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The Victorian professional fishing survey, aquaculture assessment and regional economic results.

Appended Report to the FRDC project FRDC 2017-092: *Victoria's fisheries and aquaculture: economic and social contributions*, University of Technology Sydney.

By ANCORS, University of Wollongong

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Australian National Centre for Ocean Resources and Security (ANCORS), University of Wollongong is Australia's only multi-disciplinary university-based centre dedicated to research, policy advice and education on national and international ocean law, marine resource management and conservation and maritime security and cooperation. ANCORS has forged a strong national and international reputation as the foremost centre for oceans research, and has long term working relationships with a large number of government departments and international organizations in training and education in the Asia Pacific region.

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Project contact: Professor Alistair McIlgorm, ANCORS, UOW.

Email: amcilgor@uow.edu.au

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1 Introduction

This report is further background material to the Fisheries Research and Development Corporation (FRDC) project FRDC 2017-092: Victoria's fisheries and aquaculture: economic and social contributions, University of Technology Sydney (Abernethy et al. 2020). Sections 2 and 3 report the survey results of the Victorian professional fishing sector and the Victorian aquaculture sector. Section 4 reports the regional economic analysis associated with the results undertaken by Western Research Institute (WRI 2019).

2 The Victorian professional fishery economic survey

This section summarises the methods and results of an economic survey of operators in Victorian professional wild catch fisheries. A state-wide economic survey was conducted by interviewers to professional fishing businesses operating in the 2016-17 financial year, who had indicated a willingness to participate in the survey. The purpose of the survey was to collect data on fishing business costs and income in order to determine the contribution of fishing businesses to regional economies. The interviewees had a reassurance the survey was conducted under University approved ethics processes, which had protocols to protect fisher confidentiality. For more details on the methods see Section 4.5.2 of the main report.

2.1 Fishing operator survey

The economic survey had 46 responses from an estimated 200-250 businesses operating at the time of the interviews - a 18.4-23% response rate. In 2016-17 there were 643 professional fishing licence holders however in many cases a fishing business operates multiple licences. All responses were deemed useable. Assuming a 18.4% response rate, the businesses interviewed had a total revenue of \$17,252,022, approximately 31.7% of the total wild catch state-wide revenue of \$54,362,000 (ABARES 2016-17).

The original proposal to the FRDC proposed an analysis of seven regions covering the whole Victorian coast. For the areas to the east and west of Melbourne it was found that ABS data areas and numbers of fishing vessels at different ports made two regions on the west coast and two for the east coast appropriate, making five regions in all. This regional coverage was achieved and the Input-output (IO) model was used to do the regional economic analysis for these five regions.

A sample is assumed to be reasonably representative of the total population being studied, but as indicated above, the businesses responding to the survey had a higher level of business activity as indicated by their fishing revenues. There is likely an unknown degree of respondent bias arising from more active businesses participating in the survey. The survey results are from a diverse range of businesses and so averages should be interpreted with caution.

2.2 Appraising economic viability

Fishing enterprise viability can be estimated through accounting data collected in a business survey. This gives an accounting view of a firm's individual performance but is not appropriate for measuring performance across different businesses in the fishing industry, or between fishing and other industries. Economists adjust accounting data to give economic profit which is an economic performance measure that can be compared with other industries in the whole economy.

While it would be desirable to calculate economic profit for each fishery in Victoria, the limited survey response rate for individual fisheries required fisheries to be combined. The results are therefore for

businesses with the following endorsements; Southern rock lobster – eastern zone (RLE), Southern rock lobster – western zone (RLW), abalone (all zones) (AB), restricted access 1 (RA1) and restricted access 2 (RA2).

The group AB comprised of five abalone diver business responses which did not enable further sub-division into different licence categories by zone due to conventions about confidentiality of business entity data in fisheries which general preclude disaggregating to less than five responses. The two restricted access fishing businesses comprised the remainder of the Victorian State professional fishing businesses, who primarily catch finfish. These were divided into two groups to reflect the differing amount of capital in businesses and size of vessel, often being much smaller for inshore and bay fisheries. The Restricted access 1 category included fishing businesses who fished for wrasse, pipi collectors, bait fishers, and Bay and Inlet fishers in Gippsland Lakes, Corner Inlet and Port Phillip Bay. Restricted access 2 businesses included inshore trawlers and ocean access fisheries with some of these businesses also fishing using Commonwealth entitlements, which we have apportioned out by asking the operators to apportion State and Commonwealth fish catch revenue. RA2 had higher capital invested in these fishing operations.

The residual of Total Revenue less Operating Costs is Operating Profit. Depreciation and the opportunity cost of capital are deducted to give economic profit or loss (George and New 2013, Econsearch 2013, 2014). In the study a 7% opportunity cost of capital was included in costs and an estimate of the opportunity cost of labour, including unpaid labour was made (George and New 2013). Fisheries management charges and licences are included in operational costs even though they are not necessarily a factor of production being a transfer payment from industry to government in respect of access and management services. The recoverable portion of management costs are treated as management fees and we exclude other costs of management that are born by the government from the analysis (George and New 2013). Depreciation was calculated on a straight line basis using accounting information provided in the survey on the current market values, the original or replacement cost and the age of capital items attributable to each fishing business. This was adjusted to an economic depreciation estimate to compensate for any distortions caused by the tax system.

2.3 Victorian Fisheries Profitability Results

We report the business revenue by fishery licence category (RLE, RLW, AB, RA1 and RA2) in Table 1.

Table 1. Respondent numbers, average business revenue and range of revenues for the five operating groups in the Victorian fishery

Licence category	Respondent numbers	Average revenue (\$)
RA1	17	\$230,886
RA2	8	\$538,249
RLE	8	\$176,064
RLW	8	\$665,056
AB (divers)	5	\$226,434
	46	

Source: Economic Questionnaire, 2018

The variety of businesses categories and activity levels among fishers are evident. The majority of the survey respondents engaged in restricted access fisheries (RA1) fishing with 17 of the 46 surveys (36%) with businesses operating in this group.

2.4 Accounting measures

The survey accounting revenues and cost results are reported in Table 2.

Table 2. The accounting revenues and costs for a representative fishery in each of five operating groups

\$	Restricted Access 1	Restricted Access 2	Rock Lobster East (days)	Rock Lobster West (Days)	Abalone (DAYS)
Gross revenue	\$ 230,866	\$ 538,249	\$ 176,064	\$ 665,056	\$ 226,434
Total direct costs	102,450	270,616	53,108	183,428	91,416
Total Fixed Costs	\$ 53,189	\$ 41,848	\$ 55,297	\$ 268,794	\$ 25,339
Total costs	\$ 155,638	\$ 312,464	\$ 108,406	\$ 452,222	\$ 116,755
Gross Operating Profit	\$ 75,227	\$ 225,785	\$ 67,658	\$ 212,834	\$ 109,680
These costs include:					
*wages	\$ 34,991	\$ 183,772	\$ 16,840	\$ 96,752	\$ 69,167
* Interest	\$ 9,569	\$ 1,326	\$ 648	\$ 25,760	\$ 2,000
\$	Restricted Access 1	Restricted Access 2	Rock Lobster East (days)	Rock Lobster West (Days)	Abalone (DAYS)
Gross revenue	100%	100%	100%	100%	100%
Direct costs	44%	50%	30%	28%	40%
Fixed costs	23%	8%	31%	40%	11%
Total costs	67%	58%	62%	68%	52%
Gross Operating Profit	33%	42%	38%	32%	48%

Source: Economic Questionnaire, 2018

The results report that direct operating expenses, such as bait, fuel, boat repairs, fishing gear repairs, freight costs and wages to employees are between 28% and 50% of revenue in the five activity groups RLE, RLW, AB, RA1 & RA2. Indirect costs such as boat and vehicle registrations, insurance, fishery management charges, rates, bank and business administration expenses were between 8-40% of revenue, making total operational costs between 52-68% of total revenue.

The wages recorded are for both owner operators and employees. Where wages provided in the survey responses did not also cover those of the owner operator, these were imputed on the basis of information provided on fishing income as well as fishing effort. Wages accounted for between 9-34% of revenue for businesses. Operating profit in the five groups was between 32-48% of total revenue. Conclusions on long run commercial viability are difficult to draw from accounting data alone and hence certain economic adjustments have to be made to determine more meaningful profitability results, as seen in an economic rate of return.

2.5 Economic results

The economic analysis differs from the accounting analysis because it includes opportunity costs of capital and labour. This means that an economic surplus would return more than normal profits and it is this (or lack of it) that causes businesses to enter (or leave) the industry. This measure is for the data collected for 2016/17 and does not provide an indication of the underlying health or sustainability of the fish resources.

Wild catch professional fisheries in Victoria have several different management approaches with all fisheries restricted by licences or quantitative limits. Firstly there are the restricted inshore and ocean Victorian State fisheries. Then there are the quantitatively restricted Individual transferable quota (ITQ) fisheries, such as Southern rock lobster and abalone.

With the development of ITQ systems, over time there has been a reduction in the number of owner-operators, and we see an increasing separation between the operators (fishers and divers) and the quota ownership (often a third party investor). This leads to some businesses being quota owner-operators and others with fishers just being operators, fishing the quota owned by others on a lease or contract agreement.

The survey found that the results for rock lobster still had a significant number of owner-operators in the fishery, with leasing also taking place. However, in the abalone fishery there were fewer owner-operators. Instead, divers are employed to take the catch at an agreed rate contracted with the owner as a commercial transaction. The results for ITQ fisheries, rock lobster fishers and Abalone divers, are presented in separate sections.

Restricted fisheries 1 and 2

RA1 and RA2 fisheries are those not under ITQ management. The RA1 (wrasse, pipi, bait, and Bay and Inlet) and RA2 (inshore trawl and ocean access fisheries). RA1 fishing businesses were significantly different to the more highly capitalised RA2 fishing operations. There was diversity within these groups and the researchers were careful to apportion out Commonwealth fishing activity by some of the ocean vessels operating in the east and west of the state.

Southern rock lobster

The rock lobster fishery is divided into two fisheries for the purpose of management: an eastern and a western zone.

The Eastern Zone

In 2016-17 the total allowable catch (TAC) was 59t, but only 52t was caught due to arrangements with an oil and gas company who were undertaking seismic testing activities on rock lobster fishing grounds. However, there were 121,000 pot lifts, a substantial increase on past seasons (VFA 2018). The catch per unit effort (CPUE) was 0.63 kg a pot lift in 2012/13, but this had fallen to 0.45kg per pot lift in 2016/17. There were 24 vessels in the fleet (VFA 2018).

The Western Zone

This is the larger rock lobster fishery with a 230t TAC in 2016-17 and only 209t caught due to the oil and gas seismic testing activities. The total fishing effort was 324,000 pot lifts (VFA 2018). There were a record low in the number of vessels, with only 42 vessels operating in the 2016/17 season. The average catch per vessel for the last three years between 4.7 and 5 tonnes, fishing an average number of 52 days in 2015/16 (VFA 2018).

In both rock lobster zones, the reduction in quota over time has led to some rationalisation among operators, however high product prices have enabled some operators to reduce their days fished and remain in the fishery.

The economics of rock lobster businesses is reported in the projects business survey results. The results show a mix of owner-operators and some contracted fishers. Given that operators have different amounts of quota holdings, this was taken into account in processing the survey results, weighting activity by days fished.

Abalone

The abalone fishery is divided into three management zones, western, central and eastern zones, with significantly different total allowable catches allocated to each zone. The economics survey had five responses from divers across the three zones and therefore were analysed together.

Over the past decade the fishery has seen a reduction in the number of owner-operators, shifting towards quota owners hiring divers on a contractual basis. Thus, most of those “in the water” are divers on contract and these were the respondents to the economic survey and able to provide fishing operation costs and revenues. The quota owners were less suited to the survey analysis and their economics were addressed differently, through information on lease prices, estimated ITQ capital values and costs of holding and managing quota, gained from surveys and interviews with quota owners.

Hence the results for abalone from the economic survey, presented in Table 3, are from divers only. The divers have access to different quota holdings and this was taken into account in processing the survey results weighting their fishing activity by days fished. This also accounted for some divers being able to take their leased quota in a low number of days per year that would not constitute full time employment.

2.6 Results

The economic survey results include adjustments to give the economic depreciation, the imputed cost of labour and opportunity cost of capital, and are reported in Table 3.

The results in Table 3 indicate that the profitability as seen by boat business profit are all positive and show a positive return to full equity. The truer measure of long-term profitability is the net economic returns. These take into account the opportunity costs of the resources employed in the fishing operation to see if there is an economic surplus, above normal.

The results show the following. For the abalone fishery the divers are making a normal economic return to capital (0.04%) gaining the 7% opportunity cost assumed for the capital involved. This suggests the incentives for divers to enter or leave the industry will be related to prices negotiated in diver contracts. In the other ITQ fishery, rock lobster, eastern zone rock lobster operators have slightly negative economic returns (-2.3%) as does western zone (-1.0%). These may not be significantly different from the normal return scenario.

For the non-ITQ managed fisheries, the RA1 vessels have slightly negative economics returns (-1.1%) and RA2 operators appears to have an economic surplus (14.5%). However, this should be interpreted with caution as these inshore trawl and ocean access vessels vary significantly across the small sample size. In the ocean access operators sampled, all of the vessels are old (30 years) and are thus their effective capital costs are low, relative to their capital replacement costs, flattering their apparent economic profit. The capital value of licences in non-ITQ fisheries is not openly available and the estimates here may be either an under- or over-estimate impacting the apparent economic returns. It is unlikely any economic surplus would be sustainable in the long term and is considered short run for the survey year in question. The capital will need to be replenished and any available surplus would likely be required for this. The economic survey method does not indicate anything about long run stock or resource sustainability.

Overall across the State wild catch fisheries, most businesses groups, with the exception of the RA2 group, were just under a zero rate of return which indicates they are almost covering opportunity costs and effectively earning a normal return to capital. The results indicate no great incentives for investors to enter or exit most of the State fisheries.

Victorian fishing & aquaculture economic assessment

Table 3. Results of the economic survey of the Victorian professional wild-catch fisheries in the financial year 2016-2017, by fishing activity group

		Restricted Access 1	Restricted Access 2	Rock Lobster East	Rock Lobster West	Abalone (Divers)
	Observations (n=46)	17	8	8	8	5
1	Gross Revenue	\$ 230,866	\$ 538,249	\$ 176,064	\$ 665,056	\$ 226,434
	<i>Less Costs</i>					
	Cooperative commission	\$ 8,756	\$ 37,586	\$ 460	\$ -	\$ -
	Bait	\$ 13,878	\$ 455	\$ 11,539	\$ 27,685	\$ -
	Boat fuel	\$ 9,493	\$ 23,701	\$ 11,196	\$ 31,368	\$ 6,232
	Repairs and Maintenance	\$ 11,731	\$ 14,823	\$ 4,718	\$ 17,917	\$ 6,923
	Gear replacement	\$ 5,672	\$ 4,617	\$ 2,084	\$ 6,715	\$ 637
	Other item	\$ 2,072	\$ 1,394	\$ 100	\$ 411	\$ 3,107
	Other cost	\$ 3,376	\$ 338	\$ 1,283	\$ 20	\$ 70
	Protective Clothing/other	\$ 388	\$ 313	\$ 198	\$ 1,073	\$ 1,504
	Vehicle Fuel	\$ 3,953	\$ 1,132	\$ 4,609	\$ 1,482	\$ 3,776
	Freight	\$ 8,140	\$ 2,485	\$ 79	\$ 5	\$ -
	Labour - Paid	\$ 34,991	\$ 183,772	\$ 16,840	\$ 96,752	\$ 69,167
2	Labour-unpaid	\$ 31,519	\$ 12,923	\$ 27,975	\$ 12,466	\$ -
3	Total variable costs	102,450	270,616	53,108	183,428	91,416
	Boat registration	\$ 1,586	\$ 9,840	\$ 4,068	\$ 4,645	\$ 444
	Brokerage	\$ -	\$ -	\$ 290	\$ 3,100	\$ 23
	Vehicle Registration & Repair	\$ 761	\$ 4,221	\$ 789	\$ 899	\$ 1,384
	Insurance	\$ 2,855	\$ 5,742	\$ 3,302	\$ 7,763	\$ 3,533
	Licence Fees	\$ 4,613	\$ 4,131	\$ 9,571	\$ 16,411	\$ 1,067
	Accounting and legal	\$ 2,410	\$ 2,820	\$ 1,976	\$ 2,830	\$ 3,086
	Litigation	\$ 13,851	\$ 50	\$ 77	\$ -	\$ -
	Telephone	\$ 2,279	\$ 1,506	\$ 1,257	\$ 2,000	\$ 3,607
	Power	\$ 5,395	\$ 1,971	\$ 485	\$ 3,759	\$ 130
	Rates and rent	\$ 4,385	\$ 733	\$ 268	\$ 658	\$ 1,953
	Bank Charges	\$ 1,146	\$ 501	\$ 202	\$ 356	\$ 166
	Building/plant repair	\$ 207	\$ -	\$ 8	\$ 689	\$ -
	Vehicle repair	\$ 615	\$ 255	\$ 1,051	\$ 926	\$ 317
	Travel	\$ 108	\$ 426	\$ 152	\$ 2,151	\$ 5,392
	Memberships/other	\$ 169	\$ 135	\$ 186	\$ 350	\$ 168
	Other Costs	\$ 3,239	\$ 4,100	\$ 2,868	\$ 5,210	\$ 2,067
4	Interest	\$ 9,569	\$ 1,326	\$ 648	\$ 25,760	\$ 2,000
5	Leasing	\$ -	\$ 4,091	\$ 28,099	\$ 191,287	\$ -
6	Total Fixed Costs	\$ 53,189	\$ 41,848	\$ 55,297	\$ 268,794	\$ 25,339
7	Total Boat Cash Costs (3 + 6)	\$ 155,638	\$ 312,464	\$ 108,406	\$ 452,222	\$ 116,755
	Boat Gross Margin (1 - 3)	\$ 128,416	\$ 267,633	\$ 122,956	\$ 481,628	\$ 135,019
2	unpaid labour	\$ 31,519	\$ 12,923	\$ 27,975	\$ 12,466	\$ -
	Gross Operating Surplus (1-7+2)	\$ 106,746	\$ 238,708	\$ 95,633	\$ 225,300	\$ 109,680
8	Boat Cash Income (1-7)	\$ 75,227	\$ 225,785	\$ 67,658	\$ 212,834	\$ 109,680
9	Depreciation (economic)	\$ 17,958	\$ 38,500	\$ 7,382	\$ 9,634	\$ 6,119
10	Boat Business Profit (8-9)	\$ 57,270	\$ 187,285	\$ 60,277	\$ 203,201	\$ 103,561
11	Profit at full equity (10 + 4 + 5)	\$ 66,839	\$ 192,702	\$ 89,024	\$ 420,248	\$ 105,561
12	Boat Capital (CV)	\$ 289,297	\$ 410,000	\$ 111,024	\$ 297,320	\$ 98,863
	Boat capital (RC)	\$ 430,331	\$ 1,883,138	\$ 318,259	\$ 499,666	\$ 298,236
	Licence Value*	\$ 310,000	\$ 425,000	\$ 1,200,000	\$ 5,600,000	\$ 1,400,000
13	Total Capital	\$ 599,297	\$ 835,000	\$ 1,311,024	\$ 5,897,320	\$ 1,498,863
	Rate of return on boat capital	23%	47%	80%	141%	107%
	Rate of return on total capital	67%	22%	35%	60%	33%
8	Boat cash income (1-7)	\$ 75,227	\$ 225,785	\$ 67,658	\$ 212,834	\$ 109,680
	unpaid labour	\$ 31,519	\$ 12,923	\$ 27,975	\$ 12,466	\$ -
	Opportunity cost of capital (7%)	\$ 41,951	\$ 58,450	\$ 91,772	\$ 412,812	\$ 104,920
9	Depreciation (economic)	\$ 17,958	\$ 38,500	\$ 7,382	\$ 9,634	\$ 6,119
	<i>Plus interest, leasing and management fees</i>					
	Interest	\$ 9,569	\$ 1,326	\$ 648	\$ 25,760	\$ 2,000
	Leasing	\$ -	\$ 4,091	\$ 28,099	\$ 191,287	\$ -
	Net Economic returns	-\$ 6,630.63	\$ 121,329.31	-\$ 30,722.56	-\$ 5,030.43	\$ 640.56
14	Economic Rate of Return to Capital	-1.11%	14.53%	-2.34%	-0.09%	0.04%

Source: Economic Questionnaire 2018

2.7 Limitations of the analysis

The main limitation of the survey relates to the limited response rates. The survey had 46 responses (18.3%) assuming a total of 250 Victorian professional fishing businesses. They represented 31.7% of the total revenue from state fisheries.

As licence value data was not available from the survey responses collected, it was necessary to estimate licence values in order to calculate both accounting and economic rates of return to capital. It was also necessary to adjust for depreciation. Survey respondents were asked to provide depreciation data in their response, however many omitted this information or provided it on an accounting basis, which may result in much of the assets value being written off in the first few years of ownership due to tax incentives and thus fail to take into consideration the true value of the asset being consumed annually, the economic measure of depreciation. It was therefore necessary to calculate an economic estimate of depreciation based on information provided by respondents regarding original cost, residual value and asset age.

Unpaid labour is an important input in many fishing businesses, however it is difficult to estimate in monetary terms. Values for unpaid labour have been imputed on the basis of information gained from the survey regarding the numbers of staff and unpaid hours worked. Labour costs are imputed from questions in the survey regarding days fished and unpaid days worked by the fishers and their family in the fishing operation. Award wages for miscellaneous employment were used to calculate an imputed value of labour. The basis of imputation was for an annual average wage imputed on a daily basis from ABS data (ABS 2018). The number of unpaid hours per year per fishing business has then been assigned a value using the miscellaneous award wage. For the abalone fishery we calculated unpaid hours at a high rate in line with the Professional Diving Industry (industrial) Award 2010 Award. It is important to note that given the 'lifestyle' nature of fisheries, unpaid labour estimates may be under-estimated relative to its opportunity cost.

Finally, the data provided covers the 2016-2017 financial year only and inferences from such for other time periods may potentially under-represent the degree of inter-annual variation found in some fisheries. Accounting and economic data does not indicate whether the levels of economic activity are sustainable, which depends on the fish resource and its management.

2.8 Demographics of those who replied to the economic survey

The majority of survey respondents were male (95%) with no respondents being female (0%) and two respondents not providing any demographic details. Of the 46 respondents, the majority (86%) were of Anglo European descent. The remainder were of indigenous (2%), Mediterranean (4%) and other descent. The remainder identified as Australian.

The ages of respondents ranged from 24 years to 75 years, the average male respondents age was 53 years. In terms of education, 8% had completed a year 8 (n=5), 13% had complete year 9 (n=8), 15.2% complete year 10 (n=7), 8% completed year 11 (n=5), 34% had completed year 12 (n=21), 6.5% completed an undergraduate degree (n=3), 13% of respondents had completed an industry or business course (n=6) and 23% of respondents had obtained trade or TAFE certificates (n=11).

3 The Victorian aquaculture economic assessment

This section summarises the methods and results of the economic assessment of Victorian aquaculture businesses in the 2016-17 financial year. The purpose of the assessment was to gather data on costs and income to determine the contribution of aquaculture businesses to regional economies via regional economic modelling. Profitability was also assessed.

The project initially proposed an analysis of seven regions in Victoria, but this was not possible due to low numbers of aquaculture businesses at such a disaggregated regional level, impacting confidentiality requirements. Upon discussions with the VFA and industry, two areas were agreed on: the coastal area (along the west Victorian coast) and then the inland area (along the coast east of Melbourne and then covering inland aquaculture enterprises). In 2016-17 there were 122 aquaculture licences (VFA 2018) with only 18 aquaculture businesses registered with Primesafe (Primesafe 2018).

3.1 Aquaculture operator questionnaire

The project developed an economic survey instrument to give to all operators. The initial data review and social interviews revealed a diversity of aquaculture businesses culturing a range of different species. There were significant differences in farm size and operation designs for the same species, for example salmonid farms being on lakes or using flowing water sources.

From the initial social survey interviews, ten aquaculture businesses indicated they were prepared to discuss and share economic business data. This low response limited how we could gain data and present results within confidentiality constraints.

The survey approach focussed on the viability of the main species cultured in each study area, salmonids – mainly trout – (inland) and abalone (coastal). Information from past surveys (Econsearch 2011 c,e,f) was adapted to current price levels and made into a profile of a “representative” farm and a “state wide summary” for each sector. Those willing to participate were called and had the choice to amend the projected data estimates or to complete the project survey. Telephone and email were used to refine the estimates to make a “representative farm unit” and a “State-wide industry projection”.

3.2 Appraising economic viability

Aquaculture enterprise viability can be estimated through accounting data collected in a questionnaire. This gives an accounting view of a firm’s individual performance but is not good for measuring performance against businesses in other industries. Economists adjust accounting data to gain more useful industry economic returns performance measures. The limited survey responses meant that only salmonid and abalone farm results could be presented on the basis of a representative farm and a projected State-wide average.

The residual of total income less variable costs is the gross margin and shows a gross level of operating profitability. The financial returns to capital on an all equity basis can then be measured. Economic returns differ from the financial returns by including opportunity costs to enable comparison of economic rates of return with other industries. Depreciation and the opportunity cost of capital are deducted to give economic profit or loss. Depreciation was taken to be as indicated in the interviews, as full details of capital assets and their ages were not provided.

In a recent study, a 7% opportunity cost of capital was included in costs and an estimate of the opportunity cost of labour, including unpaid labour, was made following ABARES (George and New 2013). This exceeds the real interest rate that could be earned on an investment elsewhere and takes some account of investment risk in the aquaculture sector. We chose to follow the Guy et al. (2014)

approach and applied a higher discount rate of 8% to aquaculture venture appraisal, though higher risk adjusted rates could detrimentally impact the assessment of commercial viability.

3.3 Accounting and economic measures

The survey accounting revenues and cost results are reported in Tables 4 and 5.

The results reveal that total variable costs for salmonids are 68.9% of gross income and fixed costs are 20.7%, with total costs being 89.6% of gross income. Feed is the largest cost and is 33.6% of total income, with labour at 22% of total income and electricity at 6.4%.

For abalone farms, variable costs are 39% of total income and 15.5% fixed costs, totalling 54.5% of gross income. Labour is the largest cost at 20.8% of total income, with feed and electricity being 8.8% and 7.0% respectively. The operator/manager costs and allowances were 5.1%.

Gross operating surplus is higher for abalone farms at 46% of total income and lower for salmonids at 10.3% of total income. However, conclusions on long run viability are difficult to draw from accounting data alone. Certain economic adjustments have to be made to determine more meaningful profitability results such as an economic rate of return.

3.4 Economic results

The economic survey results can be adjusted for economic depreciation and the opportunity cost of capital and are reported in Tables 4 and 5. The study was unable to include results on unpaid labour and economic depreciation as there was insufficient information returned in interviews.

Inland results – Salmonids in Victoria

The surveys only enabled an analysis of salmonid (trout) production to be undertaken. The previous report of Econsearch (2011c,e) was price index adjusted and formed the basis of interviews with farmers who chose not to complete the economic survey. The results for a 100tonne trout farming unit and a State-wide extrapolation are presented in Table 4. Given the production capacity of many businesses is much less than 100t, and each business needs to be evaluated on its design, location and other characteristics, the results should be taken as a “representative scenario” and not depended on for financial decisions.

Coastal results – Abalone aquaculture in Victoria

The coastal aquaculture region had bivalve (mussels) businesses and abalone farms at various stages of development, producing a total of 462t of abalone in 2016-17. Results from a previous study (Econsearch 2011c,f) were indexed to current values and became initial of revenues and costs for discussion and updating with abalone farms (Table 5).

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Table 4. Estimate of revenue, and costs, in Victoria trout farming in the financial year 2016-2017 for a representative 100t farm and Industry wide

No	Income and costs	Representative 100 tonne operation	Industry Total	Cost as % income
	Income:			
	Wholesale			
	Production (t)	95	1,200	
	Average price (\$/kg)	9.4	9.4	
	Income (\$)	893,000	11,280,000	
	Retail/Fish Out			
	Production (tonnes)	5	60	
	Average price (\$/kg)	15	15	
	Income (\$)	75,000	900,000	
	Total			
	Production (tonnes)	100	1,260	
1	Income (\$)	968,000	12,180,000	100%
	Variable Cost:			
	Labour (incl on-costs)	213,742	2,689,437	22.1%
	Feed	325,303	4,093,168	33.6%
	Fingerlings ^b	0	0	0.0%
	Electricity	62,267	783,478	6.4%
	Fuel and Oil	25,944	326,449	2.7%
	Other	39,914	502,229	4.1%
2	Total Variable Costs	667,170	8,394,761	68.9%
	Fixed Costs:			
	Legal & Accounting	2,594	32,645	0.3%
	Communications/Admin	3,193	40,178	0.3%
	Insurance	2,395	30,134	0.2%
	Licence Fees	14,369	180,803	1.5%
	Repairs and Maintenance	25,146	316,404	2.6%
	Operator/Manager Allowance	30,135	379,183	3.1%
3	Interest	100,385	1,263,106	10.4%
	Other Fixed Costs	3,193	40,178	0.3%
	Depreciation	20,000	240,000	2.0%
4	Total Fixed Costs	201,411	2,522,632	20.7%
5	Total Cash Costs (2+4)	868,581	10,917,393	89.6%
	Gross margin (1-2)	300,830	3,785,239	31.1%
6	Gross Operating Surplus (1-5)	99,419	1,262,607	10.3%
7	Depreciation	20,000	240,000	2.0%
	Business profit (6-7)	79,419	1,022,607	8.4%
	Profit at Full equity (8+3)	179,804	2,285,713	18.8%
	Capital Investment	1,500,000	20,000,000	
	Rate of return on capital	12.0%	11.4%	
	Cash Income (6)	99,419	1,262,607	
	Less Opp. Cost of capital (8%)	120,000	1,600,000	
	Depreciation	20,000	240,000	
	Plus interest	100,385	1,263,106	
	Net Economic returns	59,804	685,713	
	Economic rate of return to capital	4.0%	3.4%	
	Total Employment (fte)	3	33	
Source: VFA, EconSearch (2011c,e) and industry consultations				

The results are indicative only, as the farms vary in size, location and are at different stages in their projected business growth, some only starting to reach originally planned production levels. The data should be treated as indicative of a 100tonne unit, which exceeds the production of some current farms, but gives an estimate of profitability for the industry State-wide.

Table 5. Estimate of revenue, and costs, in Victoria abalone farming in the financial year 2016-2017 for a representative farm and Industry wide

No	For financial year 2016-17	Representative farm	Statewide estimate	% of gross income
1	Income:			
	Production (t)	100	462	
	Average Price (\$/kg)	38.33	38.33	
	Gross Income (\$'000)	3,834	17,708	100
	Variable Costs (\$'000):			
	Paid Labour	797.88	3,686.19	20.8%
	Labour On-costs	40.43	186.80	1.1%
	Feed	338.94	1,565.89	8.8%
	Spat	-	-	0.0%
	Electricity	267.13	1,234.14	7.0%
	Fuel and Oil	39.19	181.07	1.0%
	Other	11.29	52.14	0.3%
2	Total Variable Costs	1,494.86	6,906.23	39%
	Fixed Costs (\$'000):			
	Legal & Accounting	12.01	55.47	0.3%
	Communications/Admin	5.14	23.75	0.1%
	Insurance	95.52	441.28	2.5%
	Lease and Licence Fees	11.37	52.54	0.3%
	Repairs and Maintenance	130.62	603.46	3.4%
	Operator/Mgr Allowance	194.94	900.63	5.1%
3	Interest	126.44	584.14	3.3%
	Other Fixed Costs	16.08	74.28	0.4%
4	Total Fixed Costs	592.11	2,735.54	15%
5	Total Cash Costs (2+4)	2,086.96	9,641.77	54.4%
	Gross Margin (1-2)	2,338.79	10,805.20	61%
6	Gross Operating Surplus (1-4)	1,746.68	8,069.66	46%
7	Depreciation	404.32	1,867.95	11%
8	Business Profit (6-7)	1,342.36	6,201.71	35%
9	Profit at Full Equity (8+3)	1,468.80	6,785.84	38%
10	Capital Investment \$('000)	6,091.03	28,140.56	
	Rate of return on capital	24%	24%	
	Cash Income (6)	1,746.68	8,066.69	
	Less Opp. Cost of capital (8%)	487.28	2,251.24	
	Depreciation	404.32	1,867.95	
	plus interest	126.44	584.14	
	Net Economic returns	981.51	4,531.63	
	Economic rate of return to capital	16%	16%	
	Employment (FTE)	14.2	65.41	
	Source:VFA, Econsearch (2011c,f) industry consultations			

3.5 Discussion of trout and abalone farm results

The results for trout farming indicate that the 100t unit and State-wide industry had an estimated rate of return to capital of 12%, an economic return of \$59,804, which is an economic rate of return to capital of 4%. This indicates that under the assumed ratio of wholesaled fish and then retail/fish out, there is a small economic surplus above opportunity costs. The model would be sensitive to variations in income (quantity, price and amount of retail/fish out activity) and to feed, labour and electricity cost rises. The method has not included unpaid labour and if costed, this would likely reduce the economic surplus, as trout farmers and assistants can apply more hours than are paid from the business.

The results for abalone farms indicate that the 100t unit (and the State-wide industry) had an estimated rate of return to capital of 24%, an economic return of \$981,510, which is an economic rate of return to capital of 16%. The results indicate that the abalone farming sector are earning a return that may attract businesses to enter the industry. The trout sector also has a small economic surplus.

Under the assumed production and prices for both trout and abalone, this is a projected economic surplus above opportunity costs. The model would be sensitive to variations in income (quantity, prices) and to labour, feed and electricity costs. Again, the method has not included unpaid labour and if costed, this would likely reduce the economic surplus for both sectors.

3.6 Limitations of the analysis

The main limitation of the study relates to the limited response rate. Only 10 operators were prepared to provide business information across the variety of species farmed. Trout and abalone were the two sectors for which we could develop results for a representative 100t unit and for the State-wide industry.

The trout and abalone businesses that replied to the survey may be more active and possibly more viable, than non-responding businesses, and thus introduce unknown respondent bias. Given the lifestyle nature of many aquaculture businesses, non-inclusion of unpaid labour estimates may make the economic profits an over estimate. There was not enough information to estimate capital values of assets in building, ponds and equipment and accounting depreciation was used. The data provided covers the 2016-17 financial year only and inferences from this one year may not reflect unknown inter-annual variation.

3.7 Investment in the aquaculture industry

Capital investment in the aquaculture industry takes place in purchasing of sites, building of farms, ponds and major equipment. There are also shorter-term capital investments in other infrastructure, farm and fish handling equipment, vehicles and smaller machinery.

Investment in any industry is a strong sign of economic health and reliable information about future prospects. Due to strong production value growth in the last few years in the salmonid, mussel and abalone aquaculture sectors, this is an indication of the future value to be captured in return for current outlays.

Capital outlay has occurred in several instances which indicate healthy investor sentiment amongst informed operators. Several such indications are as follows:

- Recent expansion of capacity of abalone farms in both Port Fairy and Portland
- The Portland abalone farm is proposing to build a new abalone farm, processing plant and abalone feed production plant near Portland, which would double their total output. The EPA

has issued works approval in April 2019, though the application has currently stalled as it is under VCAT review.

- Purchase and expansion plans of the abalone farm at Indented Head.
- Release of 41 additional Crown lease sites in Port Phillip Bay and Western port in 2017 for mussel farms that were successfully subscribed by existing industry participants. This is consistent with a re-emerging mussel industry who have also established a cooperative spat production facility in Queenscliff to ensure consistent supply due to increasing variability in natural spat fall. This is a prime industry example of collective cooperation and entrepreneurial individual action creating significant individual and community benefits. The industry high of 1,582 tonnes in 2001/02 was reduced to 446 tonnes in 2008/09, but has re-emerged to recover production to 1,136 tonnes in 2016/17. Industry production value also increased from \$1.33 million in 2008/09 to \$4.32 million in 2016/17.
- Expansion in the warm finfish barramundi hatchery and culture sector with exports of juveniles.
- Industry leaders in salmon, rainbow trout and brook trout roe emerging as “cultural influencers” championing industry and “adding value” in the gourmet food area.
- Expansion opportunities of Murray Cod aquaculture with successful ASX fund raising undertaken by Murray Cod Australia Ltd. While the current focus is Southern NSW, irrigation schemes of the prospective business model includes significant areas of Victoria. Recent announcements have seen celebrity chef Heston Blumenthal and the Fat Duck Group as key advocates for five years. The arrangement also included an equity stake of 1.5 million shares in the business operations. This long-term position is indicative of future belief in success.

In summary, recent investment patterns, the growth of the aquaculture sector and the information on profit in the salmonid and abalone culture sectors, indicate a healthy aquaculture sector with prospects in Victoria. There are also warm water finfish, ornamentals and other niche species with emerging prospects.

4 Regional economic impacts of the catching, aquaculture and processing sector in Victoria.

Economic activity takes place in different areas and regional economics investigates the connections between different sectors of the economy. In this study we use an input-output modelling approach as described in the WRI report (WRI 2019).

The business receipts received by fishing and aquaculture businesses enables the initial expenditure on inputs for seafood production, which then produces an amount of output in the Victorian economy. Fishing and aquaculture businesses require inputs in the form of goods such as fuel, power, food, equipment, and services such as maintenance services by different trades.

The information on industry expenditure gained from the economic survey is used to derive the impacts on regions via regional economic modelling. It also estimates the relationships with other businesses along supply chains in the local areas. This project uses a sophisticated input-output (IO) model called Generation of Regional Input-Output Tables (GRIT) technique (see WRI 2019). This type of IO model avoids the problems of over-estimation sometimes associated with IO models more generally. The WRI state economy modelling utilizes Australian Bureau of Statistics (ABS) data in analysing regional economies. The economic information from the operational and financial data, collected from the economic surveys of professional fishing and aquaculture operators across Victoria, was used to generate regional expenditure estimates.

This study extended the analysis of the economic contributions of the fishing and aquaculture industry to include examination of economic ‘multipliers’ – that is, how the income from fishing and aquaculture flows through to other businesses through expenditure on goods and services for the industries.

The initial expenditure estimates, generated after taking account of interstate purchases, depreciation and profit, were inserted into WRI’s model of the Victorian regional economy to calculate the economic impacts of professional fishing and aquaculture on regional coastal economies and at the Victorian State level. Modelling was undertaken for the financial year 2016/17.

4.1 Background – Regional Expenditure flows for the wild catch sector

In Table 6 the regional economic analysis for the five regions of wild catch fishing are presented. The response rates from the economic survey by region are shown (assuming 250 fishing businesses in Victoria).

Table 6. Economic survey responses and professional fishing business revenue by region

ABS	Statistical Area Level	UTS Study Region	% responses per region	Number of responses	Revenue per region (%)
Warrbanbool	SA3	Far west	19.6%	3	30.9%
Glenelg (Vic.)	SA2			2	
Portland	SA2			4	
Surf Coast - Bellarine	SA3	Near west	30.4%	5	15.0%
Corangamite - South	SA2			2	
Otway	SA2			7	
Melbourne - West	SA4	Melbourne	8.7%	4	9.5%
Melbourne - Inner	SA4				
Melbourne - Inner South	SA4				
Frankston	SA3				
Geelong	SA3				
Mornington Peninsula	SA3	Near East	17.4%	4	14.9%
Gippsland - South West	SA3			3	
Yarram	SA2			1	
Gippsland - East	SA3	Far East	23.9%	10	29.8%
Longford - Lock Sport	SA2			1	
		Total	100%	46	100.0%

Source: Economic Questionnaire this study

The business data from the survey was combined with the State-wide catch revenue estimate of \$54.36 million and detailed regional catch data for each area provided by the VFA to determine regional revenues.

The Gross Value of Production (GVP) was estimated for each area using catch data per region supplied by VFA as reported in Table 2. This does not include Commonwealth fisheries. In order to account for expenditure flows between the various regions, as well as those expenditure flows leaving the state of Victoria, it was necessary to adjust the regional level revenues to reflect all such movements that were indicated in the economic survey responses. The net adjustments are reported in Table 7.

Table 7. The adjustments to revenues in each area reflect intra and interstate expenditure movements

UTS study region	Total apportioned revenue (\$)	Net flow adjustments (\$)	Adjusted GVP (\$)
Far West	16,776,094	- 772,423	16,003,671
Near West	8,132,473	- 169,680	7,962,793
Melbourne	5,153,352	- 446,000	4,707,352
Near East	8,103,541	- 882,173	7,221,368
Far East	16,196,539	- 203,036	15,993,503
Total GVP	54,362,000	- 2,473,312	51,888,688

Source: This study's economic survey

Table 7 shows that in 2016-17 approximately \$2.5 million of expenditure on fishing inputs moved between each intrastate area (net movements) and interstate from Victoria. The majority of this, approximately \$2.0 million, was interstate expenditures with South Australia and New South Wales in 2016-17. These expenditure flows represent spending on items such as bait, boat expenses and

repairs, freight, fuel and oil, leasing fees, marketing and vehicle expenses. Where larger capital purchases were made outside of the state, these were apportioned on an annualised flow basis. This meant that a \$51.88m net revenue was used in the regional analysis, thus accounting for this interstate expenditure leakage when analysing how initial expenditures impacted the Victorian economy.

4.2 Regional Economic Impacts for the Victorian State Professional Catching Sector

The economic significance of an industry, such as professional fishing, can be measured in terms of direct and indirect effects. The direct effects from the initial expenditure are a measure of the value of output of the industry itself, the number of people employed and the income they receive. The indirect effects, or flow-ons reflect induced indirect responses in the economy¹.

The multipliers indicate the size of those impacts relative to the level of sales to final demand. The Type II ratios reflects the relationship between the total impact (direct and indirect) to the direct effect. The calculation of multipliers from fishing will only include the linkage effects that occur back through the supply of inputs to fishers and not any effects downstream toward the consumer.

The regional expenditure economic impact approach measures the economic expenditure at the primary producing fishing business level (point of first sale), as opposed to subsequent economic activity in the processing, wholesaling and retailing of seafood which are the secondary sector, which will be addressed later.

For the primary catching sector, initial expenditure by fishing businesses can be used to estimate direct output and added value to the Victorian economy, and also the indirect economic activity from the inputs sourced from the community. The results of the economic survey are used to estimate the level of initial expenditure inputs used in the fishing process, with this data being inputted into a regional economic model of the Victoria economy. See WRI (2019) for the detailed report of the regional economic modelling.

Regional economics is sometimes referred to as input-output modelling. From the revenue obtained by a business from professional fishing, there is an initial expenditure on inputs required for fishing from industries in the general economy. This initial expenditure is on goods and services and thus profit and depreciation are removed from gross revenues. This initial expenditure produces an amount of economic output across the economy, and within this is an amount of added value. There is also household income (eg. wages) and employment associated with this expenditure.

The initial expenditures were estimated for the five coastal areas in this study and for the whole Victorian economy using the economic survey results and the catch records to make regional revenue estimates. These expenditures were inserted into the Victorian regional economic model to produce output, added value, household income and employment estimates (WRI 2019). Table 8 reports the results of the regional economic analysis are presented for each regional area along the Victorian coast.

¹ Flow-ons can be divided into production induced and consumption induced effects in the economy. Production induced effects are the industry's purchase of goods and services from other industries. Consumption induced effects arise from the spending of household income received as payment for labour.

Table 8. The initial and flow-on economic impacts of State professional fishing in Victoria

Initial Expenditure by region (\$m) \$31.6	Output (\$m)	Value added (\$m)	Household Income (\$m)	Employment (no.)
Initial	50.6	31.9	12.9	346
Flow-on		39.1	18.7	233
Total Impact		71	31.6	579
Type II multiplier		2.23	2.45	1.67

Source: Adapted from WRI 2019

From the initial expenditure of \$31.6m State-wide by Victorian State professional fishing businesses, there is an initial direct output of \$50.6m² in the Victorian economy. The direct added values are \$31.9m and indirect of \$39.1m giving a total impact of \$71m added value.

For the total employment of 579 FTE jobs, 346 of these are associated with wild-catch fishing businesses, while the 233 are jobs in the fishing communities in businesses supplying the fishing industry. The total impact can be related to the initial impact as a ratio, referred to as a Type II multiplier. The value added and income type II multipliers are 2.23 and 2.42 respectively. The Type II employment multiplier is 1.67 for all Victoria. These results indicate the dimensions of multiplication in the general economy associated with the wild-catch input expenditures. The regional results for all regions are presented in Table 9.

Table 9. The economic impacts of State professional fishing in Victoria in 2016-17 on the respective regions

Regions	Far West	Near West	Melbourne	Near East	Far East	Sum of regions	Total Victoria
Initial Expenditure (\$m)	10.9	5.1	3	4.1	8.3	31.4	31.6
Output (\$m)- Direct only	15.7	7.8	4.5	7	15.6	50.6	50.6
Value Added (\$m)	18.2	8.7	6.9	8.2	19.7	61.7	71
Household income (\$m)	7.6	3.2	3.4	3.2	8.3	25.7	31.3
Employment (no.)	133	76	63	78	177	527	579

Source: Adapted from WRI (2019)

In Table 9 the results are for each coastal fishery region with the “Sum of regions” being a sum of the regions, whereas the “Total Victoria” is at the state wide level which accounts for intra-Victorian regional economic activity, hence having results greater than for the sum of each region.

² Indirect impacts from output are not estimated as they are prone to have double counting issues. Added value is a much more reliable indirect impact indicator. These indirect inputs are for fishing and its indirect effects only. Processing is included later in the study in Table 20 where the data are fishing and processing and the indirect effects for both.

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Table 10. An overview of the output, value added, household income and employment in the five areas of the Victorian Coast in the regional study for State professional fishing

Far West	Output (\$m)	Value added (\$m)	Household income (\$m)	Employment (FTE)
Total Expenditure (\$ 11.0 million)				
Initial	15.7	7.7	3.0	64
Flow-on		10.5	4.7	69
Total		18.2	7.7	133
Percent of region		0.55%	0.48%	0.56%
Near West	Output (\$m)	Value added (\$m)	Household income (\$m)	Employment (FTE)
Total Expenditure (\$ 5.1 million)				
Initial	7.77	4.4	1.8	54
Flow-on		4.3	1.4	21
Total		8.7	3.2	76
Percent of region		0.26%	0.29%	0.45%
Melbourne	Output (\$m)	Value added (\$m)	Household income (\$m)	Employment (FTE)
Total Expenditure (\$ 3.1 million)				
Initial	4.5	2.8	1.4	40
Flow-on		4.1	2	23
Total		6.9	3.4	63
Percent of region		0.00%	0.00%	0.01%
Near East	Output (\$m)	Value added (\$m)	Household income (\$m)	Employment (FTE)
Total Expenditure (\$4.1 million)				
Initial	7	5	2.1	61
Flow-on		3.2	1.1	17
Total		8.2	3.2	78
Percent of region		0.08%	0.09%	0.14%
Far East	Output (\$m)	Value added (\$m)	Household income (\$m)	Employment (FTE)
Total Expenditure (\$8.3 million)				
Initial	15.6	12	4.8	126
Flow-on		7.6	3.5	50
Total		19.6	8.3	177
Percent of region		0.85%	0.76%	1.19%
Sum of regions	Output (\$m)	Value added (\$m)	Household income (\$m)	Employment (FTE)
Total Expenditure (\$31.6 million)				
Initial	50.6	31.9	13.1	345
Flow-on		30	12.6	180
Total		62	25.7	527
Percent of region		0.02%	0.01%	0.02%
State Professional Fisheries Victoria	Output (\$m)	Value added (\$m)	Household income (\$m)	Employment (FTE)
Total Expenditure (\$31.6 million)				
Initial	50.6	31.9	13	346
Flow-on		39.1	18.4	233
Total		71	31.4	579
Percent of region		0.02%	0.01%	0.02%

Source: Adapted from WRI (2019)

Table 10 shows the estimate as a percentage of the regional economy, the added value and employment which is 0.02% of the Victorian economy. However, for the western regions, the added value is 0.55%, and employment is a 0.5% of the total in the regional economy. The far east region contributes 0.85% of added value, 0.76% of household income and 1.19% of employment in that region, showing the significance of professional fishing the far east coastal region of Victoria.

In Table 11 the Type II ratios are the multipliers and are given by the ratios of total impact/initial input for each region. The ratio shows how the economy in each region responds to the additional stimulus from professional fishing. Ratios are shown for added value, household income and employment. The higher the ratio, the more induced effect there is relative to stimulus in that regional economy.

Table 11. An overview of the Type II multiplier ratios for value added, household income and employment in the five areas of the Victorian Coast in the regional study

Output (\$m)	Initial	Total	Type II ratio	Household income (\$m)	Initial	Total	Type II ratio
Far West	15.7			Far West	2.97	7.63	2.57
Near West	7.77			Near West	1.75	3.18	1.82
Melbourne	4.5			Melbourne	1.37	3.42	2.50
Near East	7.01			Near East	2.08	3.19	1.53
Far East	15.56			Far East	4.79	8.28	1.73
Sum all Regions	50.54			Sum all Regions	12.96	25.70	1.98
All Victoria	50.55			All Victoria	12.96	31.32	2.42
Value added (\$m)	Initial	Total	Type II ratio	Employment (no. fte)	Initial	Total	Type II ratio
Far West	7.71	18.24	2.37	Far West	64	133	2.08
Near West	4.4	8.7	1.98	Near West	54	76	1.41
Melbourne	2.82	6.89	2.44	Melbourne	40	63	1.58
Near East	4.96	8.17	1.65	Near East	61	78	1.28
Far East	12.03	19.63	1.63	Far East	126	177	1.40
Sum all Regions	31.92	61.63	1.93	Sum all Regions	345	527	1.53
All Victoria	31.92	71.04	2.23	All Victoria	346	579	1.67

Source: Adapted from WRI (2019)

For value added measures, the Melbourne region had the highest economic induced effects. Household income and employment economic indicators were highest in the far west. The near east region had the lowest indicators in 3 of the 4 indicators reflecting lower induced effects. Input-output multipliers can be used to estimate the economic impacts of an increase or decrease in spending in an economy.

4.3 Regional Economic Impacts for the Victorian Commonwealth Professional Catching Sector

The regional economic impact of the Commonwealth fishery operating in Victoria is reported in Table 12. The ABARES income survey data for the Commonwealth vessels (Bath et al. 2018) was used to develop the initial expenditure estimates for 2016-17 in each region for the regional economic analysis. The ABARES economic survey results enables the gross expenditures to be adjusted to initial expenditures taking account of the different operational costs in the Trawl and Gillnet and Hook sector. The economic impacts are reported in Table 12.

Table 12. The initial and flow-on economic impacts of Commonwealth fishing on the Victorian economy

Commonwealth Professional Fisheries Victoria				
Initial Expenditure (\$m 41.8)	Output (\$m)	Value added	Household income (\$m)	Employment (FTE)
Initial	43.6	18.8	16.9	452
Flow-on		51.8	25.1	315
Total		70.6	42	767
Type II multiplier		3.75	2.48	1.70

Source: Adapted from WRI (2019)

From the initial expenditure of \$41.8m State-wide by Commonwealth professional fishing businesses, there is an initial direct output of \$43.6m. The direct added values are \$18.8m and indirect of \$51.8m giving a total impact of \$70.6 added value in the Victorian economy.

For the total employment of 767 FTE jobs, 452 of these are associated with wild catch fishing businesses, while the 315 are jobs in fishing communities in businesses supplying the fishing industry. The total impact can be related to the initial impact as a ratio, referred to as a Type II multiplier. The value added and income type II multipliers are 3.75 and 2.48 respectively. The Type II employment multiplier is 1.7 for all Victoria.

Table 13. The economic impacts of Commonwealth vessels fishing in Victoria in 2016-17 on the respective regions

Regions	Far West	Near West	Melbourne	Near East	Far East	Sum of regions	Total Victoria
Initial Expenditure (\$m)	6	2.4	5.9	6.9	21	42.2	42.2
Output (\$m)	6.3	2.5	6.2	7.1	21.6	43.7	43.7
Value Added (\$m)	8.3	3	10.7	8.6	28.6	59.2	70.6
Household income (\$m)	5.1	1.8	6.4	4.9	17.3	35.5	42
Employment (no.)	91	43	113	112	339	698	767

Source: Adapted from WRI (2019)

In Table 13 the initial expenditure by Commonwealth professional fishing businesses of \$42.2m produces \$43.7m of economic output, and \$70.6m of added value across the Victorian economy. There are \$42m of household incomes and 767 jobs in the fishing industry directly and indirectly within the Victorian economy. These results indicate the impact in the general economy associated with the Commonwealth fishery expenditures. The regional results for all regions are presented in Table 14.

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Table 14. An overview of the Commonwealth fishery output, value added, household income and employment in the five areas of the Victorian Coast in the regional study

Far West				
Total Expenditure (\$6million)	Output (\$m)	Value added (\$m)	Household income (\$m)	Employment (FTE)
Initial	6.3	2.7	2.4	51
Flow-on		5.7	2.7	39
Total		8.4	5.1	91
Percent of region		0.25%	0.32%	0.38%
Near West				
Total Expenditure (\$2.5million)	Output (\$m)	Value added (\$m)	Household income (\$m)	Employment (FTE)
Initial	2.5	1.1	1.1	33
Flow-on		1.9	0.7	10
Total		3	1.7	43
Percent of region		0.09%	0.16%	0.26%
Melbourne				
Total Expenditure (\$5.9million)	Output (\$m)	Value added (\$m)	Household income (\$m)	Employment (FTE)
Initial	6.2	2.7	2.3	67
Flow-on		8	4	45
Total		10.7	6.7	113
Percent of region		0.01%	0.01%	0.01%
Near East				
Total Expenditure (\$6.9 million)	Output (\$m)	Value added (\$m)	Household income (\$m)	Employment (FTE)
Initial	7.1	3.1	2.9	84
Flow-on		5.6	2	29
Total		8.7	4.9	112
Percent of region		0.08%	0.13%	0.20%
Far East				
Total Expenditure (\$20.6million)	Output (\$m)	Value added (\$m)	Household income (\$m)	Employment (FTE)
Initial	21.5	9.3	8.3	217
Flow-on		19.4	9	122
Total		28.7	17.3	339
Percent of region		1.23%	1.59%	2.29%
All regions				
Total Expenditure (\$41.8 million)	Output (\$m)	Value added (\$m)	Household income (\$m)	Employment (FTE)
Initial	43.6	18.9	17	452
Flow-on		40.6	18.4	245
Total		59.5	35.7	698
Percent of region		0.02%	0.02%	0.03%
Commonwealth Professional Fisheries Victoria - Total				
Total Expenditure (\$41.8 million)	Output (\$m)	Value added (\$m)	Household income (\$m)	Employment (FTE)
Initial	43.6	18.8	16.9	452
Flow-on		51.8	25.1	315
Total		70.6	42	767
Percent of region		0.02%	0.02%	0.03%

Source: Adapted from WRI (2019)

Table 14 shows the estimate as a percentage of the regional economy with the added value and employment being 0.02% of the Victorian economy. However, for the western regions added value is 0.25%, and employment is a 0.35% of the total in the regional economy. The far east region contributes 1.23% of added value, 1.59% of household income and 2.29% of employment in that region, again showing the significance of professional fishing the far east region.

In Table 15 the Type II ratios are the multipliers and are given by the ratios of total impact/direct for each region. The ratio shows how the economy in each region responds to the additional stimulus

from Commonwealth professional fishing in Victoria. Ratios are shown for added value, household income and employment. The higher the ratio, the more induced effect there is relative to stimulus in that regional economy.

Table 15. An overview of the Commonwealth fishing businesses Type II multiplier ratios for output, value added, household income and employment in the five areas of the Victorian Coast in the regional study

Output (\$m)	Initial	Total	Type II ratio	Household income (\$m)	Initial	Total	Type II ratio
Far West	6.27			Far West	2.39	5.07	2.12
Near West	2.48			Near West	1.07	1.76	1.64
Melbourne	6.22			Melbourne	2.33	6.42	2.76
Near East	7.1			Near East	2.87	4.86	1.69
Far East	21.55			Far East	8.28	17.27	2.09
Sum all Regions	43.62			Sum all Regions	16.94	35.38	2.09
All Victoria	43.63			All Victoria	16.95	42.02	2.48
Value added (\$m)	Initial	Total	Type II ratio	Employment (FTE)	Initial	Total	Type II ratio
Far West	2.69	8.35	3.10	Far West	51	91	1.78
Near West	1.1	3.04	2.76	Near West	33	43	1.30
Melbourne	2.66	10.66	4.01	Melbourne	67	113	1.69
Near East	3.09	8.65	2.80	Near East	84	112	1.33
Far East	9.26	28.64	3.09	Far East	217	339	1.56
Sum all Regions	18.8	59.34	3.16	Sum all Regions	452	698	1.54
All Victoria	18.8	70.58	3.75	All Victoria	452	767	1.70

Source: Adapted from WRI (2019)

As with the state fisheries, added value and household income measures in the Melbourne region had the highest economic induced effects. Added value and employment economic indicators were highest in the far west and far east where most of the Commonwealth fishing activity occurs. The near west and near east regions had lower induced effects relative to, the far west, far east and Melbourne regions. Input-output multipliers can indicate the economic impacts of an increase or decrease in spending in an economy.

4.4 Regional Economic Impacts for the Victorian aquaculture sector

This section examines the regional economic modelling for aquaculture production in Victoria. The aquaculture gross value of production in Victoria in 2016/17 was \$39.3m. Since 2013-14 the total value of production has increased from \$25.4 million, an increase of approximately \$14 million in 4 years. Aquaculture has been a growing economic contributor to the local, Victorian and Commonwealth economic production base (Mosby 2018).

The project covers aquaculture production for the Victorian coast and inland regions as per the Australian Bureau of Statistics (ABS) Statistical Local Areas (SLA) reported in WRI (2019).

The output can be measured for the coastal and inland aquaculture areas and then for the whole of Victoria. The initial expenditure on inputs in the general economy of \$39m, produces of \$43.66m of economic output across the economy as reported in Table 16.

Table 16. Initial and flow-on economic impacts of commercial aquaculture on the total Victoria

Aquaculture Victoria				
Total Expenditure (\$40.0m)	Output (\$m)	Value added (\$m)	Household income (\$m)	Employment (FTE)
Initial	43.7	14.4	10.5	334
Flow-on		49.4	21.5	295
Total		63.8	32.1	629
Type II multiplier		4.43	3.04	1.88
Percent of region		0.01%	0.02%	0.02%

Source: Adapted from WRI (2019)

In Table 16 the direct initial output is \$43.7m and aquaculture in Victoria has a direct \$14.4m of value added, has an indirect flow-on in the economy of \$49.4m making a total of \$63.8m across the Victorian economy. The value added is the output, less the intermediate consumption (i.e. the costs of materials, supplies and services used to produce final goods or services). Similarly, there is a total of \$32.1m generated in household incomes. The initial direct Full Time Equivalent (FTE) employment is 334 jobs and there are then 295 indirect FTE jobs in supplying inputs for aquaculture businesses making a total employment of 629 jobs.

The total impact can be related as a ratio of the initial impacts and is referred to a Type II multiplier. For example, for added value \$63.8m/\$14.4m gives a Type II added value multiplier of 4.43.

The Type II, income and employment multipliers are 3.04 and 1.88 respectively for all of Victoria. These indicate the dimensions of multiplication in the general economy associated with aquaculture production. In Table 17 the initial and flow-on for value added, household income and employment are reported for each of the aquaculture study areas in Victoria.

Table 17. An overview of the output, valued added, household income and employment in the inland and coastal aquaculture areas, and all Victoria in 2016-17

Aquaculture Inland				
Total Expenditure (\$22.3m)	Output (\$m)	Value added (\$m)	Household income (\$m)	Employment (FTE)
Initial	24.6	7.4	5.1	145
Flow-on		25.5	10.6	140
Total		32.9	15.7	285
Type II multiplier		4.43	3.08	1.97
Percent of region		0.01%	0.01%	0.02%
Aquaculture Coastal				
Total Expenditure (\$17.5m)	Output (\$m)	Value added (\$m)	Household income (\$m)	Employment (FTE)
Initial	19	7	5.4	189
Flow-on		15.6	5.3	83
Total		22.6	10.7	272
Type II multiplier		3.24	1.97	1.44
Percent of region		0.05%	0.06%	0.11%
Aquaculture Victoria				
Total Expenditure (\$40.0m)	Output (\$m)	Value added (\$m)	Household income (\$m)	Employment (FTE)
Initial	43.7	14.4	10.5	334
Flow-on		49.4	21.5	295
Total		63.8	32.1	629
Type II multiplier		4.43	3.04	1.88
Percent of region		0.01%	0.02%	0.02%

Source: Adapted from WRI (2019)

The economic significance of an industry, such as aquaculture, can be measured in terms of direct and indirect effects. The direct effects from the initial expenditure are a measure of the value of output of the industry itself, added value, the number of people employed and the income they receive. The indirect effects, of flow-on reflect induced indirect responses in the economy.

The multipliers indicate the size of those impacts relative to the level of sales to final demand. The Type II ratios reflect the relationship between the total impact (direct and indirect) to the direct effect. The calculation of multipliers from aquaculture will only include the linkage effects that occur back through the supply of inputs to aquaculture producers and not any effects downstream towards the consumer.

4.5 The Economic Impacts that include the Victorian post-harvest processing sector

The secondary sector includes fish processors, wholesalers, retailers and food services, including cafes, restaurants and fish and chip shops. Generally, the volume of fish reduces in the secondary sector due to fish cleaning and processing. However, the value of the finished fish product increases along the supply chain to the retailer and then has value added in the food services arena.

Unfortunately, there is no monitoring or data collected on the prices at different points in the Victorian seafood sector supply chain. It is difficult to accurately estimate a total value for the secondary sector. The secondary chain also varies between products like abalone and rock lobster with high handling costs when exported live, and fish which may require processing and hence more labour and other

inputs in the seafood chain. Analysis of the whole Victorian secondary sector is also made more difficult by the State data available impacted by interstate trade and international exports.

Past studies of the economics of the secondary processing, wholesaling and retailing sector within Australia are limited as the fish landed travel along different marketing pathways and become part of the food industry more generally. In South Australia and NSW there have been regional and total impacts studies (Econsearch 2013, 2016, 2018, Harrison 2010, Voyer et.al. 2015; WRI 2015). In Victoria there have been limited studies involving the economic impacts of the secondary sector with the most recent being for the Port of Lakes Entrance (Econsearch and Roberts Evaluation 2014).

While the economic questionnaire was for seafood producers, some respondents had vertically integrated businesses into the secondary sector which enabled discussion of the relationship along the value chain.

Other data on the secondary sector is collected by the Victorian government food safety agency, Primesafe, which provides a source of information on the relationship between the primary and second sectors, as reported in Table 18.

Table 17. The numbers of approved licenced wild catch, seafood and seafood retailers

Licenced businesses	2017/18	2016/17	2015/16	2014/15	2013/14
Wildcatch businesses	188	191	205	223	228
Seafood processing facilities	155	149	148	148	144
Seafood retailers	195	195	211	202	209

Source: Primesafe (2018)

For 2016-17, Table 18 shows that there were 191 licenced fishing businesses registered with Primesafe, and 149 seafood processing and 195 seafood retailers. The data show a 17% decline in the number of wild catch fishing businesses and 6% decline in seafood retailer numbers since 2013-14. There has been an increase in seafood processing facilities.

Data on sales by the wild catch sector collected in the 2016-17 economic survey are reported in Table 19.

Table 19. Survey responses to question on sales by professional fishers

Stated % of sales	Comments
19% local sales	Sold locally often in vertical intergated businesses
30% local processor	Much may end up as exports after processing
26% Out of local area, in Victoria	To Melbourne and then end up as exports?
22% Outside Victoria	Sydney or exported
3% Exported	Exported

Source: Economic survey for 2016-17

The survey only reported on the first sale transaction and the final destination of the product was not recorded. The pattern in the abalone and rock lobster sectors is less diverse as most is eventually exported to China, although some product was initially recorded as “local sales” as it enters the supply chain at local processors which then end in an overseas market.

Another study estimated that for 7,447t of catch processed or handled by processing businesses in Lakes Entrance (far east region): 3% remained in East Gippsland; 86% was sent to Melbourne and 11% was sent interstate or overseas (Econsearch and Roberts Evaluation 2014). Of the processed catch sent to Melbourne, 80% went to the Melbourne fish market, 10% direct to retailers and 10% direct to restaurants. However, these figures may have changed in the years since the study.

The most reliable data for the processing industry is in the Australian Bureau of Statistics (ABS) data on Australian industries where Seafood Processing is coded as ANZSIC (1120) under Manufacturing industries (ABS 2019). These data indicate the employment, added value and household income for the Seafood processing industry nationally. This study uses the data to generate a “secondary sector adjustment ratio” which expresses seafood process as a proportion of the value of the primary sector. This enables the processing sector data to be estimated. For the whole of Victoria, the secondary sector ratios expressing the processing sector relative to the primary estimates were: Added Value: 0.85, Household Income: 0.766 and Employment: 0.66. These were derived from ABS (2019) at a state level. However, it should be noted that at the more disaggregated regional level, applying the ratio may be less accurate, if processing is not actually happening in that specific region. The secondary sector adjustment ratios were applied to the primary sector data as presented in Table 20. The regional economic modelling revealed that in 2016/17, for the State professional fishing sector, the associated processing sector had direct contributions of \$18m of added value, \$10m of household income and 197 full time jobs derived from State-managed fisheries (Table 20).

For the Commonwealth professional fishing sector, the associated processing sector estimates for 2016/17 show the direct estimates were, \$11m of added value, \$13m of household income and 258 full time jobs associated with Commonwealth fish catch in Victoria (Table 20).

For aquaculture we assume the processing sector is similar to the processing sector for the Victorian professional fishers (ABS 2019). For aquaculture, the processing sector in 2016-17 had \$8m added value, \$10m Household income and 190 jobs in Victoria derived from Victorian aquaculture (Table 20).

It is important to note that in processing there is a high number of part time employment, and therefore the FTE estimates would translate into many more part time and casual jobs among the processing sector.

4.6 Summary of overall results for Victoria

The combined State and Commonwealth professional fishing and aquaculture industry, in 2016-17, contributed direct and indirect added value of \$323m, \$186m of household income and 3,101 jobs through professional fishing, aquaculture and processing, in the Victorian economy³.

In the financial year of 2016/17, the State professional fishing and processing sector contributed \$112m added value, \$55m in household income and the sectors employ 909 full time jobs in Victoria.

In the financial year of 2016/17 the Commonwealth fishing and processing sectors contributed \$111m added value, \$74m Household income and 1,205 jobs in Victoria.

³³ Note: Previous Tables 8 to 17 were for the fishing and aquaculture industry only, but table 20 includes processing and its indirect effects.

In the financial year of 2016/17, the aquaculture production and processing sector contributed \$100m of added value, \$56m of household income and 988 full time jobs.

Table 20. A combined total economic impact for State and Commonwealth professional fishing, aquaculture and processing in Victoria

All Victoria state professional fishing	Output (\$m)	Added Value (\$m)	Household Income (\$m)	Employment (FTE)
<i>Direct</i>				
Catching sector	51	32	13	346
Processing		18	10	197
<i>Indirect</i>		62	32	366
Total impact (direct + indirect)		112	55	909
All Victoria Commonwealth professional fishing	Output (\$m)	Added Value (\$m)	Household Income (\$m)	Employment (FTE)
<i>Direct</i>				
Catching sector	44	19	17	452
Processing		11	13	258
<i>Indirect</i>		81	44	495
Total impact (direct + indirect)		111	74	1,205
All Victoria Aquaculture	Output (\$m)	Added Value (\$m)	Household Income (\$m)	Employment (FTE)
<i>Direct</i>				
Aquaculture production sector	44	14	11	334
Processing		8	10	190
<i>Indirect</i>		77	35	463
Total impact (direct + indirect)		100	56	987
Combined State, Commonwealth & Aquaculture	Output (\$m)	Added Value (\$m)	Household Income (\$m)	Employment (FTE)
<i>Direct</i>				
Catching + Aquaculture production sectors	138	65	41	1,132
Processing		37	33	645
<i>Indirect</i>		221	112	1,324
Total impact (direct + indirect)		323	186	3,101

Source: Adapted from WRI (2019) and ABS 2019

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