629,382**	**$25.06**		**$49,687**	**$9.18**		**$425,337**	**$17.56**	
	Boat Capital									
(13)	Fishing Gear & Equip	$247,546	**$9.86**		$93,458	**$17.26**		$276,502	**$11.42**	
	Licence Value	$6,407,491	**$255.11**		$1,107,403	**$204.54**		$6,901,963	**$284.99**	
(14)	**Total Boat Capital**	**$6,655,037**	**$264.97**		**$1,200,861**	**$221.81**		**$7,178,465**	**$296.41**	
	Rate of Return on Fishing Gear & Equip (12 / 13 * 100)	**254.2%**			**53.2%**			**153.8%**		
	Rate of Return on Total Boat Capital (12 / 14 * 100)	**9.5%**			**4.1%**			**5.9%**		

[a] As discussed above, the costs and income presented here are based on the closest available estimate of the income and costs of a 'complete' fishing business: that is a business model which incorporates both shareholder and diver components of the fishing operation.

[b] Total boat cash costs. In this case total boat cash costs refer to total business cash costs. Some businesses have more than one boat used to fish in different areas or conditions.

[c] Repairs and maintenance costs have been classified as a variable cost although it is noted that some of these costs may be fixed (e.g. regulated maintenance).

[d] Unpaid labour was divided between variable (time spent fishing and on repairs and maintenance) and fixed (management and administrative duties) based on survey responses.

Source: EconSearch 2013a, EconSearch 2013b, 2013 NSW Abalone survey and EconSearch Analysis.

Appendix 2: Economic indicators for the Tasmanian Abalone Fishery 2011/12

Economic Indicators for the Tasmanian Abalone Fishery 2011/12

A report prepared for

Seafood CRC

Prepared by

econsearch

19 December 2013

EconSearch Pty Ltd
214 Kensington Road
Marryatville SA 5068
Tel: (08) 8431 5533
Fax: (08) 8431 7710
www.econsearch.com.au

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Abbreviations

ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences
ABS	Australian Bureau of Statistics
CPI	consumer price index
CRC	Cooperative Research Centre
DPIPWE	Department of Primary Industries, Parks, Water and Environment
FRDC	Fisheries Research and Development Corporation
fte	full time equivalent
GRP	gross regional product
GSP	gross state product
GVP	gross value of production
PIRSA	Primary Industries and Regions South Australia
RBA	Reserve Bank of Australia
R&M	repairs and maintenance
UTAS	University of Tasmania

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6. Introduction

The Tasmanian Abalone fishery operates in accordance with the *Living Marine Resources Management Act* 1995 and the Fisheries (Abalone) Rules 2009. The primary purpose of the act is to achieve sustainable development of living marine resources, having regard to the need to:

> (a) increase the community's understanding of the integrity of the ecosystem upon which fisheries depend; and
>
> (b) provide and maintain sustainability of living marine resources; and
>
> (ba) take account of a corresponding law; and
>
> (c) take account of the community's needs in respect of living marine resources; and
>
> (d) take account of the community's interests in living marine resource

This report was prepared as part of a research study being conducted by the Institute for Marine and Antarctic Studies (IMAS), University of Tasmania. It is part of a project that was proposed and developed by Abalone Council Australia Ltd. (ACA), using funds from the Australian Seafood CRC.

The objective of this report, *Economic Indicators for the Tasmanian Abalone Fishery 2011/12*, is to provide an assessment of the economic performance of the fishery against a series of indicators. This information is used to investigate whether the abalone fishery in Tasmania is generating economic wealth, and how changes in economic variables, such as prices of fish and fuel costs, may affect profitability of the fishers and industry as a whole. This economic data can also be used as the basis for harvest strategy evaluation where the economic outcome of alternative management rules can be assessed. The economic indicators detailed in this report include:

- gross value of production (catch and beach price);
- the cost of management of the fishery;
- financial performance indicators (income, costs, profit and return on investment);
- economic rent; and
- external factors influencing the economic condition of the fishery.

7. Method of Analysis and Definition of Terms

7.1 Survey of Licence Holders in the Fishery, 2011/12

The questionnaire for the 2011/12 survey was based on the South Australian surveys conducted for 1997/98, 2000/01, 2004/05 and 2011/12.[22] It was drafted in consultation with the CEO of the Tasmanian Abalone Industry Association, Dean Lisson, and the University of Tasmania project staff.

Economic data collected in the survey will be used in a Seafood CRC funded project to develop bioeconomic models for Southern Abalone fisheries. EconSearch has been included in a consortium of research organisations (including CSIRO and University of Tasmania) to undertake this project. In these models biological and economic data are combined to enable stakeholders to make decisions about their fishery with the goal of enhancing profitability.

In November 2012 all licence holders were sent a copy of the questionnaire and a letter from the EconSearch seeking their participation in the survey. Licence holders were then contacted by phone to arrange a convenient time to complete a face-to-face interview, or to assist licence holders who wished to complete their survey independently and return it by post. Thirty seven usable responses were collected from divers in the fishery. The majority of the remaining divers were either not contactable or were unwilling to participate in the survey due to time constraints, complicated business structures or concerns about privacy.

7.2 Definition of Terms[23]

Total Boat Income (TBI): refers to the cash receipts received by an individual firm and is expressed in dollar terms. Total boat income is calculated as catch (kg) multiplied by 'beach price' ($/kg). Total boat income is the contribution of an individual licence holder to the GVP of a fishing sector or fishery.

Total Boat Variable Costs: are costs which are dependent upon the level of catch or, more commonly, the amount of time spent fishing. As catch or fishing time increases, variable costs also increase. Variable costs are measured in current dollar terms and include the following individual cost items:

- fuel, oil and grease for the boat (net of diesel fuel rebate)
- ice
- provisions
- crew payments
- fishing equipment, purchase and repairs
- repairs & maintenance: ongoing (slipping, painting, motor)

22 The 2011/12 survey is described in EconSearch (2013).

23 Where possible definitions have been kept consistent with those used by Brown (1997) in ABARE's *Australian Fisheries Survey Report*.

Boat Gross Margin: is defined as *Total Boat Income* less *Total Boat Variable Costs*. This is a basic measure of profit which assumes that capital has no alternative use and that as fishing activity (days fished) varies there is no change in capital or fixed costs.

Total Boat Fixed Costs: are costs that remain fixed regardless of the level of catch or the amount of time spent fishing. As such these costs, measured in current dollar terms, are likely to remain relatively constant from one year to the next. Examples of fixed cost include:

- insurance
- licence and industry fees
- office & business administration (communication, stationery, accountancy fees)
- interest on loan repayments and overdraft
- leasing

Total Boat Cash Costs (TBCC): defined as *Total Boat Variable Costs* plus *Total Boat Fixed Costs*

Gross Operating Surplus: (GOS) is defined as *Total Boat Income* less *Total Boat Cash Costs* and is expressed in current dollar terms. GOS may be used interchangeably with the term Gross Boat Profit. A GOS value of zero represents a breakeven position for the business, where TBCC equals TBI. If GOS is a negative value the firm is operating at a cash loss and if positive the firm is making a cash profit. GOS does not include a value for owner/operator wages, unpaid family work, or depreciation.

Owner-operator and Unpaid Family Labour: in many fishing businesses there is a component of labour that does not draw a direct wage or salary from the business. This will generally include owner/operator labour and often also include some unpaid family labour. The value of this labour needs to be accounted for which involves imputing a labour cost based on the amount of time and equivalent wages rate. In the above calculations this labour cost can be included simply as another cost so that Gross Operating Surplus takes account of this cost. Alternatively, it can be deducted from GOS to give a separate indicator called Boat Cash Income. Owner-operator and unpaid family labour is separated into variable labour (fishing and repairs and maintenance) and overhead labour (management and administration).

Boat Cash Income: is defined as *Gross Operating Surplus* less *imputed wages for owner- operator and unpaid family labour*.

Boat Capital: includes capital items that are required by the licence holder to earn the boat income. It includes boat hull, engine, electronics and other permanent fixtures and tender boats. Other capital items such as motor vehicles, sheds, cold-rooms, and jetty/moorings can be included to the extent that they are used in the fishing business. The fishing licence/permit value is included in total boat capital.

Depreciation: Depreciation refers to the annual reduction in the value of boat capital due to general wear and tear or the reduction in value of an item over time.

Boat Business Profit: is defined as *GOS* less *Depreciation* less *Owner-operator and Unpaid Family Labour*. Boat Business Profit represents a more complete picture of the actual financial status of an individual firm, compared with GOS, which represents the cash in-cash out situation only.

Profit at Full Equity: is calculated as *Boat Business Profit* plus *rent, interest and lease* payments. Profit at Full Equity represents the profitability of an individual licence holder, assuming the licence holder has full equity in the operation, i.e. there is no outstanding debt associated with the investment in boat capital. Profit at Full Equity is a useful absolute measure of the economic performance of fishing firms.

Rate of Return to Capital: is calculated as *Profit at Full Equity* divided by *Boat Capital* multiplied by *100*. This measure is expressed in percentage terms and is calculated for an individual licence holder. It refers to the economic return to the total investment in capital items, and is a useful relative measure of the performance of individual firms. Rate of return to capital is useful to compare the performance of various licence holders, and to compare the performance of other types of operators, and with other industries.

Gross value of production (GVP): refers to the value of the total annual catch for individual fisheries, fishing sectors or the fishing industry as a whole, and is measured in dollar terms. GVP, generally reported on an annual basis, is the quantity of catch for the year multiplied by the average monthly landed beach prices.

Beach price: refers to the price received by commercial fishers at the "port level" for their catch, and is generally expressed in terms of $/kg. Processing costs are not included in the beach price, as processing operations are assumed to occur further along the value chain. The use of beach prices also removes the effect of transfer pricing by the firm if it is vertically integrated into the value chain.

Cost of management services: in a commercial fishery management services will generally include stock assessment monitoring and reporting; policy, regulation and legislation development; compliance and enforcement services; licensing services; and research. Where a commercial fishery operates under full cost recovery, licence fees will be set to cover the cost of managing the fishery or at least the commercial sector's share of the resource.

In fisheries where there is full cost recovery, it can be assumed that the cost of providing these management services to the commercial sector will be equal to the gross receipts from licence fees in the fishery. With information on licence fee receipts, GVP, catch and the number of commercial fishers in the fishery, the following indicators can be readily calculated:

- aggregate licence fee receipts for the fishery ($)
- licence fee/GVP (%)
- licence fee/catch ($/kg)
- licence fee/licence ($/licence)

8. Economic Indicators for the Tasmanian Abalone Fishery

8.1 Catch and Gross Value of Production

The data in Table 3.1 indicate that the total catch of Abalone in Tasmania has remained relatively steady since 2006. The overall stability is due to the quota management arrangements for the fishery which were introduced in the mid to late 1980s. The catch in 2012 (2,363 tonnes) was almost 6 per cent lower than that in 2006 (2,503 tonnes). Although the catch has remained relatively steady from 2006 onwards the value of the fishery has fluctuated over this period with most of the variance between years attributable to change in the Eastern Zone TAC. In 2010 the value of catch reached $104 million (27 per cent higher than the value in 2007 around $82m). This increase in GVP was principally due to an increase in prices. In 2012 GVP was very similar to 2007 levels (around $82m).

Table 3.1 shows trends in TAC and the number of active boats in the fishery since 2006. The number of active boats decreased slightly in the period between 2006 and 2011 (4 per cent), as did total catch. The high percentage of TAC caught in each year indicates that the TAC has been constraining catch in this fishery for the period of analysis.

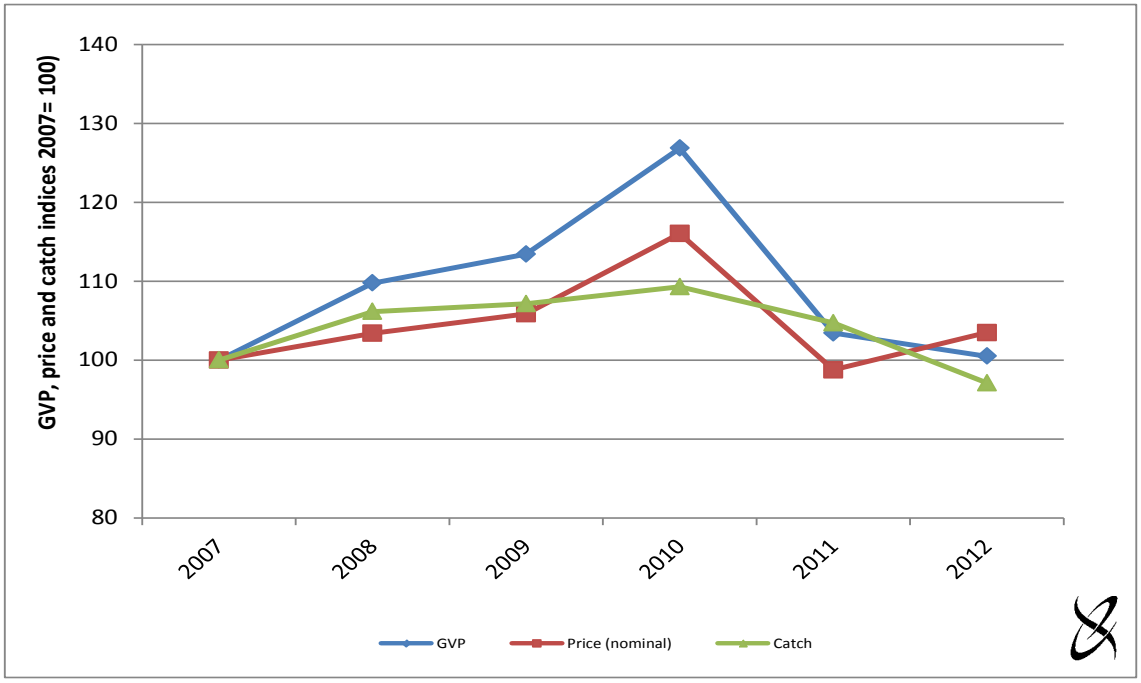
Table 3.1 Catch and value of catch of the Tasmanian Abalone fishery, 2006 to 2012

Year	Total catch (tonnes)	GVP ($m)	Average price - nominal ($/kg)	TAC (tonnes)	% of TAC caught	Active boats (no.)
2006	2,503	n.a.	n.a.	2,503	100%	189
2007	2,433	82	$34	2,503	97%	191
2008	2,583	90	$35	2,594	100%	189
2009	2,607	93	$36	2,604	100%	172
2010	2,660	104	$39	2,660	100%	189
2011	2,548	85	$33	2,566	99%	181
2012	2,363	82	$35	2,366	100%	n.a.

Source: University of Tasmania and EconSearch Analysis

The trends in the value of the fishery over the 5 years, 2007 to 2012, are illustrated in Figure 3.1.

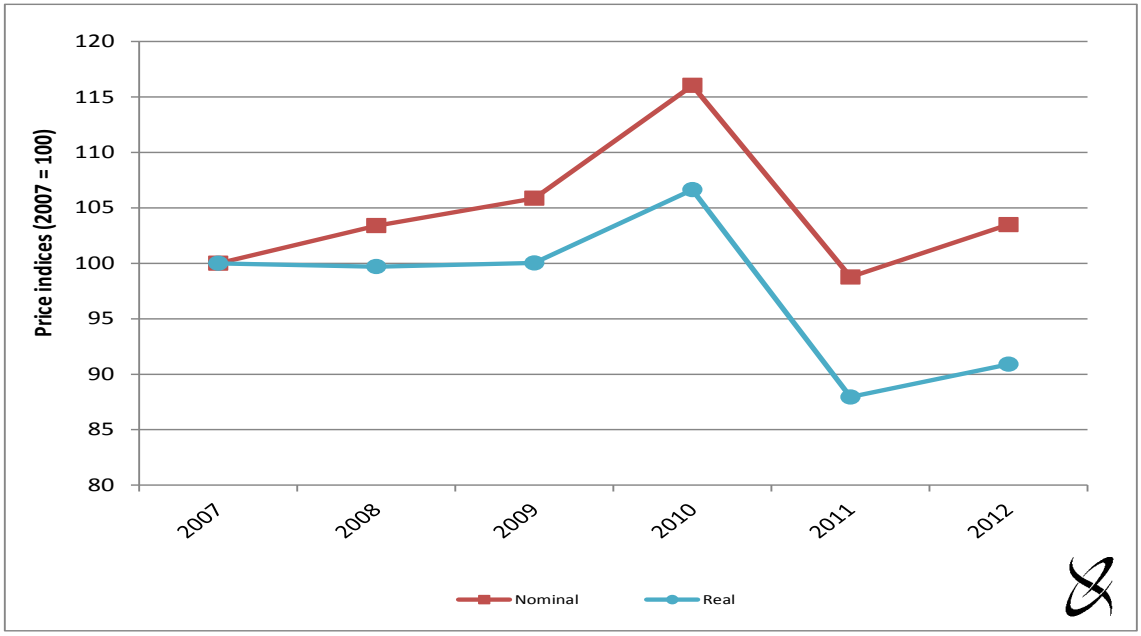
Figure 3.1 GVP, price and catch indices for the Tasmanian Abalone fishery (2007=100)



Source: UTAS pers. comm. and EconSearch Analysis

Figure 3.2 shows that the 3 per cent increase in nominal price between 2007 and 2012 was equivalent to a 9 per cent real price decrease. This means that the value of the Abalone catch in Tasmania in 2012 was 12 per cent lower in real terms than it was in 2007.

Figure 3.2 Price indices for the Tasmanian Abalone Industry (2007=100)[a]



[a] Nominal price refers to the beach price in the current year's dollars. Real price is the nominal price adjusted for the purchasing power of money. The CPI (consumer price index) for Hobart has been used to make this adjustment (ABS 2012a). It enables meaningful comparisons of prices to be made between years.

Source: University of Tasmania, ABS (2012a) and EconSearch analysis

8.2 Economic Objectives of the Abalone Fishery

The policy document for the Tasmanian Abalone Management Plan outlines key policy objectives and management strategies for the Tasmanian Abalone Fishery (DPIWE 2000). The objectives relate to a variety of social, environmental and economic goals, which have potential to impact on or be impacted by the economic status of the fishery. Objectives relating specifically to the economic status of the fishery are detailed below.

Sustaining Yield and Economic Return Objectives

- To take abalone at or above a size likely to result in the best use of the yield from the fishery.
- To protect abalone below the minimum legal size.
- To maintain economic returns by restricting the level of catch and the number of participants in the commercial fishery.

Cost Recovery and Return to Community Objectives

- To recover the Government's operating costs for the abalone fishery (commercial and recreational) from the participants through the fees agreed in the Abalone Deeds of Agreement, and licence fees from holders of abalone quota, commercial abalone divers and recreational licences.
- To recover a proportion of the resource rent generated by the commercial abalone fishery through the fees agreed in the Abalone Deeds of Agreement and licence fees from holders of abalone quota licences.

8.3 Financial Performance Indicators

The major measures of the financial performance of the surveyed boats in the Tasmanian Abalone fishery for 2011/12 are shown in Table 3.2. The table presents two sets of results based upon the same 37 survey responses. For the licence holder, total boat gross income ($841,984) includes all income received from the sale of Abalone (i.e. volume by beach price minus the royalty). Crew wages are calculated as net diver income minus other operating costs incurred by the diver plus deck hand wages. Other operating costs incurred by the diver in the operation of the fishing business, such as fuel and mothership fees are included separately. The calculation of licence value in the first column was based on the total number of quota units used by the fishing business. Because the majority of survey respondents were divers, there is limited information available on the operational or fixed costs associated with being an external licence holder, and it is possible that some costs associated with being an external licence holder have been understated.

For the diver, total boat gross income includes all money received as a dive fee, plus any income received by the diver on quota that they own themselves (royalties are subtracted). Labour costs include deckhand wages and any unpaid labour by the diver or diver's family in the operations of the business. Other operating costs incurred by the diver in the operation of the fishing business, such as fuel and mothership fees are included separately. The licence value for divers represents the value of quota units and entitlements owned by the diver.

Due to the large sample size it was possible to divide the survey responses into four groups (quartiles) according to rate of return to capital. The first quartile comprises the 25 percent of responses with the lowest rate of return and the fourth quartile includes the 25 per cent with the highest rate of return to capital. These disaggregated results for licence holders and divers are shown in Table 3.3 and Table 3.4 respectively.

Table 3.2 Financial performance in the Tasmanian Abalone Fishery (average per fishing business) [a], 2011/12

		Licence Holder			Diver		
		Average per fishing business	average per kg	Share of TBCC[b]	Average per fishing business	average per kg	Share of TBCC[b]
	Total Boat Gross Income (before Royalty)	$916,446	$36.49		$253,252	$10.08	
	Royalty	$74,461	$2.96		$7,577	$0.30	
(1)	**Total Boat Gross Income (after Royalty)**	**$841,984**	**$33.52**		**$245,674**	**$9.78**	
	Variable Costs						
	Fuel	$26,203	$1.04	14%	$26,203	$1.04	18%
	Mothership fees	$7,562	$0.30	4%	$7,562	$0.30	5%
	Repairs & Maintenance [c]	$11,923	$0.47	6%	$11,923	$0.47	8%
	Ice	$73	$0.00	0%	$73	$0.00	0%
	Provisions	$1,726	$0.07	1%	$1,726	$0.07	1%
	Labour - paid	$106,727	$4.25	55%	$33,015	$1.31	23%
(2)	- unpaid [d]	$0	$0.00	0%	$14,918	$0.59	11%
	Other	$6,455	$0.26	3%	$6,455	$0.26	5%
(3)	**Total Variable Costs**	**$160,668**	**$6.40**	**83%**	**$101,875**	**$4.06**	**72%**
	Fixed Costs						
	Licence Fee	$2,249	$0.09	1%	$2,249	$0.09	2%
	Insurance	$6,099	$0.24	3%	$6,099	$0.24	4%
(4)	Interest	$8,840	$0.35	5%	$8,840	$0.35	6%
(5)	Labour - unpaid [d]	$0	$0.00	0%	$7,443	$0.30	5%
	Legal & Accounting	$2,909	$0.12	2%	$2,909	$0.12	2%
	Telephone etc.	$2,146	$0.09	1%	$2,146	$0.09	2%
	Slipping & Mooring	$2,899	$0.12	1%	$2,899	$0.12	2%
	Travel	$2,748	$0.11	1%	$2,748	$0.11	2%
	Office & Admin	$1,733	$0.07	1%	$1,733	$0.07	1%
	Leasing	$3,105	$0.12		$3,105	$0.12	
(6)	**Total Fixed Costs**	**$32,727**	**$1.30**	**17%**	**$40,170**	**$1.60**	**28%**
(7)	**Total Boat Cash Costs (3 + 6)**	**$193,395**	**$7.70**	**100%**	**$142,045**	**$5.66**	**100%**
	Boat Gross Margin (1 - 3)	**$681,316**	**$27.13**		**$143,800**	**$5.73**	
(8)	**Total Unpaid Labour (2 + 5)**	**$0**	**$0.00**		**$22,362**	**$0.89**	
	Gross Operating Surplus (1 - 7 + 8)	**$648,589**	**$25.82**		**$125,991**	**$5.02**	
(9)	**Boat Cash Income (1 - 7)**	**$648,589**	**$25.82**		**$103,629**	**$4.13**	
(10)	**Depreciation**	**$28,047**	**$1.12**		**$28,047**	**$1.12**	
(11)	**Boat Business Profit (9 - 10)**	**$620,543**	**$24.71**		**$75,583**	**$3.01**	
(12)	**Profit at Full Equity (11 + 4)**	**$629,382**	**$25.06**		**$84,422**	**$3.36**	
	Boat Capital						
(13)	Fishing Gear & Equip	$247,546	$9.86		$247,546	$9.86	
	Licence Value	$6,407,491	$255.11		$727,568	$28.97	
(14)	**Total Boat Capital**	**$6,655,037**	**$264.97**		**$975,113**	**$38.82**	
	Rate of Return on Fishing Gear & Equip (12 / 13 * 100)	**n.a.**			**34.1%**		
	Rate of Return on Total Boat Capital (12 / 14 * 100)	**9.5%**			**8.7%**		
	Quota units owned by diver	4			4		
	Quota units owned by Licence Holder/ externally	32			32		
	Quota units fished	**36**			**36**		
	Catch (kg)	**25,117**			**25,117**		

[a] Financial performance estimates for Financial performance estimates for 2011/12 are based on the 2012/13 survey of licence holders. The figures presented in each column of Table 3.3. are based on the same survey data. The distinction between the two columns is described at the start of Section 3.3.

[b] Total boat cash costs.

[c] Repairs and maintenance costs have been classified as a variable cost although it is noted that some of these costs may be fixed (e.g. regulated maintenance).

[d] Unpaid labour was divided between variable (time spent fishing and on repairs and maintenance) and fixed (management and administrative duties) based on survey responses.

Source: EconSearch analysis

Table 3.3Financial performance in the Tasmanian Abalone fishery (average per fishing business- return to licence holder) [a], 2011/12

		Lowest 25 %		Second Quartile		Third Quartile		Highest 25 %	
		Average per fishing business	average per kg	Average per fishing business	average per kg	Average per fishing business	average per kg	Average per fishing business	average per kg
	Total Boat Gross Income (before Royalty)	$431,287	$37.55	$957,314	$32.01	$1,321,605	$41.40	$951,664	$38.21
	Royalty	$29,479	$2.57	$84,765	$2.83	$98,312	$3.08	$77,323	$3.10
(1)	**Total Boat Gross Income (after Royalty)**	**$401,807**	**$34.98**	**$872,549**	**$29.18**	**$1,223,292**	**$38.32**	**$874,342**	**$35.10**
	Variable Costs								
	Fuel	$19,169	$1.67	$22,107	$0.74	$30,306	$0.95	$31,412	$1.26
	Mothership fees	$3,308	$0.29	$9,292	$0.31	$13,220	$0.41	$3,750	$0.15
	Repairs & Maintenance [c]	$18,040	$1.57	$9,118	$0.30	$8,670	$0.27	$12,808	$0.51
	Ice	$0	$0.00	$111	$0.00	$20	$0.00	$150	$0.01
	Provisions	$1,744	$0.15	$1,978	$0.07	$1,510	$0.05	$1,700	$0.07
	Labour - paid	$51,550	$4.49	$143,348	$4.79	$147,516	$4.62	$77,120	$3.10
(2)	- unpaid [d]	$0	$0.00	$0	$0.00	$0	$0.00	$0	$0.00
	Other	$4,738	$0.41	$9,661	$0.32	$2,666	$0.08	$8,733	$0.35
(3)	**Total Variable Costs**	**$98,549**	**$8.58**	**$195,614**	**$6.54**	**$203,907**	**$6.39**	**$135,673**	**$5.45**
	Fixed Costs								
	Licence Fee	$1,264	$0.11	$1,891	$0.06	$1,930	$0.06	$3,677	$0.15
	Insurance	$4,677	$0.41	$7,947	$0.27	$5,479	$0.17	$6,193	$0.25
(4)	Interest	$3,000	$0.26	$7,000	$0.23	$14,034	$0.44	$9,973	$0.40
(5)	Labour - unpaid [d]	$11,485	$1.00	$29,904	$1.00	$31,923	$1.00	$24,907	$1.00
	Legal & Accounting	$2,075	$0.18	$3,400	$0.11	$3,359	$0.11	$2,685	$0.11
	Telephone etc.	$1,011	$0.09	$1,758	$0.06	$2,363	$0.07	$3,184	$0.13
	Slipping & Mooring	$1,770	$0.15	$2,010	$0.07	$1,428	$0.04	$1,761	$0.07
	Travel	$1,752	$0.15	$3,256	$0.11	$3,027	$0.09	$2,807	$0.11
	Office & Admin	$5,975	$0.52	$2,245	$0.08	$1,300	$0.04	$2,625	$0.11
	Leasing	$0	$0.00	$2,778	$0.09	$4,740	$0.15	$4,250	$0.17
(6)	**Total Fixed Costs**	**$33,009**	**$2.87**	**$62,189**	**$2.08**	**$69,582**	**$2.18**	**$62,061**	**$2.49**
(7)	**Total Boat Cash Costs (3 + 6)**	**$131,558**	**$11.45**	**$257,804**	**$8.62**	**$273,489**	**$8.57**	**$197,734**	**$7.94**
	Boat Gross Margin (1 - 3)	**$303,258**	**$26.40**	**$676,934**	**$22.64**	**$1,019,385**	**$31.93**	**$738,669**	**$29.66**
(8)	**Total Unpaid Labour (2 + 5)**	**$11,485**	**$1.00**	**$29,904**	**$1.00**	**$31,923**	**$1.00**	**$24,907**	**$1.00**
	Gross Operating Surplus (1 - 7 + 8)	**$281,734**	**$24.53**	**$644,649**	**$21.56**	**$981,726**	**$30.75**	**$701,514**	**$28.17**
(9)	**Boat Cash Income (1 - 7)**	**$270,249**	**$23.53**	**$614,745**	**$20.56**	**$949,803**	**$29.75**	**$676,607**	**$27.17**
(10)	**Depreciation**	**$28,047**	**$2.44**	**$28,047**	**$0.94**	**$28,047**	**$0.88**	**$28,047**	**$1.13**
(11)	**Boat Business Profit (9 - 10)**	**$242,203**	**$21.09**	**$586,698**	**$19.62**	**$921,757**	**$28.87**	**$648,561**	**$26.04**
(12)	**Profit at Full Equity (11 + 4)**	**$245,203**	**$21.35**	**$593,698**	**$19.85**	**$935,791**	**$29.31**	**$658,533**	**$26.44**
	Boat Capital								
(13)	Fishing Gear & Equip	$367,352	$31.98	$297,978	$9.96	$147,820	$4.63	$206,038	$8.27
	Licence Value	$2,484,714	$216.34	$536,000	$17.92	$553,167	$17.33	$677,333	$27.19
(14)	**Total Boat Capital**	**$2,852,066**	**$248.32**	**$833,978**	**$27.89**	**$700,986**	**$21.96**	**$883,372**	**$35.47**
	Rate of Return on Fishing Gear & Equip (12 / 13 * 100)	**66.7%**		**199.2%**		**633.1%**		**319.6%**	
	Rate of Return on Total Boat Capital (12 / 14 * 100)	**5.4%**		**9.2%**		**11.5%**		**14.1%**	
	Quota units owned by diver	12		1		2		2	
	Quota units owned by Licence Holder/ externally	8		46		45		28	
	Quota units fished	**20**		**48**		**46**		**30**	
	Catch (kg)	**11,485**		**29,904**		**31,923**		**24,907**	

[a-d] See notes to Table 3.2.

Source: EconSearch analysis

Table 3.4Financial performance in the Tasmanian Abalone fishery (average per licence fishing business- return to diver) [a], 2011/12

		Lowest 25%		Second Quartile		Third Quartile		Highest 25%	
		Average per fishing business	average per kg	Average per fishing business	average per kg	Average per fishing business	average per kg	Average per fishing business	average per kg
(1)	Total Boat Gross Income (before Royalty)	$138,666	$6.81	$302,652	$13.38	$309,296	$14.33	$261,479	$7.51
	Royalty	**$0**	$0.00	**$14,607**	$0.65	**$14,679**	$0.68	**$1,679**	$0.05
(1)	**Total Boat Gross Income (after Royalty)**	**$138,666**	**$6.81**	**$288,045**	**$12.74**	**$294,617**	**$13.65**	**$259,800**	**$7.46**
	Variable Costs								
	Fuel	**$25,574**	$1.26	**$35,904**	$1.59	**$24,525**	$1.14	**$19,547**	$0.56
	Mothership fees	**$6,744**	$0.33	**$5,536**	$0.24	**$12,738**	$0.59	**$5,463**	$0.16
	Repairs & Maintenance [c]	**$11,901**	$0.58	**$21,809**	$0.96	**$7,997**	$0.37	**$6,580**	$0.19
	Ice	**$167**	$0.01	**$111**	$0.00	**$22**	$0.00	**$0**	$0.00
	Provisions	**$2,111**	$0.10	**$2,528**	$0.11	**$1,033**	$0.05	**$1,280**	$0.04
	Labour - paid	**$23,502**	$1.15	**$30,826**	$1.36	**$36,819**	$1.71	**$40,121**	$1.15
(2)	- unpaid [d]	**$15,196**	$0.75	**$15,701**	$0.69	**$10,241**	$0.47	**$18,174**	$0.52
	Other	**$8,407**	$0.41	**$6,572**	$0.29	**$6,399**	$0.30	**$8,301**	$0.24
(3)	**Total Variable Costs**	**$93,602**	**$4.59**	**$118,987**	**$5.26**	**$99,774**	**$4.62**	**$99,465**	**$2.86**
	Fixed Costs								
	Licence Fee	**$15,196**	$0.75	**$15,701**	$0.69	**$10,241**	$0.47	**$18,174**	$0.52
	Insurance	**$8,407**	$0.41	**$6,572**	$0.29	**$6,399**	$0.30	**$8,301**	$0.24
(4)	Interest	**$1,619**	$0.08	**$1,921**	$0.08	**$3,029**	$0.14	**$2,408**	$0.07
(5)	Labour - unpaid [d]	**$6,483**	$0.32	**$9,075**	$0.40	**$4,642**	$0.22	**$4,386**	$0.13
	Legal & Accounting	**$8,530**	$0.42	**$12,422**	$0.55	**$5,578**	$0.26	**$8,830**	$0.25
	Telephone etc.	**$1,788**	$0.09	**$2,511**	$0.11	**$4,172**	$0.19	**$3,140**	$0.09
	Slipping & Mooring	**$2,748**	$0.13	**$1,703**	$0.08	**$2,511**	$0.12	**$1,673**	$0.05
	Travel	**$2,128**	$0.10	**$2,093**	$0.09	**$1,574**	$0.07	**$1,198**	$0.03
	Office & Admin	**$1,855**	$0.09	**$3,247**	$0.14	**$3,150**	$0.15	**$2,740**	$0.08
	Leasing	**$0**	$0.00	**$0**	$0.00	**$0**	$0.00	**$0**	$0.00
(6)	**Total Fixed Costs**	**$48,752**	**$2.39**	**$55,245**	**$2.44**	**$41,296**	**$1.91**	**$50,849**	**$1.46**
(7)	**Total Boat Cash Costs (3 + 6)**	**$142,354**	**$6.99**	**$174,232**	**$7.70**	**$141,070**	**$6.54**	**$150,315**	**$4.32**
	Boat Gross Margin (1 - 3)	**$45,065**	**$2.21**	**$169,058**	**$7.48**	**$194,843**	**$9.03**	**$160,334**	**$4.61**
(8)	**Total Unpaid Labour (2 + 5)**	**$21,678**	**$1.06**	**$24,776**	**$1.10**	**$14,883**	**$0.69**	**$22,560**	**$0.65**
	Gross Operating Surplus (1 - 7 + 8)	**$17,991**	**$0.88**	**$138,588**	**$6.13**	**$168,430**	**$7.80**	**$132,045**	**$3.79**
(9)	**Boat Cash Income (1 - 7)**	**-$3,688**	**-$0.18**	**$113,812**	**$5.03**	**$153,547**	**$7.11**	**$109,485**	**$3.15**
(10)	**Depreciation**	**$28,047**	**$1.38**	**$28,047**	**$1.24**	**$28,047**	**$1.30**	**$28,047**	**$0.81**
(11)	**Boat Business Profit (9 - 10)**	**-$31,734**	**-$1.56**	**$85,766**	**$3.79**	**$125,501**	**$5.81**	**$81,438**	**$2.34**
(12)	**Profit at Full Equity (11 + 4)**	**-$30,116**	**-$1.48**	**$87,687**	**$3.88**	**$128,530**	**$5.95**	**$83,846**	**$2.41**
	Boat Capital								
(13)	Fishing Gear & Equip	$267,774	$13.14	$493,163	$21.81	$122,660	$5.68	$120,683	$3.47
	Licence Value	$50,000		$1,559,000		$1,196,222		$167,300	
(14)	**Total Boat Capital**	**$317,774**		**$2,052,163**		**$1,318,882**		**$287,983**	
	Rate of Return on Fishing Gear & Equip (12 / 13 * 100)	**-11.2%**		**17.8%**		**104.8%**		**69.5%**	
	Rate of Return on Total Boat Capital (12 / 14 * 100)	**-9.5%**		**4.3%**		**9.7%**		**29.1%**	
	Quota units owned by diver	0		9		7		1	
	Quota units owned by Licence Holder/ externally	27		25		29		48	
	Quota units fished	**27**		**34**		**35**		**48**	
	Catch (kg)	**20,377**		**22,616**		**21,585**		**34,812**	

[a-d] See notes to Table 3.2.

Source: EconSearch analysis

Income…

Average boat gross income for the surveyed fishing businesses was around $916,000, or $36.49/kg which is close to the average beach price for 2011/12 ($842,000 after deduction of the 8.25 per cent state government royalty). The average boat gross income

received by surveyed divers was around $253,000 ($246,000 after deduction of the state royalty[24]) or $10.08/kg well over the average dive fee in the fishery, which anecdotally sits between $6/kg and $7/kg. The significant difference in income reflects the fact that the majority of divers surveyed own only a small amount of quota (on average around 11 per cent of the total quota fished), and are paid a portion of the beach price in a 'dive fee' to catch the quota for other quota holders.

A large proportion of the survey participants indicated that they were in a better than average position for divers in the fishery, often due to their position in a family business, suggesting that the survey sample may be biased towards divers with a higher ownership of quota. Several divers also indicated that they were able to leverage the quota that they owned to receive a better dive fee than other divers could receive. Divers who own quota are also able to receive the full income for this quota (although they also incur the opportunity cost of capital).

Fishing businesses in the highest quartile for return to total capital to licence holders do not have a significantly higher than average income, or level of catch. Similarly, fishing businesses in the highest quartile for returns to total capital to divers have a slightly higher than average level of income, fishing businesses in the lower quartile have a much lower than average (56 per cent) total boat gross income (Table 3.4).

Costs…

Table 3.2 shows total costs separated into variable and fixed costs. Variable costs (72 per cent of total cash costs for divers) represented a significantly greater proportion of total boat cash costs than fixed costs (28 per cent of total cash costs for divers).

For licence holders, the diver fee, calculated as income received by divers minus operating costs incurred by divers is treated as a cost (Table 3.2). This cost, as well as additional paid labour (i.e. deck hands), together represent the most significant operational cost for licence holders (55 per cent). As described above, only income received by the diver (either as a dive fee or from diver owned quota) is included. Paid labour costs only include additional paid labour (i.e. deck hands). The value of unpaid labour is imputed. Labour (paid and unpaid) is the most significant cost for licence holders (around 39 per cent of operating costs). Other significant costs include fuel (around $1.04 per kg caught), interest around $0.35 /kg of Abalone caught[25], and repairs and maintenance (around $0.47/kg of Abalone caught).

Fishing businesses in the highest quartile (licence holders) have on average lower variable costs than fishing businesses in the other quartiles. This difference is largely due to lower labour costs (Table 3.3). Fishing businesses in the highest quartile (divers) spend significantly less on variable costs such as fuel, mothership fees and repairs and maintenance than the least profitable fishing businesses (Table 3.4). They also spend significantly less on fixed costs such as insurance, unpaid administrative labour, and legal and accounting fees.

24 The royalty was only deducted from the income that divers received for their own quota. Royalty was not deducted from the catch fee that were divers paid.

25 The cost of interest presented here is based on the 2011/12 survey. The interest costs include interest paid by survey participants on quota (on average around 10 percent of the total quota fished) and on boat capital. Interest paid by external licence holders on quota is not included as this information was not collected during the survey process.

Cash Income and Profit…

The separation of variable and fixed costs from total cash costs enables the calculation of boat gross margin (total boat income less total boat variable costs) as a basic measure of profit (assuming that capital has no alternative use and that as fishing activity varies there is no change in capital or fixed costs). Average boat gross margin for licence holders was around $681,000, and average boat gross margin for divers was around $144,000 in 2011/12 (Table 3.2).

Gross operating surplus (GOS) was calculated excluding imputed wages for operator and family members as a cost item. The average GOS of licence holders was estimated to be around $649,000, and for divers was almost $126,000.

Boat cash income is measured as gross operating surplus with imputed wages (unpaid labour) included as cash costs. The estimated average boat cash income in 2011/12 was approximately $649,000 for licence holders and $104,000 for divers.

Gross operating surplus and boat business profit give an indication of the capacity of the operator to remain in the fishery in the short to medium term. In 2011/12, the average boat business profit for licence holders was around $621,000, and around $76,000 for divers.

Profit at full equity is a measure of the profitability of an individual licence holder, assuming the licence holder has full equity in the operation. It is a useful absolute measure of the economic performance of fishing firms. Profit at full equity in 2011/12 was around $629,000 for licence holders and $84,000 for divers.

Measures of profitability are much more variable for divers than they are for licence holders (Table 3.3 and Table 3.4). Divers in the top quartile caught 39 per cent more Abalone than the survey average. The average income per kg for this group is, however below average (around $7.30/kg) at least partially due to the below average ownership of quota by businesses in this quartile. Profit at full equity for these businesses is within one per cent of the survey average, but because businesses in this group have a lower capital investment in fishing gear (50 per cent below average), and in licence (77 per cent below average), the rate of return to total capital is above average. The least profitable quartile receives a lower dive fee ($6.80), and fish less quota than the survey average (19 per cent below average). On average the least profitable quartile is operating at a loss in both boat business profit and profit at full equity. Divers in the second and third quartiles catch a similar volume to the first quartile, but receive a much higher income per kg (at least partially because they own a larger number of units). These two quartiles are more profitable than the highest quartile in all measures of profit, but due to the much larger capital investment have a lower, although still positive, rate of return to total capital. A significant difference between the second and third quartiles is the level of investment in fishing capital (much higher for second quartile businesses).

Return on Investment…

There are a number of interpretations of the concept of return on investment. For the purpose of this analysis it is appropriate to consider the investment as the capital employed by an average licence holder in the fishery. Capital includes boats, licence/quota, fishing gear, sheds, vehicles and other capital items used as part of the fishing enterprise. It does not include working capital or capital associated with other businesses operated by the licence holder. The return on investment has been calculated as the profit at full equity as a percentage of the total capital employed.

The average total investment in fishing gear and licence in the Abalone fishery in 2011/12 was estimated to be almost $6.7 million per fishing business. This included the estimate of the value of the licences of quota used to catch the fish as well as any diving entitlement and fishing equipment owned by the diver. If only the capital owned by the diver is considered, the average total investment in gear and licence is around $975,000 (Table 3.2). The rate of return to total capital was estimated to be slightly higher for licence holders (9.5 per cent) than for divers (8.7 per cent).

Licence values…

The value of licences represents a significant proportion of the capital used by each licence holder in the fishery. The reported licence value for 2011/12 in Table 3.2 represents the licence holders' estimate of the value of their licence based on the 2012 survey responses.

There was a large degree of variability in the licence holders estimates of licence value. Survey respondents estimates of licence value ranged from approximately $140,000 to $240,000 per quota unit. Some of the surveyed licence holders and divers fished parts of licences. Estimates of per boat licence value, based on part or multiple licence, varied from around 16 million to 1.5 million.

Table 3.5 Sensitivity of rate of return to changes in licence value, 2011/12 [a]

Licence Value ($/ quota unit)	$87,000	$174,000	$261,000
Rate of Return to Total Capital (%)	18.2%	9.5%	6.4%

[a] Based on the licence value estimated for 2011/12 and values 50 per cent above and below this estimate.

Source: EconSearch analysis

Based on the costs and returns shown for the year 2011/12 in Table 3.2, a quota unit value of $87,000 (approximately 50 per cent below the licence value estimated for 2011/12) would mean an annual return to the total asset of 18.5 per cent, while a quota unit value of $261,000 (approximately 50 per cent above the licence value estimated for 2011/12) would mean an annual rate of return to the total asset of 6.4 per cent (Table 3.5).

8.4 Economic Rent

Economic rent[26] is defined as the difference between the price of a good produced using a natural resource and the unit costs of turning that natural resource into the good. In this case the natural resource is the Abalone fishery and the good produced is the landed Abalone.

The unit costs or long term costs all need to be covered if the licence holder is to remain in the fishery. These long-term costs include direct operating costs such as fuel, labour (including the opportunity cost of a self employed fisher's own labour), ice, overheads such as administration and licences and the cost of capital invested in the boat and gear (excluding licence). Capital cost includes depreciation and the opportunity cost of the capital applied to the fishery. The opportunity cost is equivalent to what the fisher's investment could have earned in the next best alternative use.

Determining the opportunity cost of capital involves an assessment of the degree of financial risk involved in the activity. For a risk-free operation, an appropriate opportunity cost of capital might be the long-term real rate of return on government bonds. The greater the risks involved, the greater is the necessary return on capital to justify the investment in that particular activity. For this analysis the long term (10 year) real rate of return on government (treasury) bonds of 5 per cent has been used and a risk premium of 5 per cent has been applied.

Perceptions of exposure of the industry to risk are subjective and include considerations such as the security of the Deed, exposure to exchange rate fluctuations, general price volatility, potential problems of resource sustainability such as has occurred with disease elsewhere and political risk in export countries. Given this it is possible to argue for a higher or lower risk premium than is applied here.

What remains after the value of these inputs (labour, capital, materials, services) has been netted out is the value of the natural resource itself. The economic rent generated in the Tasmanian Abalone fishery was estimated at $64.9 million in 2011/12 (Table 3.6). Of this rent, $6.9 million, or 10.6 per cent) was charged by the State Government as a royalty.

Table 3.6Economic rent in the Tasmanain Abalone fishery 2011/12, ($m)

	Gross Income	Less Labour	Less Cash Costs	Less Depreciation	Less Opportunity Cost of Capital (@10%)	Economic Rent	Royalty
2011/12	82.4	9.6	5.3	2.5	2.2	62.8	6.7

[26] Economic rent is comprised of three types of rent: entrepreneurial rent, quasi-rent and resource rent. As in any business some operators are more skilful than others and will therefore earn more profit. These profits, which are one component of economic rent, are *entrepreneurial rents*. In the short-term fishers may earn large surpluses over costs, which may provide prima facie evidence of substantial resource rents. However, there are some circumstances where such surpluses can occur but they are not true rents. These are referred to as *quasi-rents*. One example is where a fishery is developing or recovering and there may be under-investment in the fishery. Another example is where there is a short-term but unsustainable increase in price due to, for example, exchange rate fluctuations. However, some profits will be obtained because the natural resource being used (i.e. the fishery) has a value. These profits are described as *resource rents* and are also a component of economic rent.

Source: EconSearch analysis

When an economic rent is generated in a fishery and there are transferable licences, the rent represents a return to the licences, which affects their value when traded in a market. The aggregate value of diving entitlements in 2011/12 was estimated to be approximately $18 million (123 entitlements with an average value of $146 000 per entitlement). The value of quota in the fishery was estimated to be $609 million (3,500 quota units with an average value of approximately $174,000 per unit).

An annual Economic rent of $62.8 million represents a rate of return of 10.0 per cent to the capital value of the fishery.

9. Other Economic Indicators

9.1 Factors Influencing the Economic Condition of the Abalone Fishery

There were a number of factors in 2011/12 that impacted on the economic performance of the fishery. Most of these are likely to continue to affect economic outcomes for the fishery in the future.

9.1.1 Catch fees, (Felmingham Report)

A large number of divers expressed concerns that catch fees paid by licence holders to divers are not sufficient to cover operational and capital costs. This issue was investigated several years ago in the industry commissioned 'Felmingham report' which found that the average rates paid to divers were insufficient to cover their operational costs.

9.1.2 Fishery stock assessment

The 2011 Abalone Fishery Assessment (Tarbarth and Gardner 2012) includes a stock assessment for each zone of the fishery. Changes in stock abundance and productivity affect the catch that can be taken from regions which changes revenues. Stock abundance also affects regional catch rates and thus the cost of harvesting. These stock changes potentially have a profound impact on economic performance of both the commercial and recreational fisheries and are covered in detail in the fishery assessment.

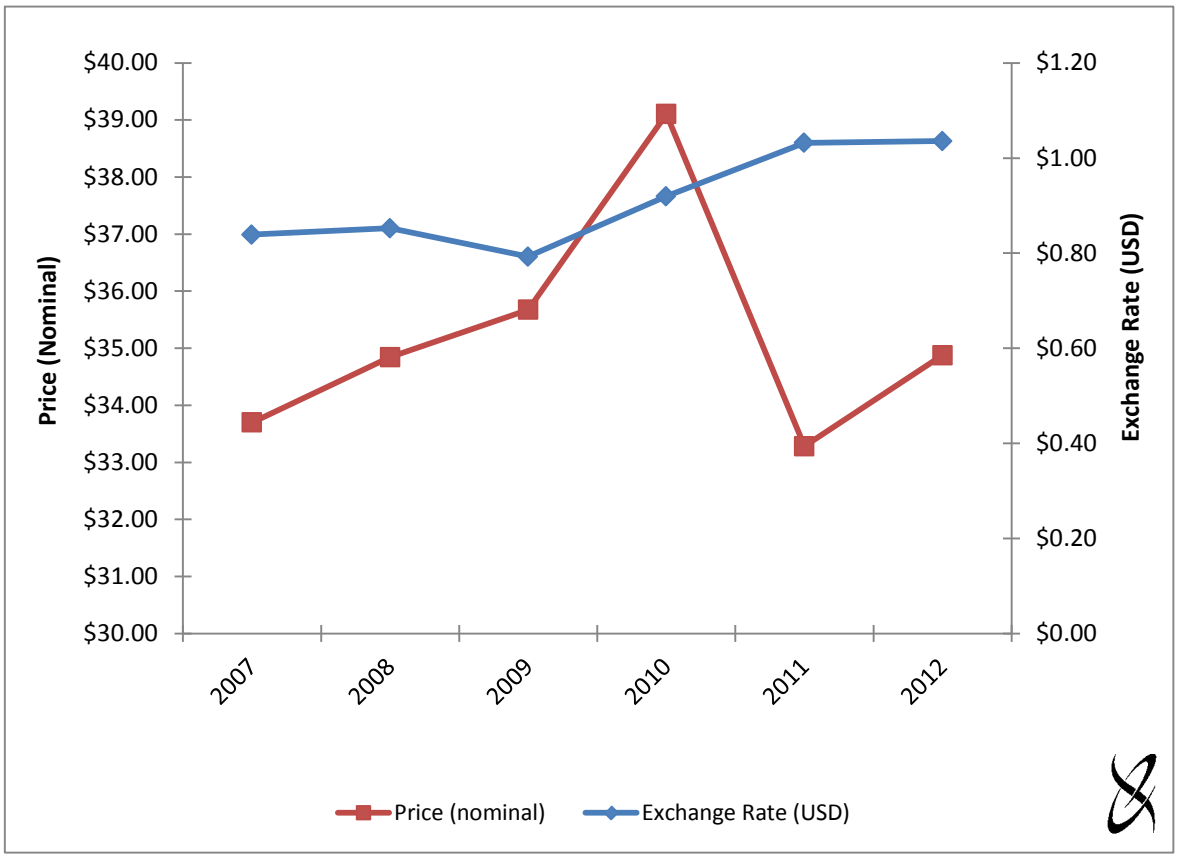
9.1.3 Exchange rates

A large proportion of the Tasmanian Abalone catch is exported overseas. Accordingly, the value of the Australian dollar can have a significant impact on the economic performance of the fishery. The value of the Australian dollar influences the price of Australian exports overseas. Significant changes in the value of the Australian dollar have the potential to influence the demand for Australian Abalone exports. The Australian dollar generally remained high in 2011/12, typically valued above or very close to parity with the US dollar. Several survey participants commented on the downward pressure the high Australian dollar was placing on the price of Abalone.

The average exchange rate in 2012 was US$1.04, 27 per cent higher than in 2007 (Figure 4.1). Other things held equal, a rise in the value of the currency would have the effect of decreasing the price of Abalone received by Australian exporters between 2007 and 2012.

The relationship between the price of Abalone and the exchange rate between 2007 and 2012 can be readily observed in Figure 4.1. A widely used measure of the relationship between two variables, such as price and exchange rate, is the coefficient of correlation. The coefficient of correlation can range in value from +1.0 for a perfect positive correlation to –1.0 for a perfect inverse correlation. The coefficient of correlation between the exchange rate (USD) and the average price for Tasmanian Abalone for the period 2007 to 2012 is –0.16. This indicates that there is a weak inverse relationship between the two variables. Thus, when the Australian dollar appreciates, as it did over the last five years, there is, generally, a corresponding decline in the average price of Tasmanian Abalone.

Figure 4.1 Exchange rate (USD) and price for Tasmanian Abalone, 2007 to 2012



Source: UTAS and RBA (2012 and previous issues)

9.2 Licence Holder Comments

Participants in the 2012 survey were invited to make comments about the fishery, including any concerns they might have about the social, ecological or economic performance of the fishery. The respondents raised a variety of issues, with the most common economic concerns related to the catch fee paid to divers, and the high

exchange rate. The most common environmental concern related to localised overfishing. A summary of the key issues raised during the survey follows.

Catch fee

A large number of participants in the survey (more than half) expressed concern that the catch fee paid to divers was too low, both in terms financial viability and return to effort and skill.

Divers who owned their own quota tended to be much better off financially and many of these divers commented on the difficulties faced by divers who did not own their own quota.

Deck hand wages

Several divers commented that they were unable to pay their deck hands as much as they wanted to. It was commented by several divers that deckhands were highly skilled, and that their position on the boat was one of great responsibility.

Zoning

A few licence holders mentioned that the zoning system had not been able to achieve the goal of reducing localised overfishing. The participants who criticised the zoning system acknowledged that the idea made sense, but criticised the mechanism for being too coarse and too slow to respond to changes in fish stocks. A couple of licence holders suggested that in some cases it actually worsened the overfishing problem as it prevented licence holders from being able to direct their effort to where the fish stocks were most abundant.

Overfishing

A few divers indicated that historical overfishing had been detrimental to fish stocks, and that the fishery had not yet recovered.

A significant number of divers expressed a strong concern regarding the health of stocks in the Eastern Zone, many of these divers felt that quota cuts had not been aggressive enough to remedy the problem. A couple of divers indicated that while the stocks of catchable fish were still low there were some signs of recovery (increased numbers of smaller fish).

Size limits

Opinions on the usefulness of size limits were mixed. Some survey respondents indicated that the higher size limits used in the past had created great gains for the health of fish stocks, and that they should be introduced. Others felt that increasing the size limits would not create any benefit for the fish stocks, and would only serve to make fishing operations less profitable.

Overfishing

There were mixed opinions expressed about which, if any, zones were being overfished. However a significant number of survey participants expressed concern about at least some areas being over exploited.

Representation

A few licence holders suggested that representation of divers on the Tasmanian Abalone Council was not adequate, and that licence holders and processors dominated decision making.

Climate change

Several licence holders indicated that they felt that climate change posed a significant threat to the future of the fishery. The sensitivity of Abalone to temperature fluctuations exposes the fishery to this threat. A small change in ocean temperatures could have a significant effect on the health of fish stocks.

Fleet dynamic

A number of divers indicated that they had little control over the times when they fished due to the high concentration of power by a few processors. They highlighted the key problems with this being a lack of independence, and an increasing pressure on divers to fish when in less safe conditions increasing risk. This issue is relevant to fishery economic performance because this regulation of the fleet dynamic affects revenue (because processors target higher value product) and decouples fishing effort from density (because divers have less ability to distribute their effort based on catch rate).

Safety (Risk)

Several participants in the survey commented on the high level of risk borne by fishing operators. Many divers expressed the opinion that the high level of capital required to operate a fishing business meant that divers were at least as exposed to the financial risk of investing in the fishery as licence holders. In addition, many licence holders commented that they also bore significant risk to their equipment and their own safety as part of the fishing operation. In theory, increased risk incurred by divers should increase the wages they receive as a kind of risk premium. However, there was no evidence that this occurred.

Paper work

Several licence holders commented on the high or increasing burden of paperwork in the fishery. They commented that it made the whole operation much slower and more tedious. The comment that this workload is increasing suggests that the proportion of unpaid labour may be changing through time.

Search costs

Another aspect of unpaid labour is the significant amount of time and energy spent by some divers searching for quota to fish. Several divers commented that this part of the business can be as time consuming as the actual fishing.

Stock effect

A number of licence holders indicated that decreased catch rates was their primary concern. Lower catch rates result in higher per unit costs, and these were increasing. Several divers commented that the costs of decreased catch rates were born entirely by the diver and not by the licence holder because the market for diving labour was unresponsive to cost. These differing incentives led to differences in opinion regarding the optimal strategy for setting quota (divers tended to be more in favour of quota reductions than licence holders).

Research

A few licence holders commented that researchers could benefit from a closer relationship with divers (in particular divers who had been involved in the industry for extended periods). Some of the older licence holders have been in the fishery for more than thirty years and could play an important part in informing directions of research or informing current research.

Market risk

In addition to concern about the exchange rates, a few fishers commented on the dependency of the fishery on demand from China. They thought it was necessary to diversify the markets. Others commented that the tariffs were too high and were making it difficult for Abalone exporters. It was suggested that a free trade agreement would be beneficial to the industry.

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