Economic Research Associates

Economic Impact Study

Commercial Fishing in Western Australia

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Executive Summary

Commercial Fishing in Western Australia

Licensing of commercial fisheries in Western Australia first occurred in the 1960's when the West Coast Rock Lobster fishery was declared a limited entry fishery. Since this time the concept has developed rapidly to the point that entry to most fisheries under the control of the Western Australian Fisheries Act is either currently restricted, limited or the subject of immediate plans for such restrictions.

Commercial fisheries in Western Australia are dependent on high value, low volume products. In 1991/92 the value of the total commercial catch was $455 million. This included $81 million from aquaculture.

Over 90% of the value of the Western Australian catch comes from three fisheries;

- the West Coast Rock Lobster fishery;

- the pearling industry; and

- West Coast Prawn fisheries encompassing the Exmouth Gulf, Shark Bay and Nickol Bay prawn fisheries.

Recent Trends in Commercial Fishing Activity

Western Australia is the largest contributor to the total quantity and value of Australian fisheries production of all the states and territories. In 1991/92 Western Australia accounted for 26% of the quantity and 34% of the value of Australian fishery production. In 1990/91, when the catch was more typical, Western Australia accounted for 18% of the quantity and 28% of the value.

In 1991/92 the total commercial catch from Western Australian fisheries was 55,385 tonnes. The year was a record for Western Australian fisheries in terms of quantity and value. This was primarily due to the large catch of scallops achieved for the year.

Over the last seventeen years the catch in Western Australia has grown at an average annual rate of 10% per annum. Figure 1 shows the total commercial catch each year over the seventeen year period. A linear trend has been fitted to the data and is shown as the solid line in the graph.
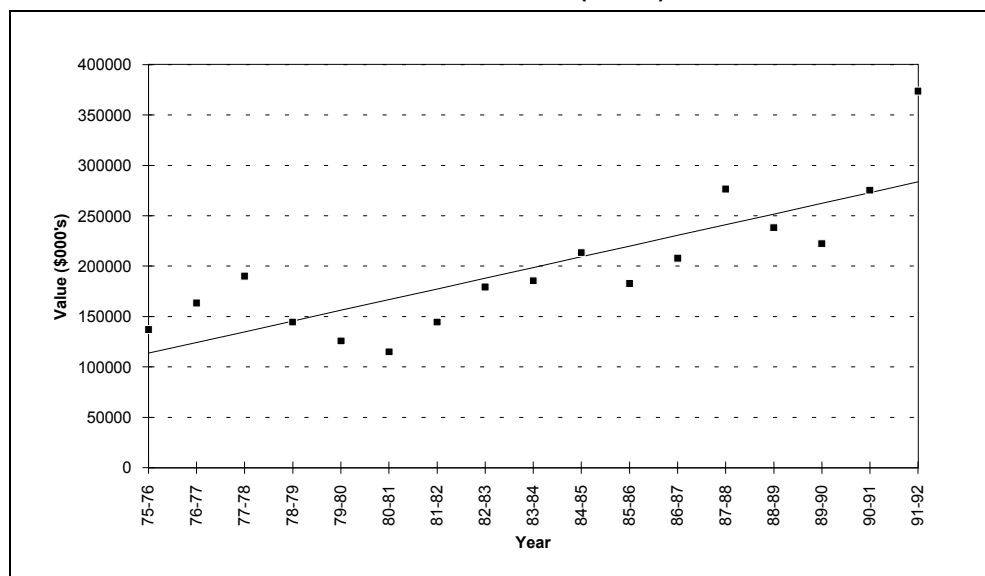
Figure 1.   **Total Commercial Catch - Western Australia (Tonnes)**
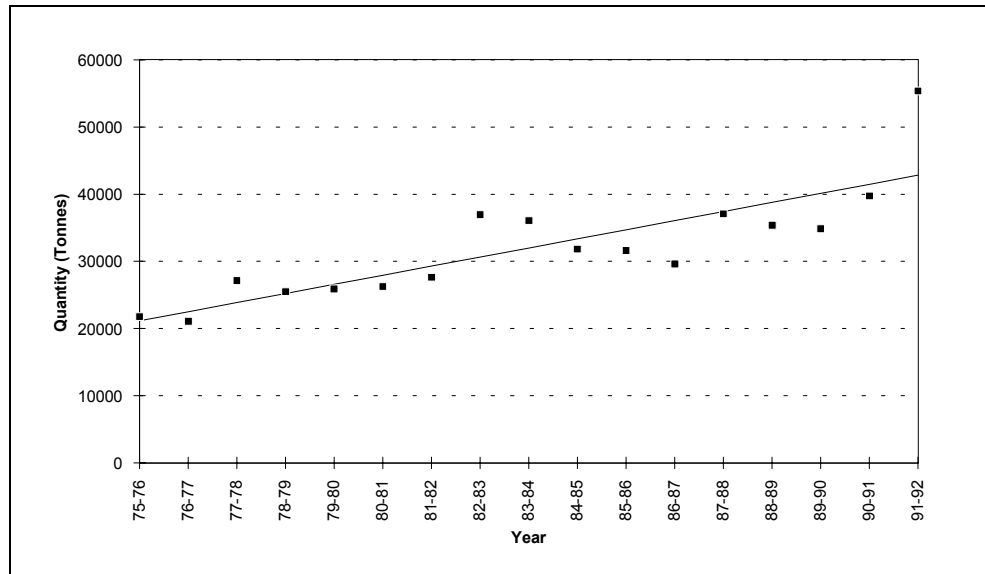
Source: ABS and ABARE

Excluding aquaculture, the gross value of fisheries production in 1991/92 was $374 million (1991/92 dollars). Since 1975/76 the gross value has grown at an average rate of 11% per annum in real terms. Figure 2 below shows the value of commercial catch in 1991/92 dollars together with the associated linear trend.
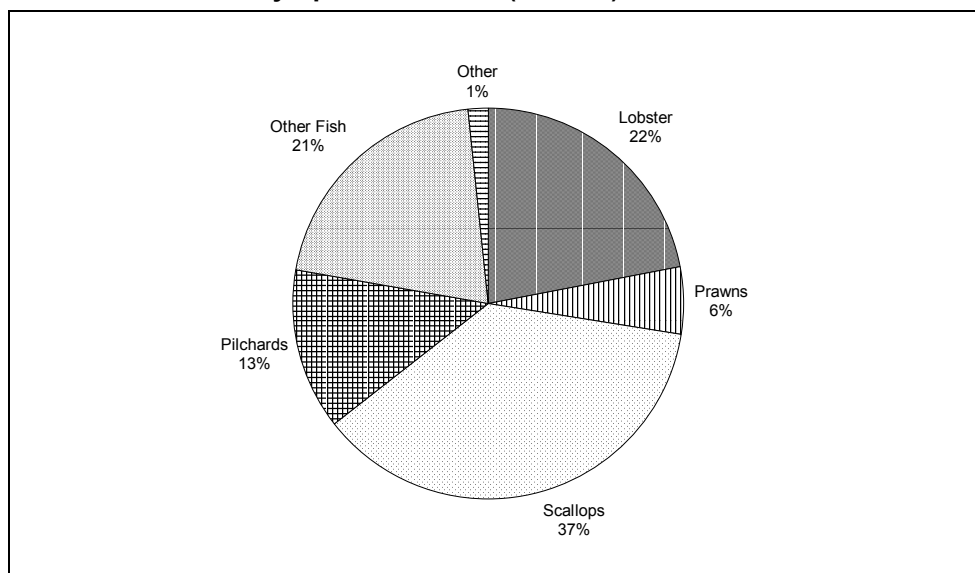
Figure 2.   **Total Commercial Catch - Western Australia (Value)**

Source: ABS and ABARE

Figure 3 shows the break down of the Western Australian commercial catch by species in terms of weight. Scallops accounted for the largest proportion of the catch (20,539 tonnes) followed by Rock Lobster (12,202 tonnes). The main species included as 'Other fish' (11,455 tonnes) were shark (2,1136 tonnes), salmon (1,306 tonnes), herring (1,298 tonnes) and snapper (1,192 tonnes).
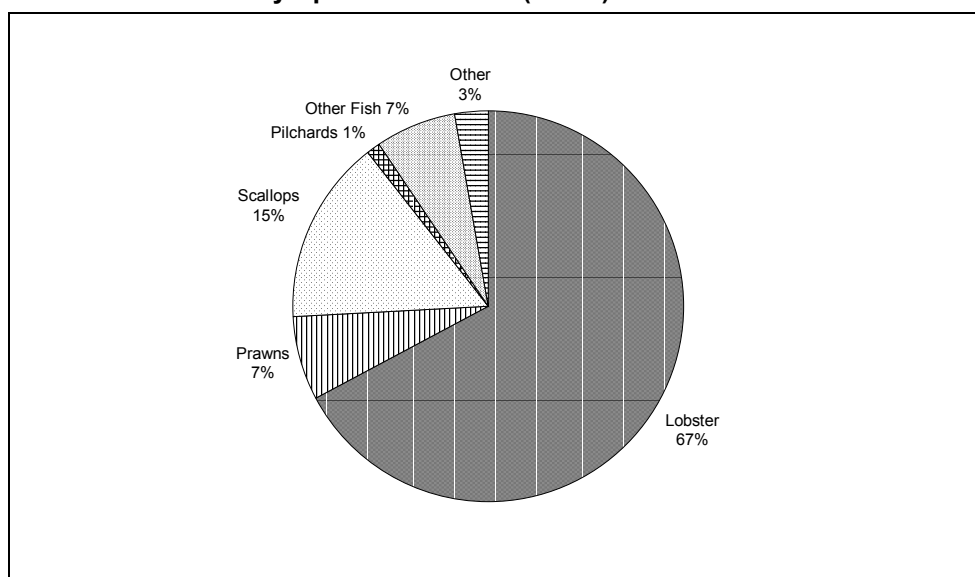
Figure 3.   **Commercial Catch by Species 1991/92 (Tonnes)**

Source: ABARE

Rock lobster is the dominant fishery in Western Australia in terms of value. In 1991/92 the value of the rock lobster catch was $252 million. Rock lobster and prawns combined accounted for 74% of the total value of the commercial catch.

Figure 4.   **Commercial Catch by Species - 1991/92 (Value)**

Source: ABARE

Economic Impact

The measurement of economic impacts in this study concentrates on employment and income impacts which flow from the operation of the commercial fishing industry.

The direct impacts on income and employment flow from the economic activity that is directly related to the commercial fishing activity. Flowing on from these direct impacts are indirect impacts on income and employment which are generated because of the backward linkages between the agencies and firms directly involved with commercial fishing activity and firms in the rest of the economy who supply them. Additional impacts flow from the fact that the production of the various directly related commercial fishing

activities, together with the production of goods and services in supplying industries, gives rise to additional household incomes being generated in the economy.

The primary information required for the analysis of economic impact was the number of people employed directly in comercial fishing activities, the associated wage and salary expenditure, the value of fishing activity and the major operational and capital expenditure items. In order to collect these data a mail survey was undertaken of the holders of commercial fishing licences.

The direct impact associated with commercial fishing activity will give rise to further impacts in the form of flow on effects. These arise as a result of the additional output, income and employment generated in those industries supplying the goods and services for commercial fishing firms. The increased household incomes generated in this process will cause increases in general consumption expenditure thereby inducing further production, income and employment increases. In order to estimate the flow on effects associated with a given activity, a multiplier is applied to the direct impact estimates.

The overall impacts associated with commercial fishing operations in Western Australia, are set out in the following table.

Table 1.   **Summary of Economic Impact Associated with Commercial Fishing in Western Australia**

	Output ($mill)	Household Income ($mill) (2)	Employment (Job Equivalents) (3)
Direct Impact	424.3	113.7	4002
Production Induced Effects	246.1	76.6	3482
Induced Consumption Effects	271.3	88.2	4922
Total Impact	**941.7**	**278.5**	**12406**

Based on survey results the direct employment impact of comercial fishing is estimated to be approximately 4002 full time equivalent jobs. These are jobs that can be attributed directly to commercial fishing and firms and agencies whose activity is directly linked to fishing. .

In conjunction with the employment impact commercial fishing generates significant income impacts. The total wages and salaries expenditure associated with the direct employment impact is estimated to be approximately $113.7 million. This implies an average wage/salary across the total estimated direct employment of approximately $30,000.
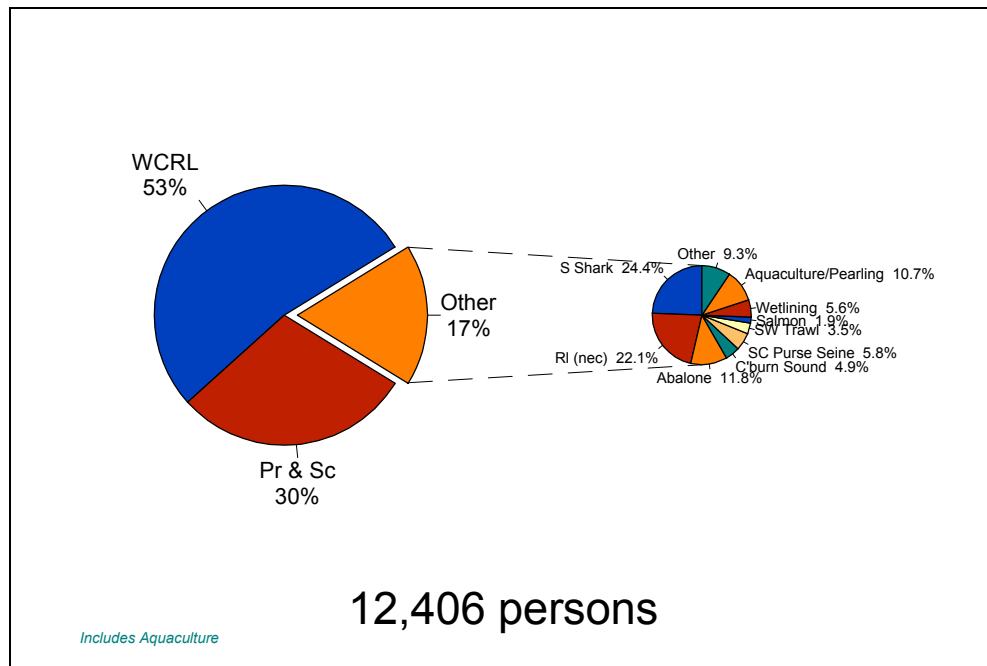
The aggregate direct employment of 4002 is estimated to increase to 7,484 when the Type I multiplier is used. This impact flow-on accounts for the direct plus production induced effects associated with the industry. If we allow for the induced consumption effects, that is use the Type II multiplier, the total employment impact increases to 12,406. At 12,406 full time job equivalents commercial fishing activity accounts for approximately 1.4 percent of total Western Australian employment.

The direct wages and salaries of $113.7 million becomes $190.3 million using the Type I multiplier and $278.5 million using the Type II multiplier.
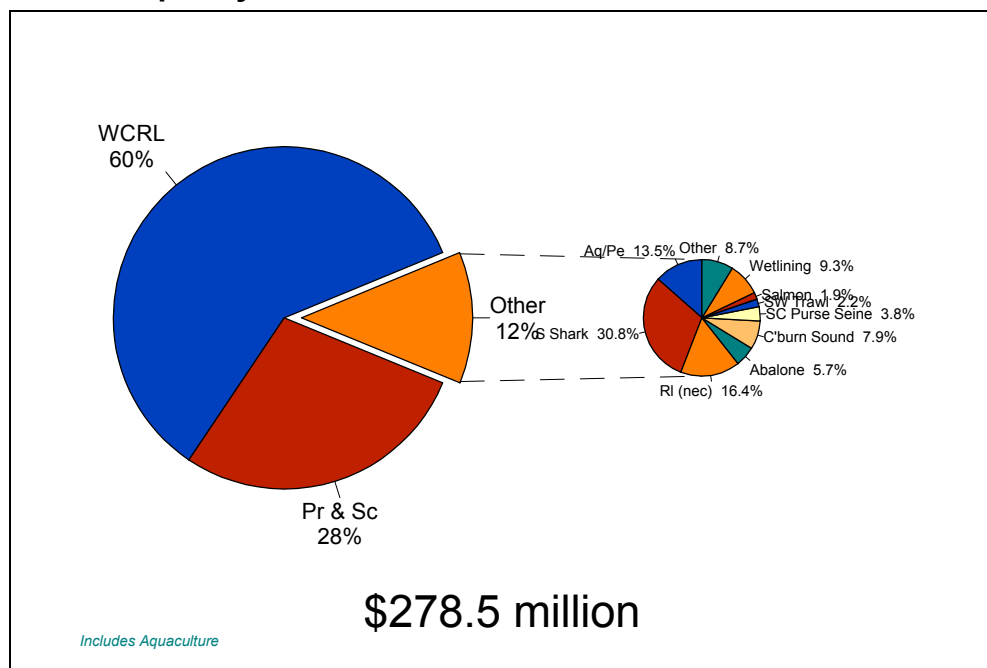
Based on the survey results, the gross value of production associated with commercial fishing is estimated to be $424.3 million. This gives an aggregate output impact of $941.7 million using a Type II multiplier.

The output, income and employment effects are spread over a range of fisheries as shown in the following charts.

Figure 5.   Total Employment by Main Fisheries

WCRL 53%

Other 17%

Pr & Sc 30%

S Shark 24.4%
Other 9.3%
Aquaculture/Pearling 10.7%
Wetlining 5.6%
Salmon 1.9%
SW Trawl 3.5%
SC Purse Seine 5.8%
C'burn Sound 4.9%
Rl (nec) 22.1%
Abalone 11.8%

12,406 persons

Includes Aquaculture

Figure 6.   Total Output by Main Fisheries

WCRL 60%

Other 12%

Pr & Sc 28%

Aq/Pe 13.5%
Other 8.7%
Wetlining 9.3%
Salmon 1.9%
SW Trawl 2.2%
SC Purse Seine 3.8%
C'burn Sound 7.9%
Abalone 5.7%
S Shark 30.8%
Rl (nec) 16.4%

$278.5 million

Includes Aquaculture

Figure 7.   Total Output by Main Fisheries

WCRL
59%

Aquaculture/Pearling 24.3%

Other
14%

Pr & Sc
27%

S Shark 25.6%

Other 8.4%
Wetlining 8.4%
Salmon 2.8%
SW Trawl 1.7%
SC Purse Seine 3.5%
C'burn Sound 4.6%
Abalone 5.9%
RI (nec) 14.8%

$941.7 million

Includes Aquaculture

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1 Introduction

Background

Competition exists for the aquatic resources in Western Australia from three broad areas: commercial fishing, recreational fishing and aquaculture. In 1991 Economic Research Associates undertook an analysis of the economic impact on Western Australia of recreational fishing activities in the State. On completion of this study the Western Australian Fishing Industry Council (WAFIC) suggested that a comparable study should be undertaken for the commercial fishing industry. The results of this study are presented in this report.

Scope and Purpose of Study

The current study seeks to document the extent of the economic activity which is directly related to commercial fishing activities in Western Australia and the magnitude of the flow-on effects which these have in the rest of the economy. Impacts are measured in terms of employment and household incomes generated and flow on effects are estimated using multipliers from the Western Australian input-output table.

Commercial fishing is a substantial industry in Western Australia. For 1991/92 ABARE estimates that the total value of fish caught in Western Australian fisheries was $455.0 million (including Aquaculture). In addition to describing the economic impact associated with this level of activity this study also presents an overview of the role of commercial fishing in the economy and how it is placed to meet the demands of future growth.

The study was designed in such a way that would provide to the greatest extent possible compatibility with the previous recreational fishing study.

Information such as that assembled in this study is an effective way to gain greater insight into both the social role and the economic impact of the the industry.

Structure of the Report

The report has four main chapters and four appendices.

Chapter Two presents a detailed overview of recent trends in catch and in fishery management. This is essential background information to the analysis of economic impacts. Conventional economic impact analysis measures the impact of an industry at a point in time. The data presented in Chapter Two documents the current position of the industry in terms of the volumes and value of catch by type. Recent trends in each of these activities are presented which illustrate the extent to which the industry is experiencing growth which will increase its flow-on effects in terms of economic activity in the future.

The only effective way to obtain the data needed for the economic impact estimates was to survey commercial fishing licence holders regarding their level of fishing activity, income, expenditure and employment. Chapter Three discusses the survey metholodgy including estimates of the number of fishing boat licences by fishery and survey response rates. Chapter Four presents the survey results and the population estimates based on scaling the survey results to reflect the total commercial fishing industry in Western Australia.

The economic impact results are presented in Chapter Five. This chapter also presents an overview of the methodology used to analyse the economic impact associated with the industry. It highlights the need to undertake surveys of commercial fishing licence holders in order to estimate the direct impact associated with the industry and discusses the application of multiplier analysis to the resulting estimate. The estimates of the direct and indirect effects on employment, household incomes and output which flow from the current level and pattern of activity in the industry are presented.

Appendix A presents a brief description of the input-output methodology which is the basis for the multipliers used in this study. Appendix B presents in detail the various industry multipliers for the Western Australian economy. Appendix C presents complete sets of the questionnaires used in the survey of fishers and Appendix D gives the full data base on activity within Western Australian fisheries which was used to undertake the analysis in Chapter Two.

2 Recent Trends

Introduction

Fisheries management activities in Western Australia can be grouped under four main headings:

1. Commercial fishing

2. Aquaculture

3. Recreational fishing and

4. Commonwealth fisheries and foreign fishing.

The discussion in this chapter is limited to activity in the commercial fishing industry with brief reference to Commonwealth fisheries off the Western Australian coast.

Commercial fisheries in Western Australia are dependent on high value, low volume products. In 1991/92 the value of the total commercial catch was worth $455 million which included $81 million from aquaculture[1].

Over 90% of the value of the Western Australian catch comes from three fisheries;

• the West Coast Rock Lobster fishery;

• the pearling industry; and

• West Coast prawn fisheries encompassing the Exmouth Gulf, Shark Bay and Nickol Bay prawn fisheries.

In order to describe the value of the fishing industry, an overview of recent trends is presented in this section in terms of catch volume and value for the major fisheries. While this information is valuable in its own right it also forms the context in which the survey results and the economic impact results can be assessed. In particular, it describes the background activity level which gives rise to the substantial economic impact documented later in the report.

The data has been obtained from Fisheries Department of WA, the Australian Bureau of Statistics (ABS) and the Australian Bureau of Agricultural and Economic Research (ABARE) publications.

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[1] Aquaculture in this context differs from the definition used in this report. For this reason aquaculture has been excluded from the discussion in this chapter. For a definition of aquaculture as it relates to this report see Chapter 3.

The focus of the analysis is the seventeen year period 1975/76 to 1991/92. As much as possible the information is presented graphically with percentages rounded to the nearest whole number. Where totals do not add to 100%, it is due to the rounding of the data. The tables of raw data used to compile the graphs in this Chapter are included in Appendix D.

The ABS stopped publishing much of the data used in this report in 1989/90 and so from this time the data has been sourced from ABARE. This potentially creates a break in the series with different definitions and reporting. Comparison of the 1989-90 information from each source was undertaken and as the differences were minor it is considered that this change has not adversely affected the analysis in this chapter.

Where data is expressed in value terms it has been converted to 1991/92 dollars using the agriculture, forestry and fishing price index of materials used in manufacturing industries.[2]

Commercial Fishing Licensing in WA

Licensing of commercial fisheries in Western Australia first occurred in the 1960's when the West Coast Rock Lobster fishery was declared a limited entry fishery. Since this time the limited entry concept has developed rapidly to the point that entry to most fisheries under the control of the Western Australian Fisheries Act is either currently restricted, limited or subject to immediate plans for such restrictions.

A restricted entry fishery is defined as a fishery where the number of vessels or fishermen with access to fishery is controlled by the numbers licensed, and the transfer of entitlements is not permitted or is partially restricted for policy reasons. Restricted entry fisheries management arrangements are applied to estuarine and beach fisheries, fisheries undergoing development or fisheries within an interim phase leading to the creation of formal limited entry fisheries.

A limited entry fishery is defined as a fishery where access to the fishery is controlled by vessel licensing and licences are normally transferable.[3]

In contrast, there are no restrictions on the number of vessels or on the use of specific types or quantities of fishing gear in an open access fishery.

Table 2-1 below list the status of the Western Australian fisheries.

Table 2-1.   **Western Australian Fisheries**

LIMITED ENTRY FISHERIES

West Coast Rock Lobster	Shark Bay Scallop
Windy Harbour / Augusta Rock Lobster	Esperance Rock Lobster
Shark Bay Prawn	Exmouth Gulf Prawn
Nickol Bay Prawn	Abrolhos Island Otter Trawl
Shark Bay Snapper	Abalone
Australian Salmon	King George Sound Pilchard
Southern Demersal Gillnet & Longline Fishery	Pearl Oyster
Bremer Bay Purse Seine	West Coast Purse Seine

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[2] Australian Bureau of Statistics Catalogue 6411.0. Price Indices of Materials used in Manufacturing Industries.

[3] Fisheries Department of Western Australia. Fisheries Management Paper No 21. Commercial fishing licensing in Western Australia. January 1989.

| South West Inshore Trawl | Kimberley Gillnet and Barramundi |
| Onslow Prawn | Pilbara Trap |

RESTRICTED ENTRY FISHERIES

Exmouth Gulf Beach Deine	Shark Bay Beach Deine
Swan-Canning Estuarine	Mandurah Estuarine
Leschenault Inlet Estuarine	Hardy Inlet Estuarine
South Coast Estuarine	Lake Argyle Catfish
Cockburn Sound	Kimberley Prawn
Australian Herring	West Coast Gillnet
Inshore South Coast Trawl	Aquarium Fish
Pilbara Fish Trawl	Charter boat fisheries
Specimen sea shells	

Examples of open access fisheries, or fisheries where no management plans are operative, include ocean blue manna crabs, dropline, troll and handline fisheries.

The term **fishing unit** will be used in this report. For most fisheries a fishing unit will refer to a single fishing boat, however in some cases it may refer to an individual fisherman.

Total Commercial Catch

Western Australia is the largest contributor to the total quantity and value of Australian fisheries production of all states and territories. In 1991/92 Western Australia accounted for 26% of the quantity and 34% of the value of Australian fishery production. In 1990/91, when the catch was more typical, Western Australia accounted for 18% of the quantity and 28% of the value.

In 1991/92 the total commercial catch from Western Australian fisheries was 55,385 tonnes. The year was a record year for Western Australian fisheries in terms of quantity and value. This was largely due to the large catch of scallops recorded for the year.

Over the last seventeen years catch in Western Australian has grown at an average annual rate of 10% per annum. Figure 2-1 shows the total commercial catch each year over a seventeen year period. A linear trend has been fitted to the data is shown as the solid line in the graph.

Figure 2-8.   **Total Commercial Catch - Western Australia (Tonnes)**
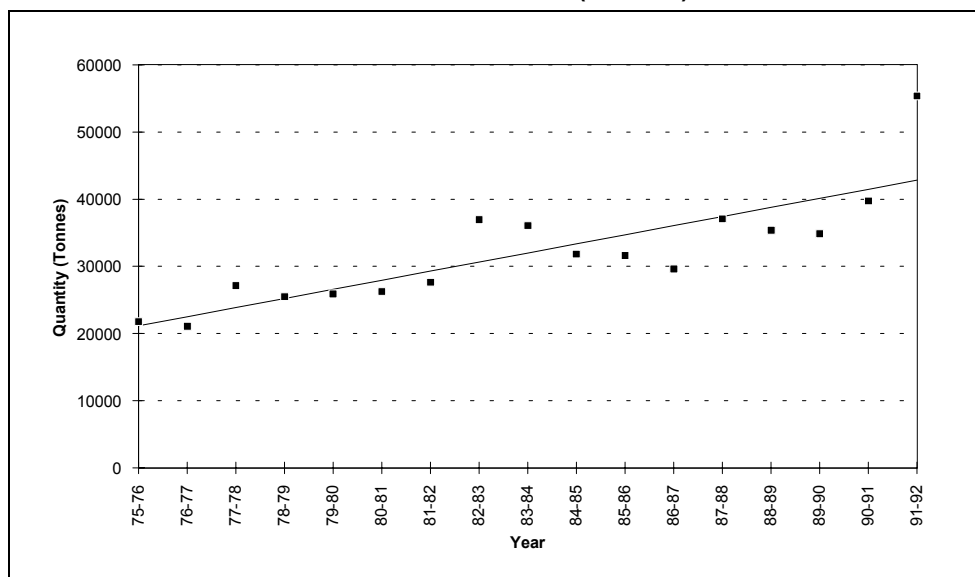
Source: ABS and ABARE

The gross value of fisheries production in 1991/92 was $374 million (1991/92 dollars). Since 1975/76 the value has grown at an average rate of 11% per annum in real terms. Figure 2-2 below shows the value of commercial catch in 1991/92 dollars. A linear trend fitted to this data and is shown as a solid line.

Figure 2-9.   **Total Commercial Catch - Western Australia (Value)**
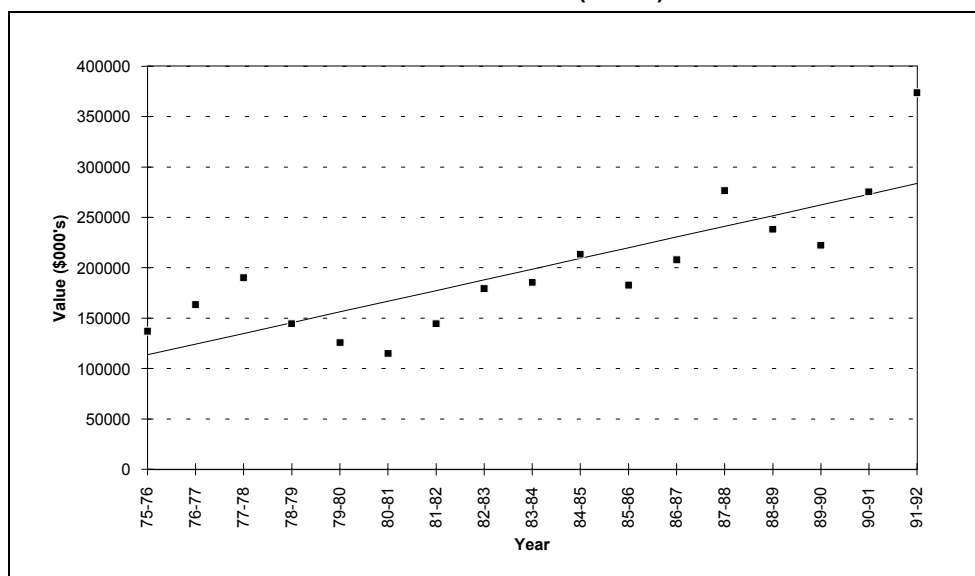
Source: ABS and ABARE

Catch by Species

Overview

Figure 2-3 shows the break down of the Western Australian commercial catch by species in terms of weight. Scallops accounted for the largest proportion of the catch (20,539 tonnes) followed by Rock Lobster (12,202 tonnes)[4]. The main species included as 'Other

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[4] As noted , 1991/92 was an unusual year; Rock Lobster has typically accounted for the largest proportion of the commercial catch in terms of weight and value.

fish' (11,455 tonnes) were shark (2,1136 tonnes), salmon (1,306 tonnes), herring (1,298 tonnes) and snapper (1,192 tonnes).

Figure 2-10.   Commercial Catch by Species 1991/92 (Tonnes)
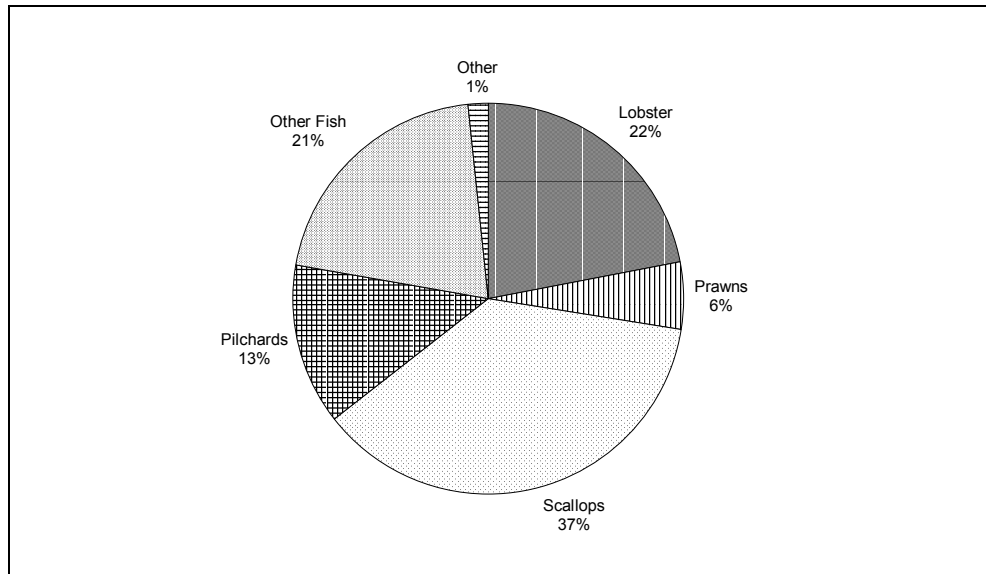
Source: ABARE

Figure 2-4 clearly shows the significance of rock lobster in terms of value. In 1991/92 the value of the rock lobster catch was $252 million. The value of rock lobster and prawn catch combined accounted for 74% of the total value of the commercial catch.

Figure 2-11.   Commercial Catch by Species - 1991/92 (Value)
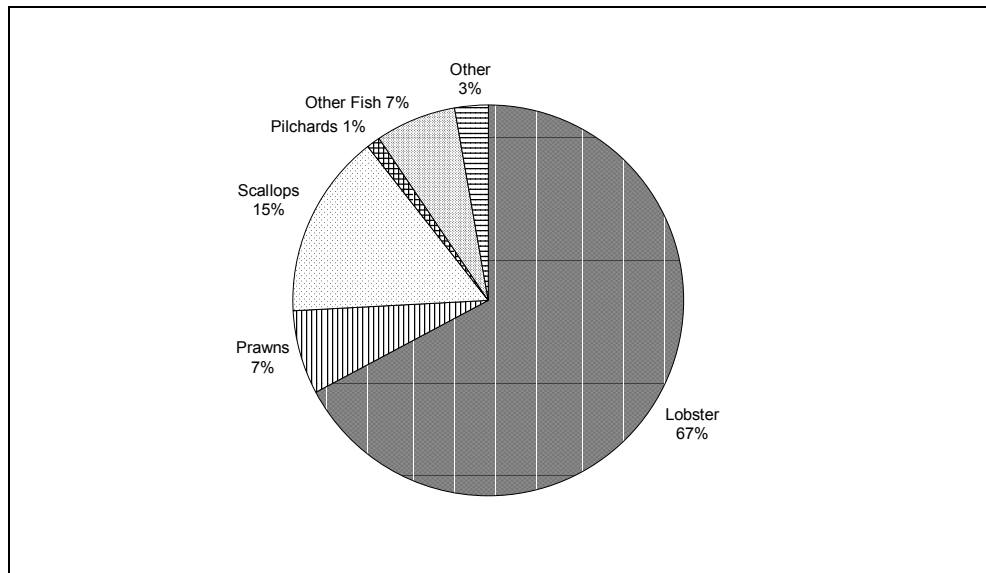
Source: ABARE

Rock Lobster

As seen in the figure above rock lobster accounted for 22% of the weight and 67% of the total value of Western Australian fisheries in 1991/92. Western Australian Rock Lobster accounted for 70% of the total value of the Australian Rock Lobster catch.

Figure 2-5 shows how the catch volumes have changed over time. Over the seventeen year period the average catch was 10,174 tonnes. The record of 15,721 tonnes was

achieved in 1982/83 and was nearly matched in 1991/92 when 15,565 tonnes were caught. Catch volumes fluctuate sunstantially about the mean reflecting the combined biological and management activity.

Figure 2-12.   Rock Lobster Catch (Tonnes)
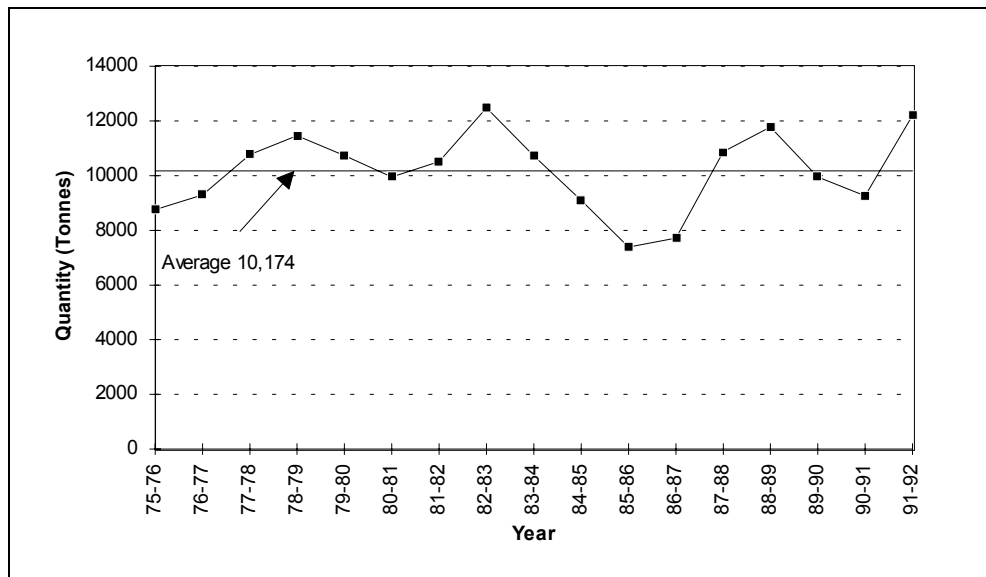
Source: ABS and ABARE

Figure 2-6 shows how the catch value has changed over time in 1991/92 dollars. The value of the catch has increased at an average annual rate of 11% in real terms. A linear trend has been fitted to the value data and is shown as a solid line.

Figure 2-13.   Rock Lobster Catch (Value)
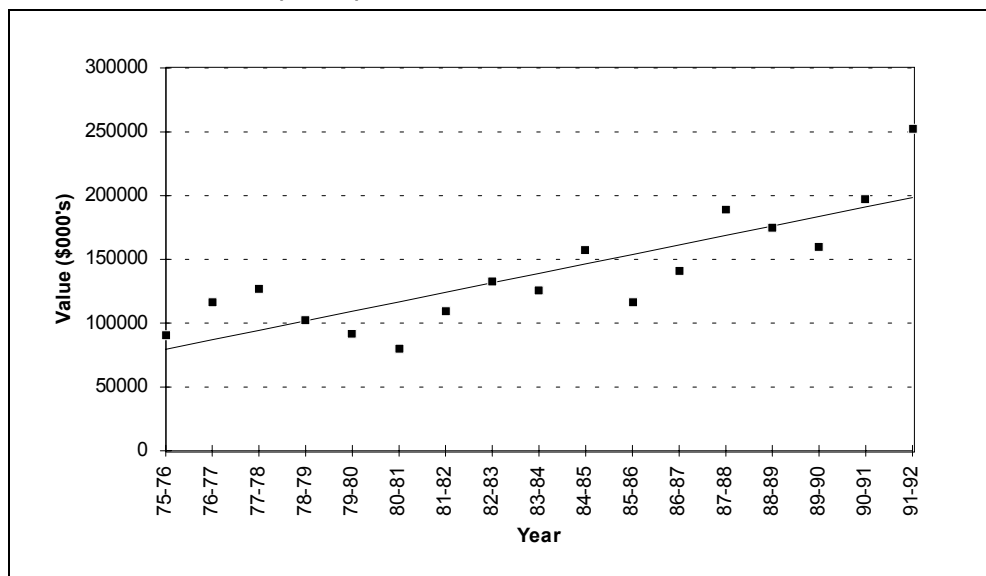
Source: ABS and ABARE

The increasing catch value in Figure 2-6 reflects the impact of increasing prices for rock lobster in real terms while catch (Figure 2-5) has been stable. The price rises have partially offset the volume or catch volatility documented in Figure 2-5. Even in the low catch years of 1985/86 and 1986/87 catch value was only slightly below its trend.

Figure 2-7 shows the average value per kilogram of rock lobster over the last seventeen years in 1991/92 dollars. The average value has increased at an average annual rate of 6.2% in real terms. In 1991/92 the average per kilogram value of Rock Lobster was $20.66. The solid line in the figure represents the linear trend fitted to the data.

Figure 2-14.   Rock Lobster Average Value
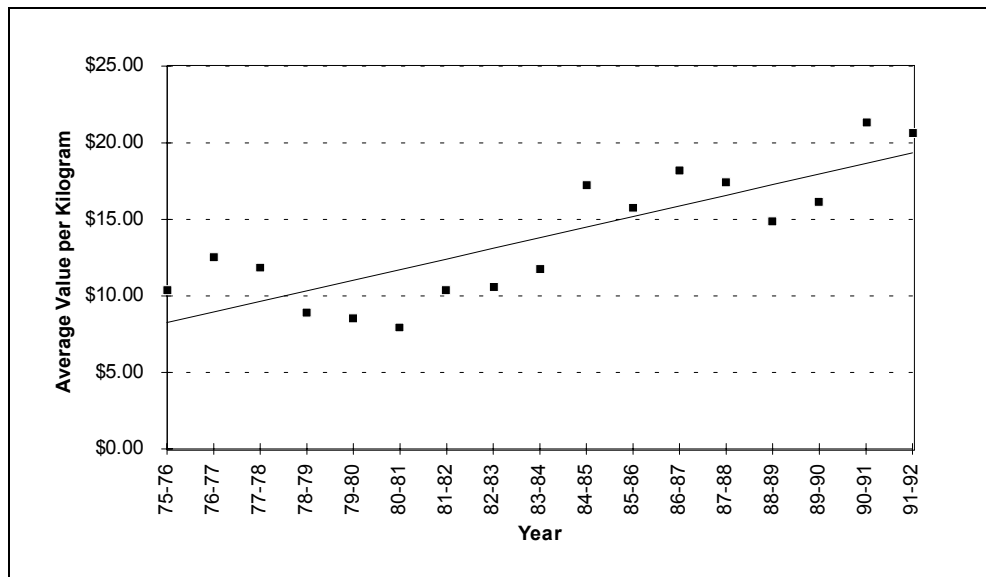
Source: ABS and ABARE

Fishing effort in the rock lobster industry is normally measured in terms of 'pot lifts', that is, the total number of times all pots are pulled in a season. Catch per unit of effort is shown in Figure 2-8 below.

Figure 2-15.   Rock Lobster Catch Effort
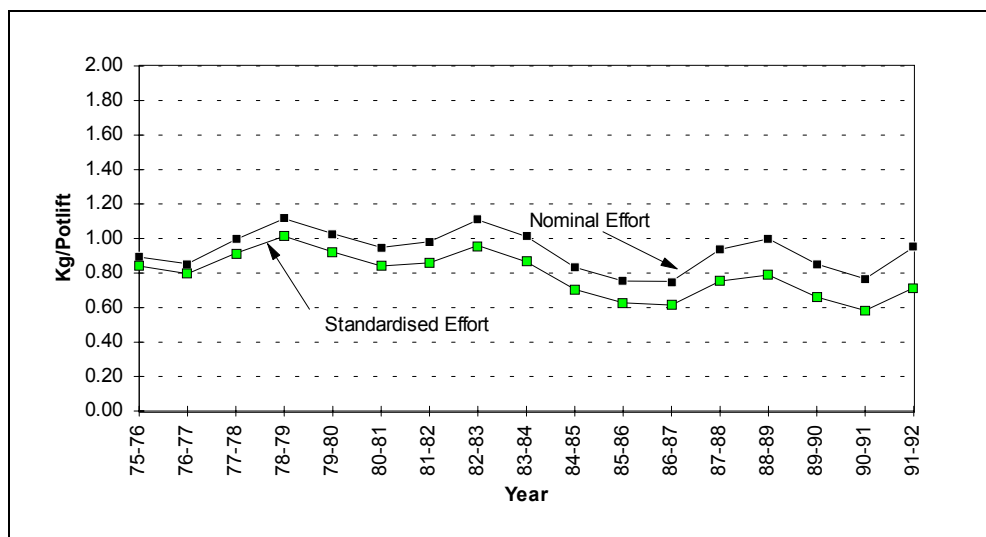
Source: Fisheries Department Western Australia

An alternative measure of fishing effort is a measure of the weight and value of the catch per man month and boat month over time[#] . Figure 2-9 shows the catch weight per man and boat month for a fourteen year period to 1989/90.

[#] The man hours and boat hours are actually higher than that included in the graphed data. The total used in the analysis excludes data that was 'not for publication' from the ABS. The effect is that the graphs are an overestimate of the weight and value per man months and boat month in all the graphs of this type in this chapter.

Figure 2-16. **Rock Lobster Fishing Effort (Tonnes)**
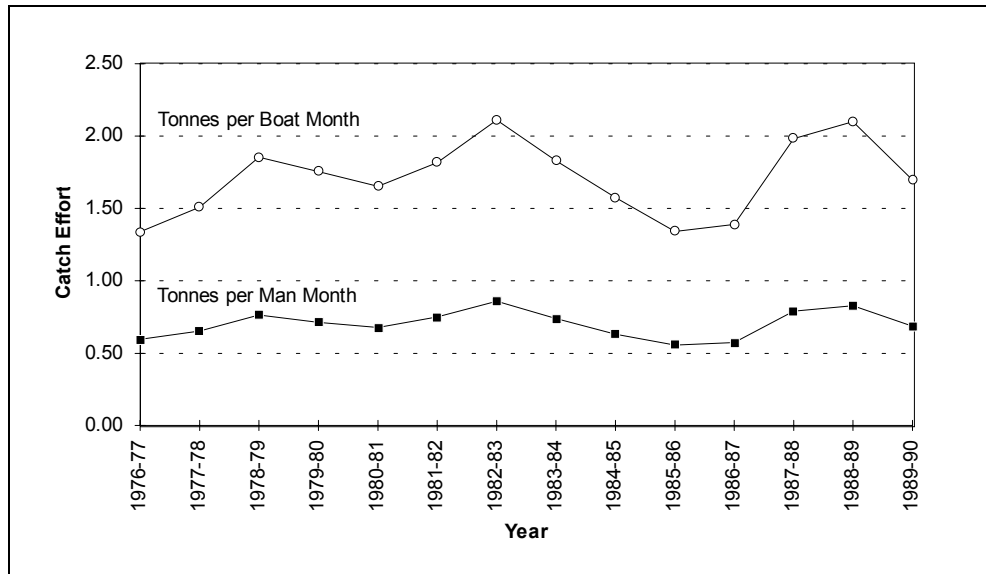
Source: ABS

Figure 2-10 shows the real catch value (1991/92 dollars) per man and boat month for a fourteen year period to 1989/90.

Figure 2-17. **Rock Lobster Fishing Effort (Value)**
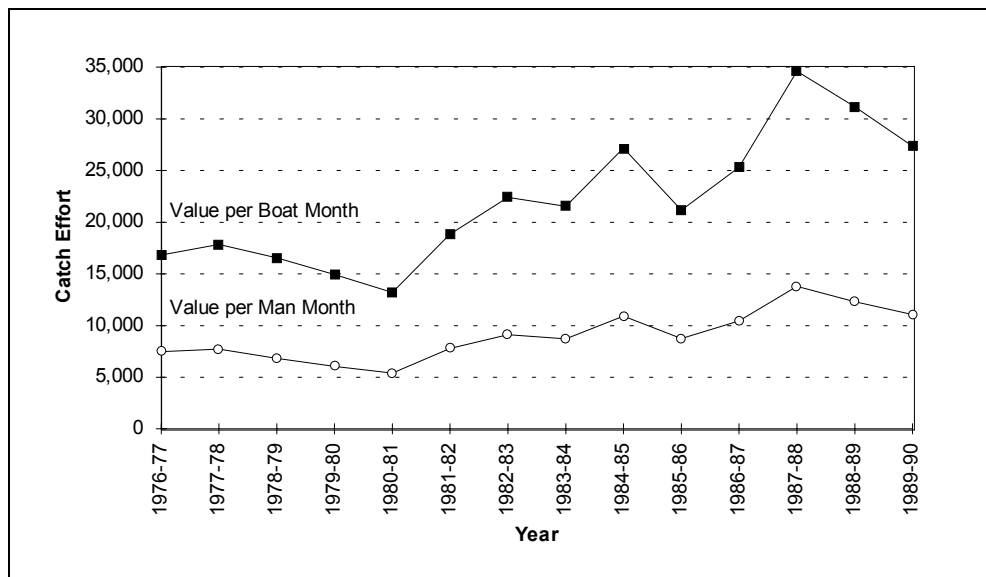
Source: ABS

Rock Lobster Fisheries

The West Coast Rock Lobster fishery, which extends from Nor West Cape to Cape Leeuwin, is the most important of Western Australia's commercial fisheries in terms of value. It was declared a limited entry fishery in 1963 and at the end of June 1992 there were 689 licensed boats and 69,300 pots. The number of licensed pots reached a maximum in 1965 of 76,632. Fishing effort is managed by means of controls on pots and input.

Other rock lobster fisheries exist in Western Australia. These include the Augusta-Windy Harbour Rock Lobster fishery, the Esperance Rock Lobster and the Tropical Rock Lobster. Table 2-2 below shows the major rock lobster fisheries and the years these fisheries were first managed.

Table 2-2. **Rock Lobster Fisheries**

Fishery	Pots Licensed (1991/92)	Year First Managed
West Coast Rock Lobster	69,300	1963
Augusta-Windy Harbour	1,058	1987
Esperance	514	1987

Source: Fisheries Department Western Australia

Pots can be transferred in these fisheries at market prices. In 1991/92 pot values ranged from $7,500 to $10,000, an increase over the previous years. Figure 2-11 shows the range of real pot values over time, all expressed in 1991/92 values.

Figure 2-18. **Rock Lobster Pot Values**
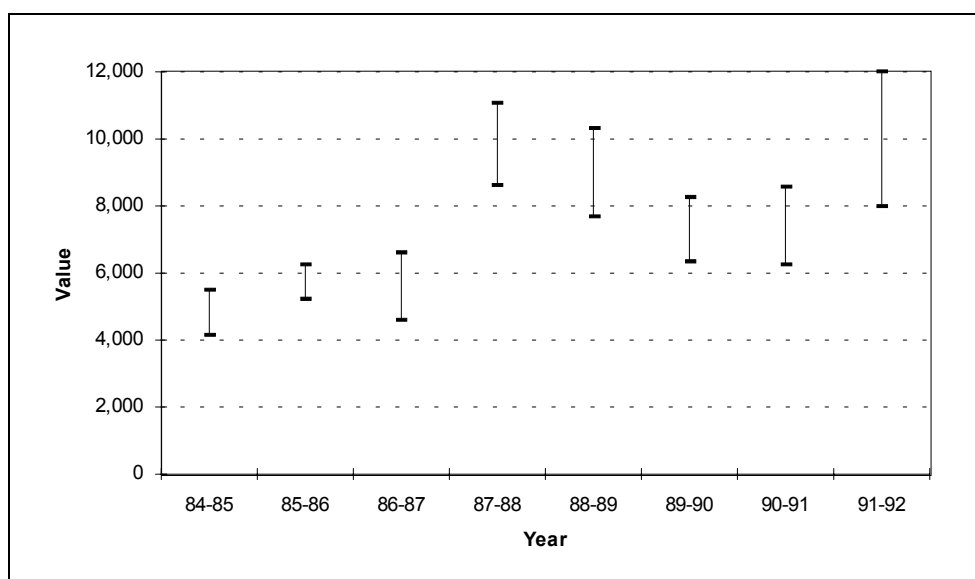
Source: Fisheries Department of Western Australia

Prawns

Prawns accounted for 6% of the weight and 7% of the value of the catch from Western Australian fisheries in 1991/92[5]. Of all the prawns caught in Australian state and Commonwealth fisheries, 10% of the value was from Western Australian fisheries in 1991/92.

Figure 2-12 shows how the catch volume for prawns has changed over time. Over the seventeen years the average prawn catch was 3,248 tonnes per year. This average reflects the high catch years of the early 1970's. Since 1980/81 the average prawn catch has been 3,079 tonnes per year, with not much variability about this figure.

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[5] This excludes the catch value of prawns from the Northern Prawn fishery. This is a Commonwealth fishery amd is discussed later in the chapter.

**Figure 2-19.**   **Prawn Catch (Tonnes)**
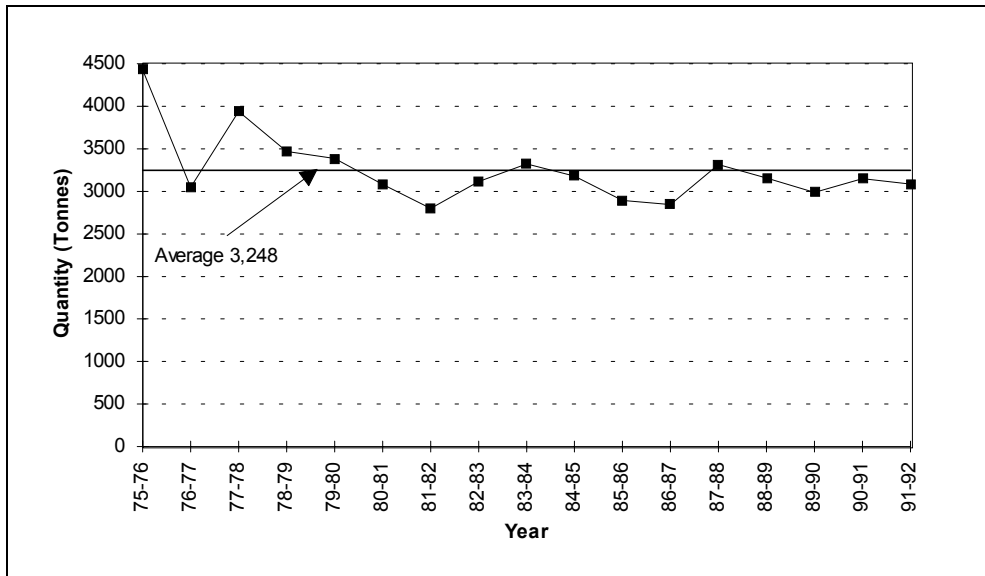
Source: ABS and ABARE

Figure 2-13 shows how the catch value has changed over time in real 1991/92 dollars. Over the seventeen years the average value of the catch in 1991/92 dollars was $28.0 million. In 1991/92 the catch was worth $25.2 million.

Figure 2-20.   **Prawn Catch (Value)**
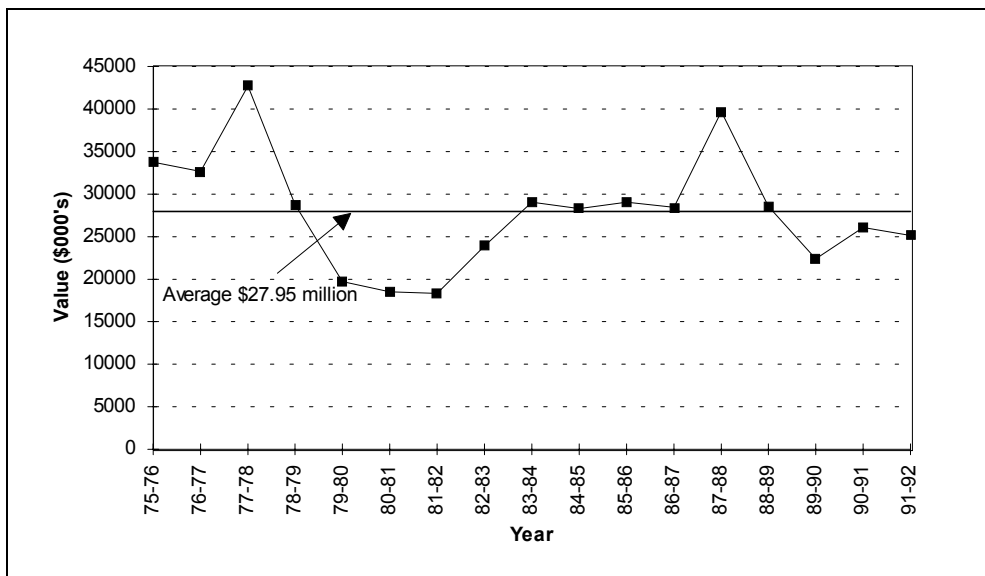
Source: ABS and ABARE

Figure 2-14 shows the average value per kilogram in 1991/92 dollars of prawn over the last seventeen years. Over the period the average value per kilogram was $8.60. A peak was reached in 1987/88 when the average value per kilogram was $11.98 expressed in 1991/92 dollars. In 1991/92 the average per kilogram value was $8.15. The average value for prawns has not been subject to anything like the increase that has occured for rock lobster.

Figure 2-21.   Prawn Average Value
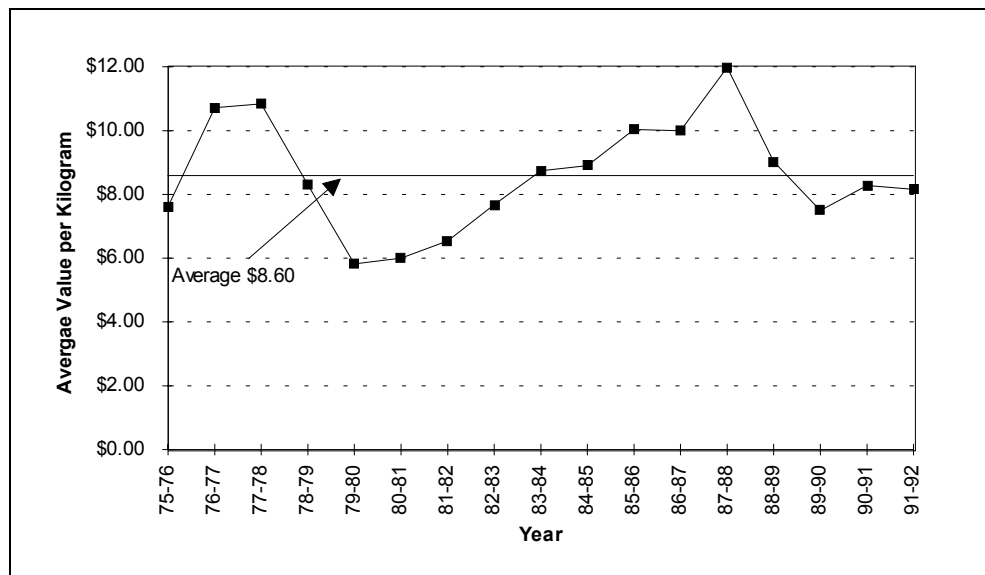
Source: ABS and ABARE

A measure of fishing effort in the prawning industry is the hours trawled. Figure 2-15 shows the hours trawled over the period 1963 to 1991 for the Exmouth Gulf fishery. As can be seen a steady increase in hours trawled was experienced until the late seventies when a maximum was reached in 1978 of 54,388 hours. In 1990/91 and 1991/92 the hours trawled was at its lowest since 1971 (36,182 and 36,008 compared to 29,706 respectively).

Figure 2-22.   Hours Trawled in the Exmouth Gulf Fishery
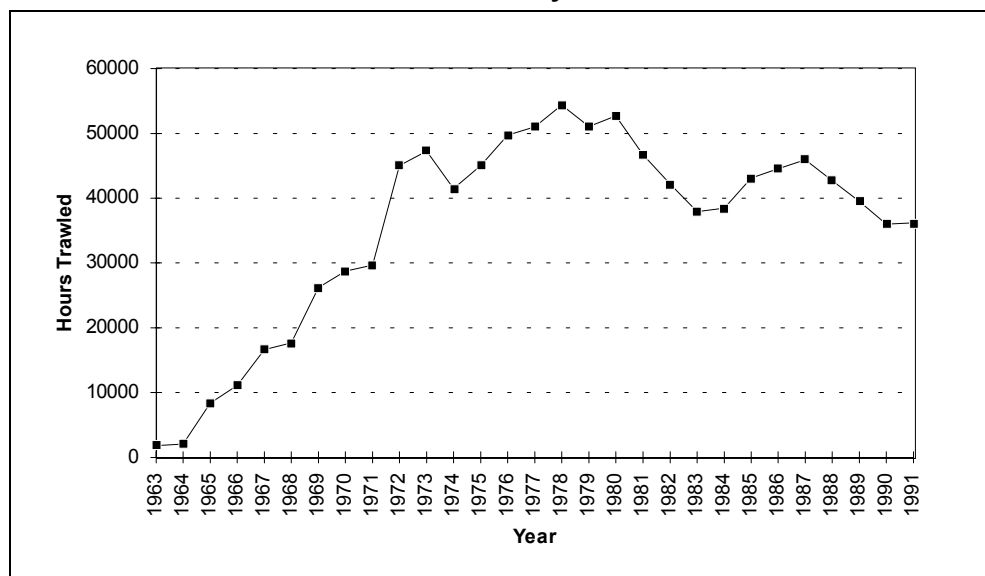
Source: Fisheries Department of Western Australia

Figure 2-16 shows the effort involved in prawn trawling in terms of the weight per man month and weight per boat month for the last thirteen years.

Figure 2-23. Prawn Trawling Effort (Weight)
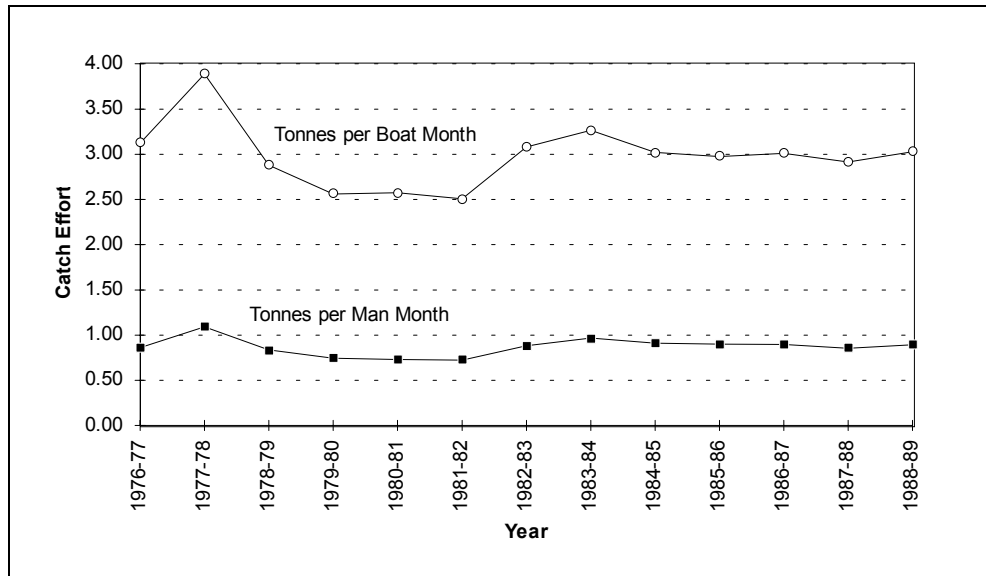
Source: ABS

Figure 2-17 shows the effort involved in prawn trawling in terms of the real value per man month and real value per boat month for the last thirteen years.

Figure 2-24. Prawn Trawling Effort (Value)
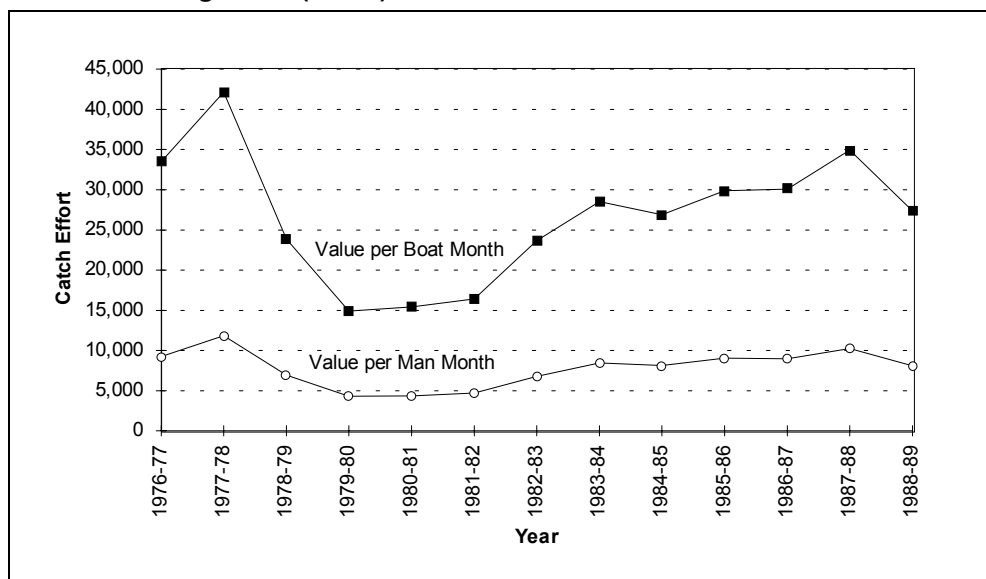
Source: ABS

Prawn Fisheries

West Coast Prawn Fisheries encompass the managed fisheries of Shark Bay, Exmouth Gulf, Onslow and Nickol Bay. Fishing effort is managed by means of boat numbers and restrictions on gear input. Table 2-3 shows the number of licensed trawlers and the year first managed.

Table 2-3. West Coast Prawn Fisheries

Fishery	Licensed Trawlers (1991/92)	Year First Managed
Shark Bay	27	1963
Exmouth Gulf	16	1965
Onslow	11	1991
Nickol Bay	14	1969

Salmon

Salmon is sold for canning and other products including fish paste and pet food. The predominate buyer of salmon in Western Australia is a local cannery although interstate operators purchase significant quantities for canning and pet food.[6]

Salmon accounted for less than 1% or $483,000 of the total value of the Western Australian catch in 1991/92.

Figure 2-18 shows how the catch volume has changed over time. Over the seventeen years the average catch was 1,650 tonnes with a peak in 1983/84 when 3,687 tonnes were caught. The 1991/92 year was below the average at 1,306 tonnes.

Figure 2-25. Salmon Catch (Tonnes)
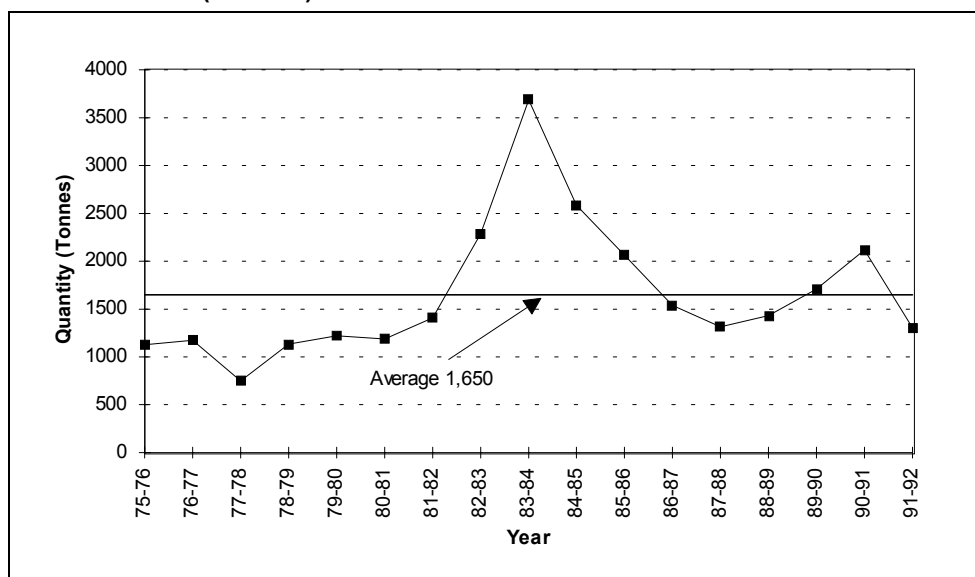
Source: ABS and ABARE

Figure 2-19 shows how the catch value have changed over time in 1991/92 dollars. Over the seventeen years the salmon catch has averaged $937,000 in 1991/92 dollars. A high of $1.7 million (1991/92 dollars) was recorded in 1983/84. In 1991/92 the value was below the average at $483,000.

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[6] Fisheries Department of Western Australia. Fisheries Management Paper No 44. A Study into the feasibility of establishing a system for the buy-back of salmon fishing authorities and related endorsements. August 1991.

Figure 2-26.   Salmon Catch (Value)
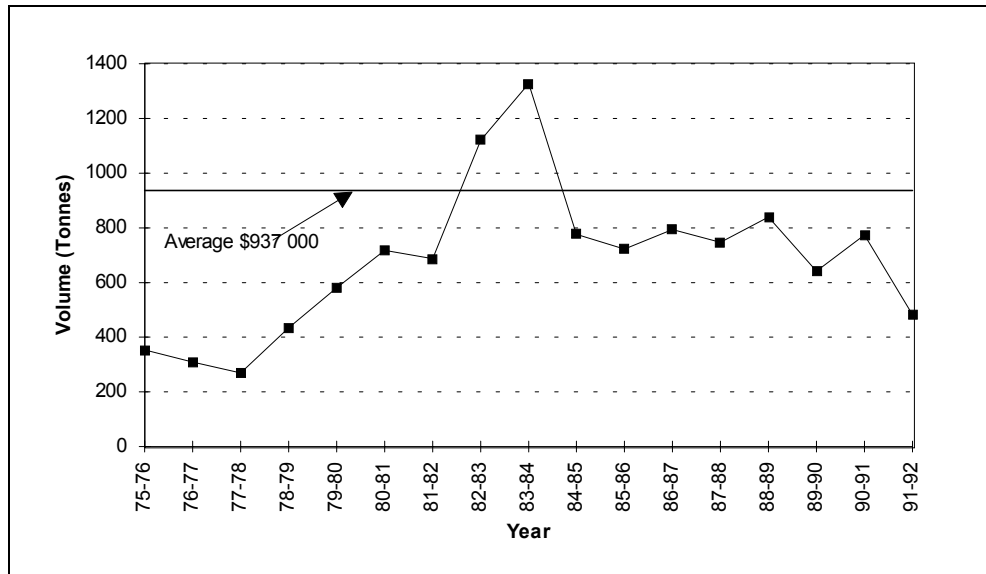
Source: ABS and ABARE

Figure 2-20 shows the average value per kilogram of salmon caught over the last seventeen years in 1991/92 dollars. The average value per kilogram has declined at an average annual rate of 4% in real terms over the seventeen years. In 1991/92 the average per kilogram value was only $0.37

Figure 2-27.   Salmon Average Value
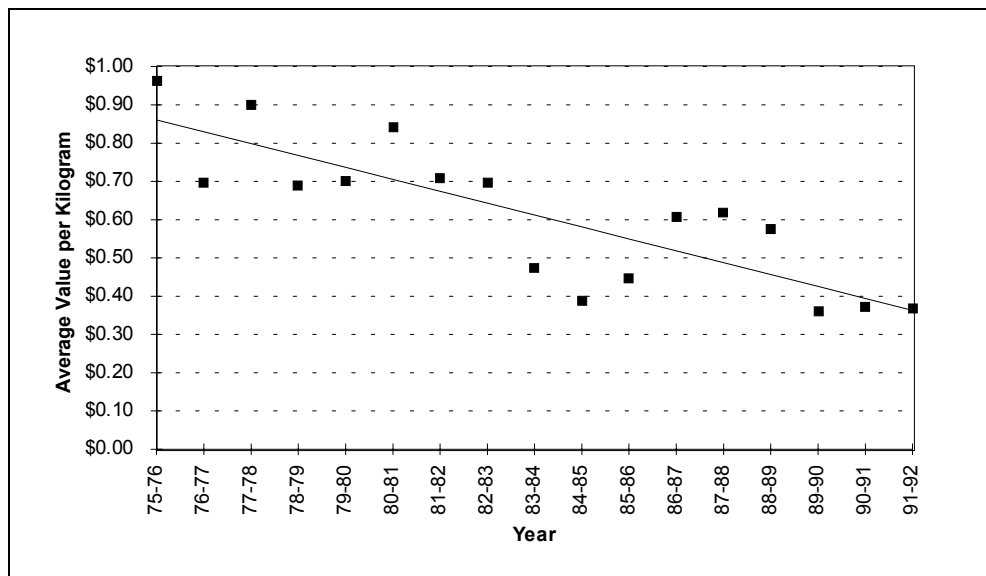
Source : ABS and ABARE

Figure 2-21 shows the effort involved in salmon fishing in terms of the weight per man month and weight per boat month for the last thirteen years.

Figure 2-28.   **Salmon Fishing Effort (Weight)**
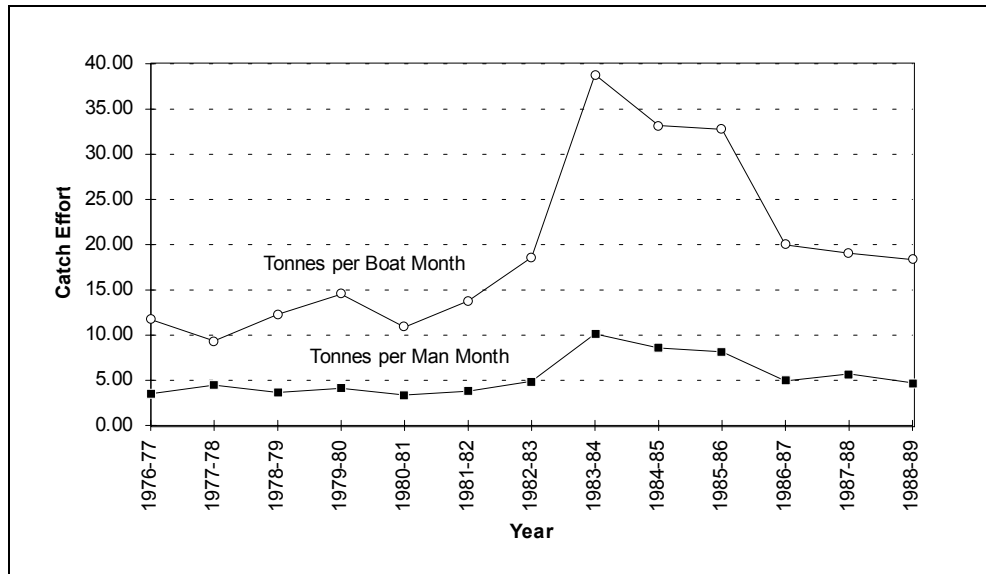
Source: ABS

Figure 2-22 shows the effort involved in salmon fishing in terms of the real value per man month and real value per boat month for the last thirteen years.

Figure 2-29.   **Salmon Fishing Effort (Value)**
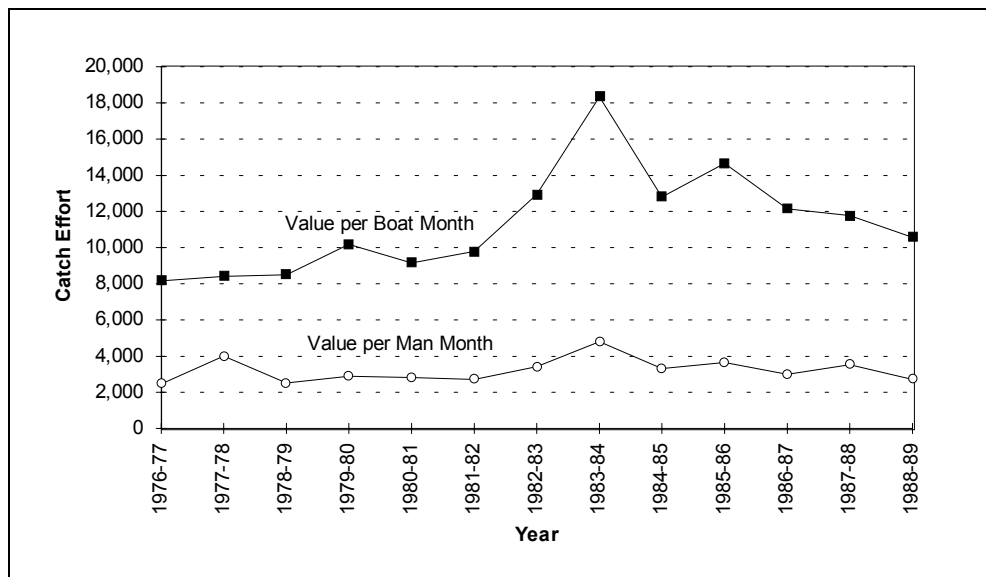
Source: ABS

Salmon Fisheries

Fishing for Australian Salmon is undertaken along the south and lower west coast beaches in Western Australia. The fishing method used is beach seining. Salmon is important to Southern Western Australia as it supports both a commercial and a recreational fishery.

There are two salmon limited entry fisheries:

• the South Coast Salmon Limited Entry Fishery; and

• the South West Coast Salmon Limited Entry Fishery.

The south coast was declared a limited entry fishery in 1967 and extends from the South Australian boarder to Augusta-Windy Harbour. The west coast was declared in 1973 and extends from Augusta-Windy Harbour to just south of Mandurah.

A significant feature of the salmon fisheries is that salmon fishing is not a full time occupation for the majority of fishermen holding commercial fishing licences.

In June 1991 there were 13 licences issued for the west coast and 21 for the south coast. The licences issued for the west coast entitle the holders to fish at any beach located within the fishery. However the licences issued for the south coast grant each licence holder exclusive use of a designated beach.

The number of licences in each fishery has decreased in recent years. Licences in the west coast peaked in 1979 at 17 and in the south coast in 1975 at 26.

Other Species

Prawns and rock lobster account for 74% of the total value of commercial fishing in Western Australia. However as discussed previously 1991/92 was a record year in terms of the scallop catch with scallops accounting for 37% of the quantity and 15% of the value of Western Australian fisheries. Apart from prawns and rock lobster, most of the remaining fisheries are relatively small. Salmon and herring has averaged around $1 million per annum over recent years. Pilchards, a low value catch, accounted for 13% of catch weight in 1991/92 but only 1% of the value.

Not surprisingly , the economic impact associated with commercial fishing (Chapter 5) is dominated by the rock lobster industry.

Commonwealth Fisheries

Table 2-4 shows the Commonwealth fisheries which operate in Western Australian waters and the gross value of catch in 1991/92.

Table 2-4.   **Commonwealth Fisheries**

Fishery	Average Annual Catch (Approx. tonnes)
Northern Prawn	9,150
Great Australian Bight	1,300
Southern bluefin tuna	5,000

Source: ABARE

The Northern Prawn fishery is the most significant Commonwealth fishery in Western Australian waters. Its area covers the Gulf of Carpenteria and Cape York to Cape Londonderry. A total of 125 boats are licenced to trawl in the fishery. In 1991/92 the catch of 7,781 tonnes was worth $90.6 million.

In the economic impact analysis that follows the Northern Prawn fishery is analysed separately from State fisheries because only a part of it can be ascribed to Western Australia.

Establishments

Based on information supplied by the Australian Bureau of Statistics a total of 668 establishments were identified as operating in the fishing industry. Table 2-5 gives the number of establishments by region and the number of people employed.

Table 2-5. **Summary of Establishment Numbers**

Region	Number of People Employed					
	<5	*5-9*	*10-19*	*20-49*	*50-99*	*Total*
Kimberley	7	5	6	3	2	23
Pilbara	2	3	1	0	0	6
Gascoyne	22	7	2	1	1	33
Central	241	16	4	0	0	261
Midlands	54	7	1	0	0	62
Metropolitan	171	32	4	2	0	209
South West	39	5	1	0	0	45
Upper Great Southern	0	0	0	0	0	0
Lower Great Southern	8	6	0	0	0	14
South Eastern	13	2	0	0	0	15
Total	557	83	19	6	3	668

Source: ABS Business Register Counts of Locations, as at August 1992.

Establishments mainly engaged in rock lobster fishing accounted for 48% and establishments engaged in prawning accounted for 6% of the total establishments.

3 Survey Description

Background

The purpose of conducting the survey of commercial fishing licence holders was to gain information about the expenditure patterns associated with commercial fishing activity. More specifically the survey aimed to collect information relating to the following:

- the level of fishing activity in 1991/92

- aggregate expenditure on operations in 1991/92

- distribution of operations expenditure across main items such as fuel, lines, maintenance, labour, fishing equipment etc.

- location of expenditure for each of the items (ie % in WA)

- aggregate expenditure on capital items, vessel and non vessel

- distribution of capital expenditure across main items

- employment, full time and part time.

Methodology

Sample Frame

The population of interest was all commercial fishing units holding Western Australian licences or those holding Commonwealth licences whose refit was largely undertaken in Western Australia.

The sampling frame used was the list of all Western Australian commercial fishing licence holders. This list was supplied by the Fisheries Department of Western Australia and includes over 1,500 licence holders. The list was supplemented by adding some 14 companies with Commonwealth licences.

Survey Procedure

The initial list provided by the Fisheries Department of Western Australia was checked for obvious duplicates. This process reduced the list to 1,283. Representatives from the commercial fishing industry requested that all commercial fishing licence holders have an opportunity to supply input to the study. As a result questionnaires were mailed to all Western Australian licence holders. The largest companies in the industry were contacted first by telephone to elicit support and then either mailed a questionnaire or visited personally.

In a covering letter sent with the questionnaire the principle researchers names were supplied as a contact if the licence holder had any queries regarding the data requirements. A reply paid envelope was also supplied. A copy of the questionnaire is included in Appendix C.

Licence holders were given the option of having their accountant complete the required details. A few sent their questionnaires directly to their accountants, others returned the questionnaire with an authorisation to collect the details from their accountant. In total, approximately ten questionnaires were completed by accounting firms.

As some licences were held in individuals' names and others in company names not all duplicates could be removed and the researchers believe that the number of participants in the industry is less than 1283. Removing duplicate records did however mean that each questionnaire could represent more than one fishing boat licence.

It was anticipated some of the licences held in 1991/92 would not have been operational in that year. The respondents were asked if they undertook any commercial fishing activities in the year and if they did not they were asked to return the first page only, indicating this. Questionnaires returned in this manner accounted for 14% of all returns.

Analysis

Fisheries

Licence holders were asked to report which fisheries they fished commercially in the 1991/92 year. Approximately 27% of the returned questionnaires listed more than one fishery. In cases where more than one fishery was listed WAFIC and the Fisheries Department were consulted in an attempt to classify each questionnaire to a single fishery. Initially, a number were eliminated as they appeared to refer to the same fishery more than once. With others a decision was made as to which fishery was the major fishery (in terms of largest proportion of expenditure). In a small number of cases it was believed that a single classification would not be appropriate and the financial data was split between the fisheries based on the number of fishing boat licences.

A total of 18 fisheries and an 'other' grouping were used in the analysis. In reporting the results some of these fisheries have been combined so as to preserve the confidentiality of the individual fishing units. The most notable of these was the grouping of all prawn fisheries with the Shark Bay Prawn and Scallop fishery and pearling which has been included in the other category.

The estimate of the Northern Prawn fishery is discussed separately in the text as the majority of income and expenditure occurs outside Western Australian.

From data supplied by the Fisheries Department it is estimated that there were 1,680 Western Australian fishing boat licences at the end of 1991/92. Estimates from ABARE suggest that there were a further 125 vessels licensed in the Northern Prawn fishery.

As previously mentioned 14% of the returned questionnaires indicated that no commercial fishing activity had been undertaken. The number of operational fishing boat licences was therefore estimated to be 1,443. It was assumed that all of the current West Coast Rock Lobster licences are operational in any year due to their high cost. In all other fisheries the number of licences, as estimated by the Fisheries Department, were reduced proportionally.

No assumptions where made about the proportion of Northern Prawn fishery licences that were non-operational.

Table 3-1 shows the estimate of total licences and operational licences by fishery.

Table 3-1.   **Population Estimates**

Fishery	Population Estimate (Fishing Boat Licences)	
	Total	Operational
Abalone	26	20
Cockburn Sound	66	50
Prawns/Scallops	244	186
Rock Lobster (nec)	42	32
South Coast Estuarine	66	50
South Coast Purse Seine	34	26
Australian Salmon	34	26
Specimen Shell	35	27
Southern Shark	89	68
South West Beach Seine	30	23
South West Estuarine	56	43
South West Trawl	16	12
West Coast Rock Lobster	676	676
Wet Lining	156	119
Pearling	13	10
Aquaculture	77	59
Other	20	15
Total	**1,680**	**1,443**
Northern Prawn	*125*	*125*

Response Rates

In total 145 questionnaires were received of which 21 reported that no commercial fishing activities had been undertaken in 1991/92. A further 14 questionnaires were not useable, either because they were returned blank or because an operator possessed the required information and was not contactable. One questionnaire was allocated to three fisheries and another to two fisheries based on the number of fishing boat licences in each fishery. These allocations were considered individual questionnaires in the analysis, that is 133 questionnaires were received representing 237 vessels.

Table 3-2 shows the number of responses in terms of questionnaires and fishing boat licences.

Table 3-2.   **Response Rates by Fishery Group**

Fishery	Questionnaires	Fishing Boat Licences	
	Number	Number	Prop of Pop.
Abalone	7	7	35%
Cockburn Sound	3	4	8%
Prawns/Scallops	6	39	21%
Rock Lobster (nec)	2	2	6%
South Coast Estuarine	3	4	8%
South Coast Purse Seine	5	9	35%
Australian Salmon	7	7	27%
Specimen Shell	5	5	19%
Southern Shark	3	5	7%
South West Beach Seine	1	1	4%
South West Estuarine	2	6	14%
South West Trawl	3	4	33%
West Coast Rock Lobster	51	67	10%
Wet Lining	12	14	12%
Pearling	2	8	81%
Aquaculture	12	12	20%
Other	3	7	46%
Sub-Total	**127**	**220**	**15%**
Northern Prawn	6	14	na
Sub-Total	**133**	**234**	na

The aggregate value of survey output (measured by value of the sale of fish, excluding accquaculture) was $87.5 million so that survey responses accounted for 19% of aggregate industry output.

Editing and Coding

Where data was omitted on returned questionnaires a decision was required as to whether a value of zero was intended or whether the variable was missing. Where an entire question was left blank it was assumed that all components were missing, however where any components of a question were completed the remaining components were treated as zeros. A few exceptions were made where it was obvious that an expenditure should have been made. In these cases the variable was treated as missing (ie it was given an average value). Office expenses were another exception as it was believed that total office expenses could legitimately all be zero.

Manual and computer checks were undertaken on individual questionnaires to ensure the validity of the data. Where amounts given were not feasible the individual variable was not included in the analysis (ie it was treated as a missing value). Most questions allowed space for respondents to add categories that were not included on the questionnaire. For non vessel capital expenditure no items were listed and respondents were asked to list all major items. In these cases the responses were grouped and coded for the analysis.

Definitions

In the presentation of results based on the survey the following abbreviations are used.

Fishery	Notes
C'burn Sound	Cockburn Sound
Prawns & Scallops	Kimberley Prawn Exmouth, Nickol Bay Onslow Prawn Shark Bay Prawn and Scallop
RL (nec)	Esperance and Augusta Rock Lobster
SC Purse Seine	South Coast Purse Seine
Australian Salmon	South Coast Salmon South West Salmon Herring
S Shark	Southern Shark
SW Trawl	South West Trawl
WCRL	West Coast Rock Lobster
Pearling	Pearling in this survey refers to the production of the shell and not to the value of the pearl and hence it is difficult to compare this to an independent estimate.

4 Survey Results

Introduction

The estimates in this Chapter are based on the estimate of operational licences given in Chapter 3. The estimates are for all Western Australian fisheries. Estimates for the Northern Prawn fishery are given separately. All survey results refer to the 1991/92 year.

The treatment of missing values was discussed in Chapter 3. The differing number of missing values on components has resulted in the scaled total not always equalling the sum of the components.

Where ever possible survey results are compared to data from other sources referred to in Chapter 2. Differences between survey estimates and independent source estimates may be due to a number of factors including:

- questionnaire classification to fishery;

- incorrect interpretation of missing data in the survey;

- inaccurate population estimates; and,

- error in other sources (eg ABARE).

Where results are given by fishery this refers to the main fishery identified for each questionnaire using the classification process explained in Chapter 3. Abbreviations used in this chapter are those listed at the end of Chapter 3.

Income

It is estimated that gross income (that is the sum of the income from gross fish sales[7], the fuel rebate and income from leases) from commercial fishing activities in Western Australia was $424.3 million in 1991/92. Total income in the Northern Prawn fishery was estimated to be $97.8 million.

Figure 4-1 below shows the breakdown of this income by fishery.

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[7] On board processing has been included. All onshore processing has been specifically excluded from the analysis.

Figure 4-1. Total Income by Main Fisheries
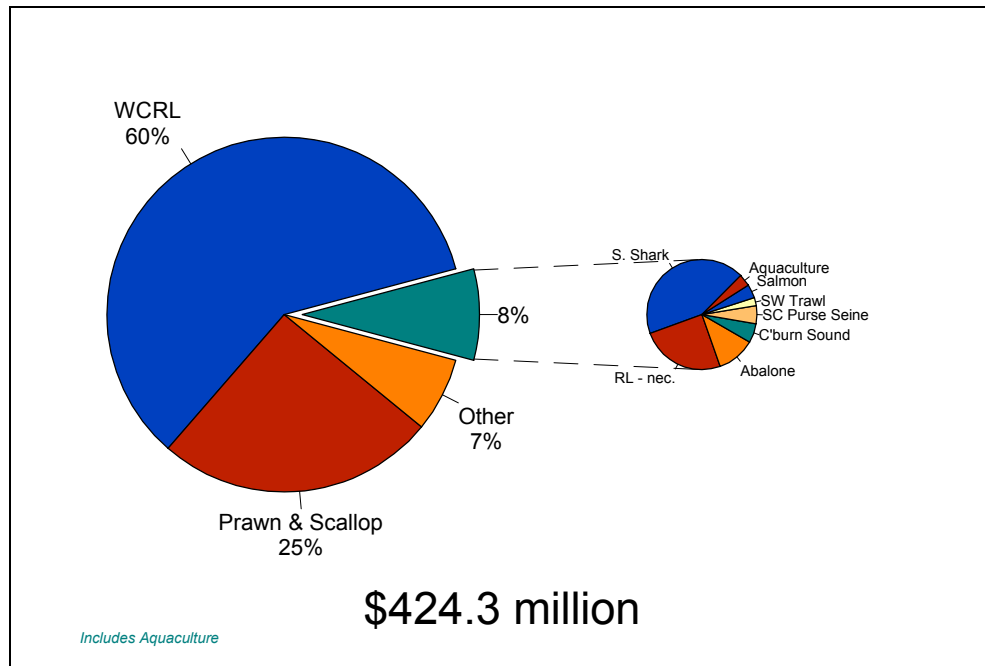
West Coast Rock Lobster and the prawn and scallop fisheries accounted for the largest proportion of the total gross income (85%).

Fish Sales

Income from the sale of fish accounted for approximately 97% of the total income reported. The estimated income from fish sales was $413.2 million for the Western Australian fisheries and $90.1 million for the Northern Prawn fishery. This compares with the ABARE estimate of $455.0 million for Western Australian fisheries and $90.6 million for all of the Northern Prawn fishery.

It was mentioned in Chapter 3 that pearling in the survey referred to the value of the shell, and therefore the two estimates should also be compared with aquaculture and pearling removed. Aggregate industry income from fish sales was estimated to be $390.6 from the survey and $373.9 from ABARE.

Figure 4-2 shows the income from fish sales for the main fisheries.

Figure 4-2. Income from Fish Sales by Major Fishery
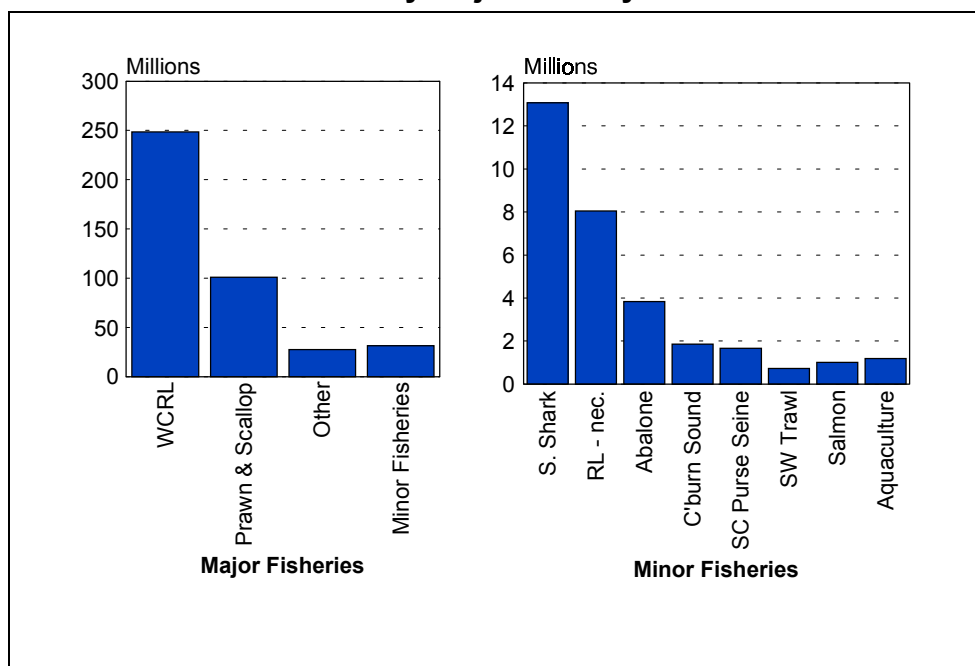
The rock lobster catch was worth $252.1 million in 1991/92 according to ABARE. Combining the two survey estimates of the rock lobster catch, West Coast Rock Lobster ($248.5 million) and Rock Lobster nec ($8.3 million), the estimate of the income of fish sales in all Rock Lobster fisheries was $256.8 million.

The combined estimate of the income derived from the sale of fish in the prawn and scallop fisheries was $103.6 million. This compares to the ABARE estimate of the value of the prawn catch in Western Australian fisheries of $25.2 million and the value of the scallop catch of $57.5 million.

Fuel Rebate

Fuel rebate was estimated to account for $8.58million or 2% of total income. In the Northern Prawn fishery $7.6 million was from fuel rebate.

Other Income

Income from vessel, quota and pot leases accounted for an estimated $1.9 million or less than 0.5% of total income. No lease income was reported in the Northern Prawn fishery.

Other income, mostly in the form of bank interest, was estimated to be $677,000. $35,000 of other income was reported in the Northern Prawn fishery.

Capital Expenditure

Capital expenditure has been divided into three components; new vessel expenditure, vessel related expenditure and non-vessel related capital expenditure. The expenditure in each category is shown in Figure 4-3. Aquaculture has been excluded and is discussed separately below.

Figure 4-3. Total Capital Expenditure
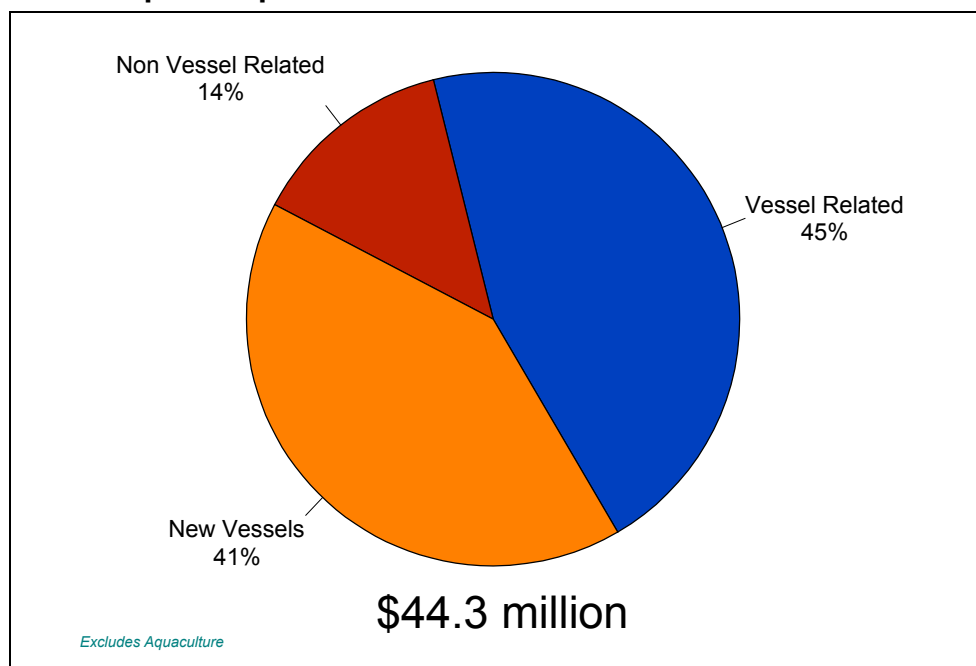
New Vessels

Respondents were asked to list all vessels that were operated for commercial fishing activity in 1991/92 and give details relating to the licence, year of purchase and the purchase price. This information was used to estimate the expenditure on new vessels in 1991/92. Where calendar years were specified the amounts were summed for both years (ie 1991 and 1992) and the result halved. Holders of aquaculture licences were not asked for this information and hence are not included in these estimates. It is believed however that given the nature of the business it is unlikely that vessels are a significant component in aquaculture.

A total of 224 boats are estimated to have been bought for commercial fishing in 1991/92. It is estimated that $17.6 million was spent on new commercial fishing vessels in 1991/92. As an independent check on this result a small number of boat builders were contacted who felt that this was a reasonable estimate of the value of boats sold.

The majority of this expenditure was undertaken within the West Coast Rock Lobster fishery, accounting for 96% of the value or 140 new boats.

No new vessels were reported in the Northern Prawn fishery.

Vessel Related Capital Expenditure

57% of respondents reported that they had not undertaken any vessel related capital expenditure in 1991/92.

The estimated amount of vessel related capital expenditure in 1991/92 was $19.6 million.

Similar amounts were spent on Hull and Engine as shown in Figure 4-4.

Figure 4-4. Vessel Related Capital Expenditure by Category

Hull
38%

Other
5%

Electrical
16%

Engine
41%

$19.6 million

Excludes Aquaculture
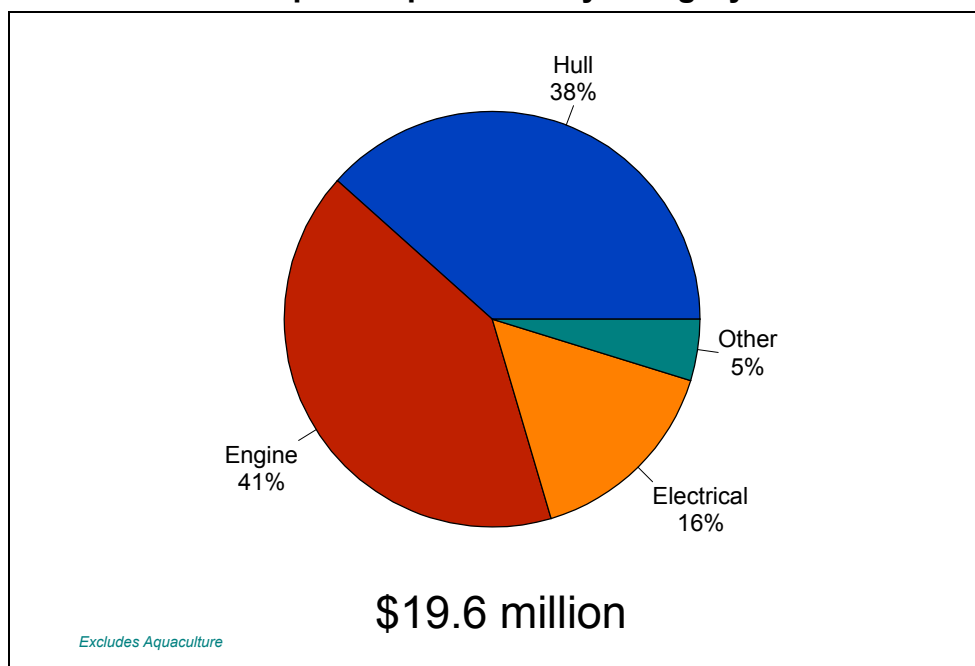
Figure 4-5 shows the breakdown of this expenditure by fishery.

Figure 4-5. Vessel Related Capital Expenditure by Fishery

WCRL
70%

SC Purse Seine

C'burn Sound
SW Trawl
Abalone
RL - nec.

4%

Other
3%

S. Shark

Prawn & Scallop
23%

$19.6 million

Excludes Aquaculture
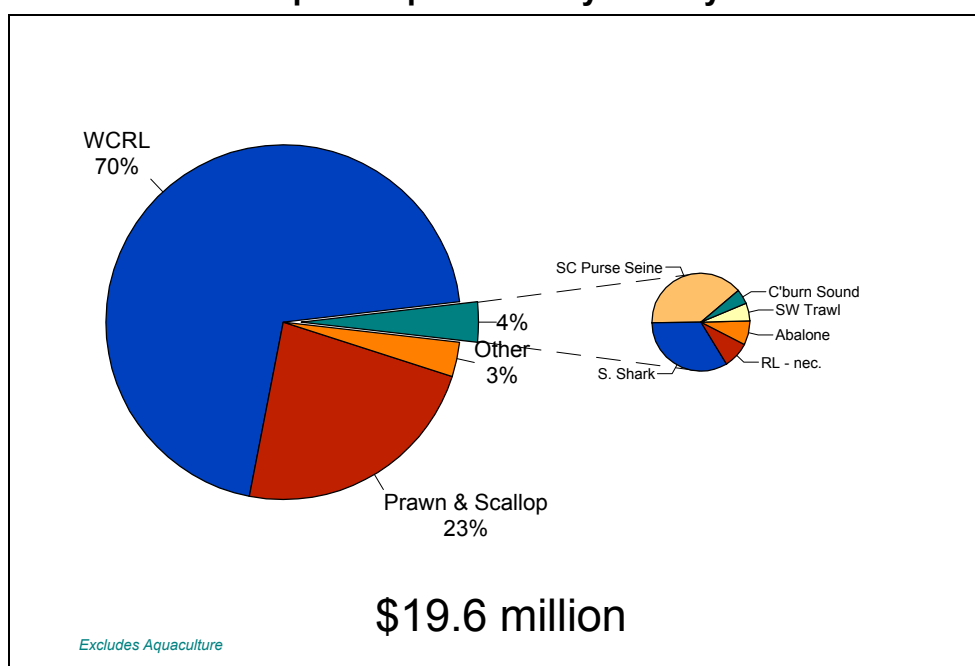
West Coast Rock Lobster and the prawn and scallop fisheries dominated with $18.2 million or 93% of all vessel capital expenditure. In the Northern Prawn fishery an estimated $8.4 million worth of capital expenditure was made.

Non Vessel Capital Expenditure

The estimated amount of total non vessel capital expenditure in 1991/92 was $5.9 million.

45% of respondents reported that they did not undertake any non vessel related capital expenditure in 1991/92.

Figure 4-6 shows the breakdown of this expenditure by fishery.

Figure 4-6. Vessel Capital Expenditure by Fishery
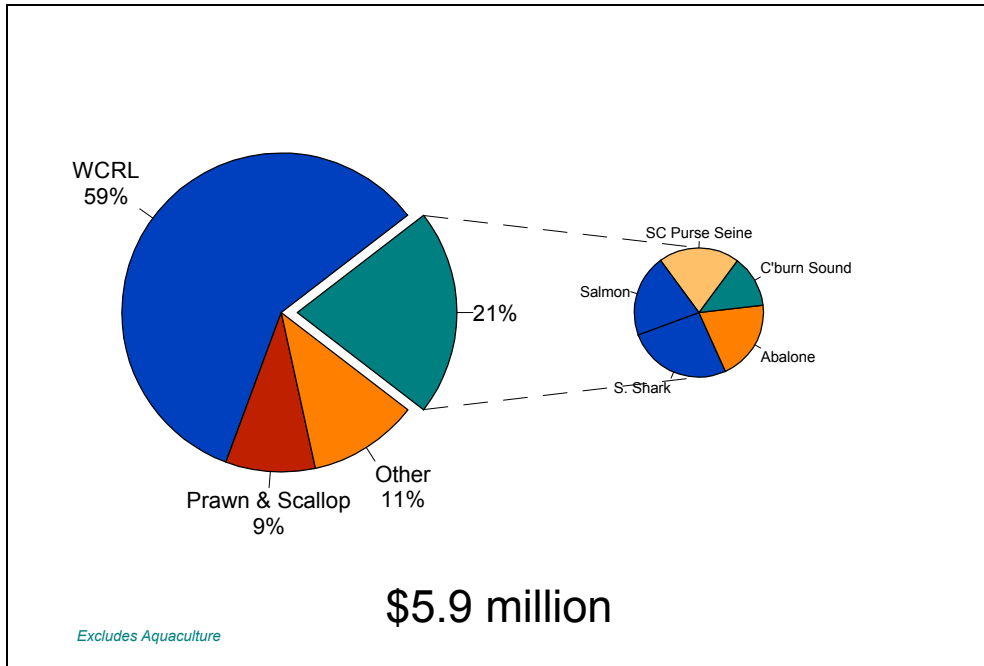
The main stated component of the non vessel capital expenditure was motor vehicles accounting for 16% of total non-vessel capital expenditure. Other items included buildings (8%) and freezers (2%) and miscellaneous equipment - unspecified (11%). No non-vessel capital expenditure was reported in the Northern Prawn fishery.

Aquaculture Capital Expenditure

A total of $433,000 worth of capital expenditure was estimated for 1991/92.

Operating Expenses

Operating expenses have been divided into four main components; basic fishing and vessel expenses, motor vehicle expenses, office expenses and wages and salaries. These components are shown in Figure 4-7, excluding aquaculture which is discussed separately below.

Figure 4-7. Operating Expenses

Basic
55%

Office
4%

Motor Vehicle
2%

Wages and Salaries
38%

$293.5 million

Excludes Aquaculture
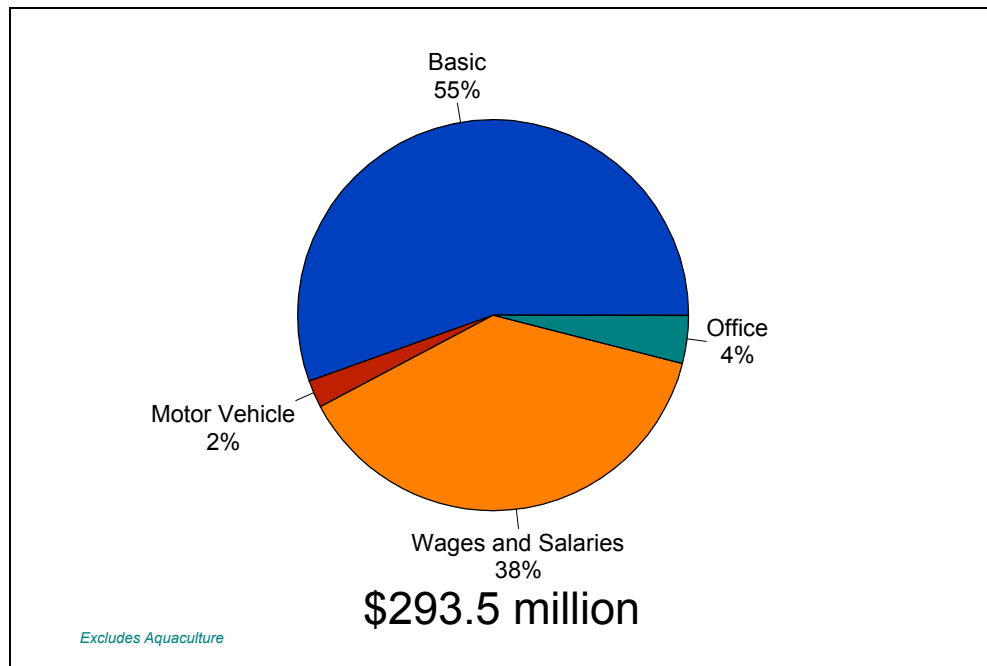
Basic Fishing and Vessel Expenses

Overview

The estimated amount of basic fishing and vessel expenses was $162.5 million or 55% of operating expenses. Figure 4-8 shows the breakdown of this expenditure by category.

Figure 4-8. Basic Fishing and Vessel Expenses by Category

Other 7%

R & M 21%

Insurance 4%

Licence Renewal 6%

Net & Gear 6%

Bait, Ice etc. 9%

Fuel, Oil etc. 17%

Deprec. 14%

Interest 15%

$162.5 million

Excludes Aquaculture
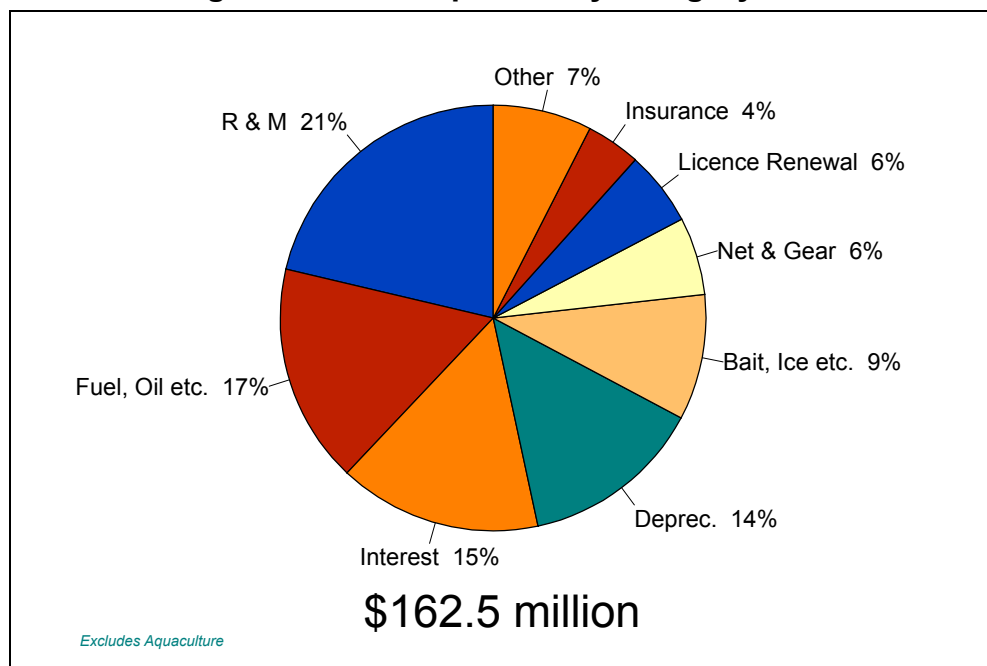
As can be seen repairs and maintenance accounted for the largest proportion of basic operating expenses ($34.8 million) followed by fuel and oil ($26.9 million).

West Coast Rock Lobster

Of the $162.5 million spent on basic operating expenses, $94.0 million or 58% was spent by those in the West Coast Rock Lobster fishery.

Operating expenses within the West Coast Rock Lobster fishery are shown in Figure 4-9 below.

**Figure 4-9.   Basic Fishing and Vessel Expenses by Category:
West Coast Rock Lobster**
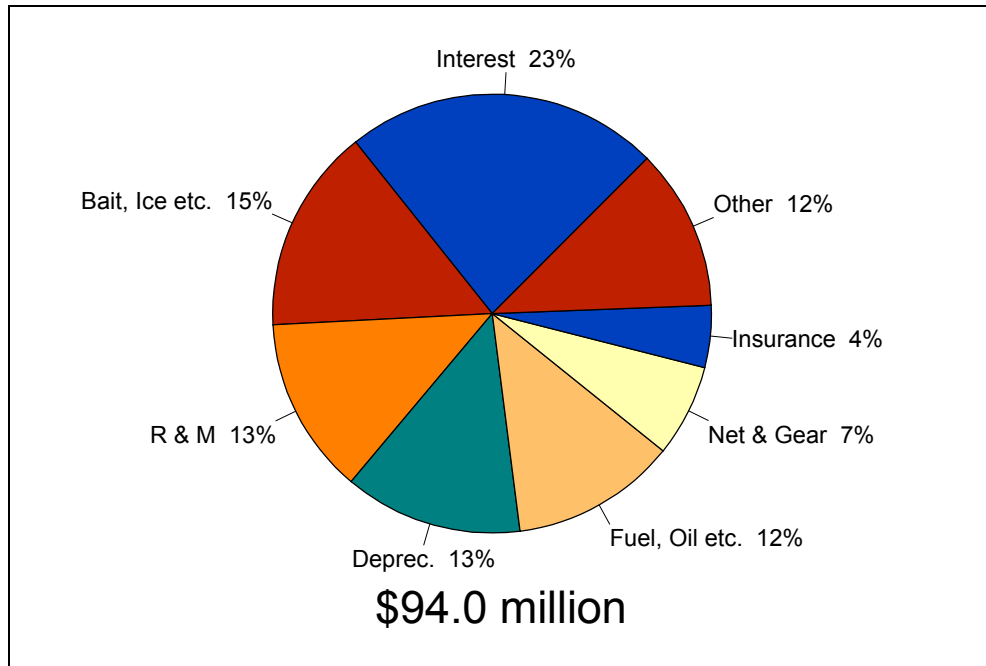
Within the West Coast Rock Lobster fishery interest was the main component of basic operating expenses accounting for $21.9 million or 23%.

Prawns/Scallops

Operating expenses within the prawn and scallop fisheries totalled $46.7 million or 29% of all basic operating expenses. The breakdown is shown in Figure 4-10 below.

**Figure 4-10. Basic Fishing and Vessel Expenses by Category:
Prawns/Scallops**

R & M 38%

Other 4%

Insurance 2%

Net & Gear 6%

Deprec. 7%

Licence Renewal 21%

Fuel, Oil etc. 22%

$46.7 million
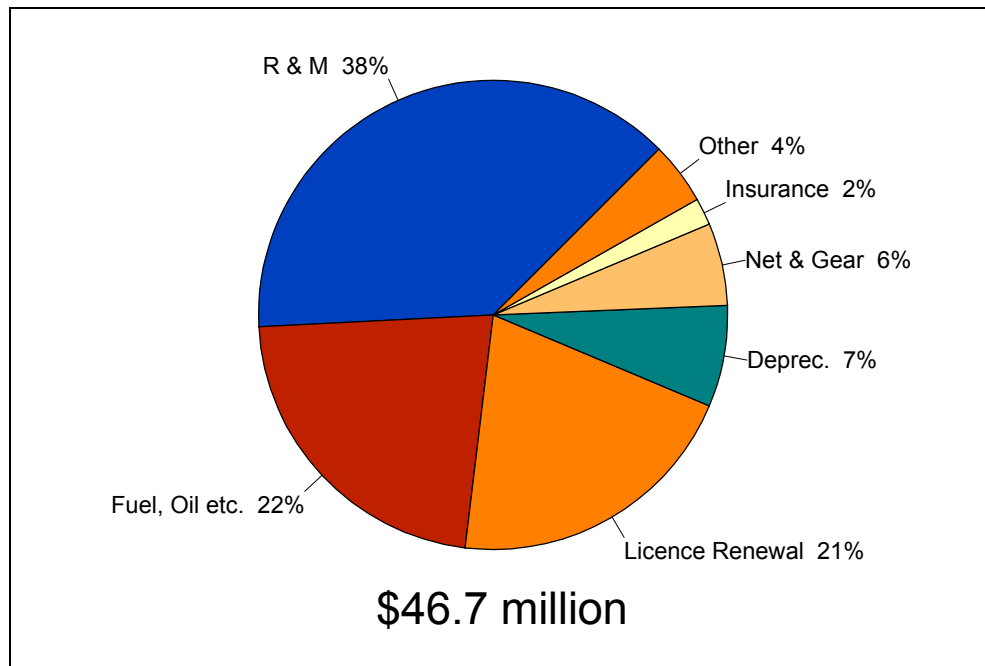
Repairs and Maintenance accounted for a large proportion of basic fishing expenses in the prawn and scallop fisheries totalling $17.9 million.

Motor Vehicle Expenses

Motor vehicle expenses are estimated to account for $6.8 million or 2% of operating expenses. The component of this expenses are shown in Figure 4-11 below.

Figure 4-11. Motor Vehicle Expenses

Deprec.
36%

Other
1%

R & M
16%

Licencing
6%

Insurance
8%

Fuel & Oil
33%

$6.8 million

Excludes Aquaculture
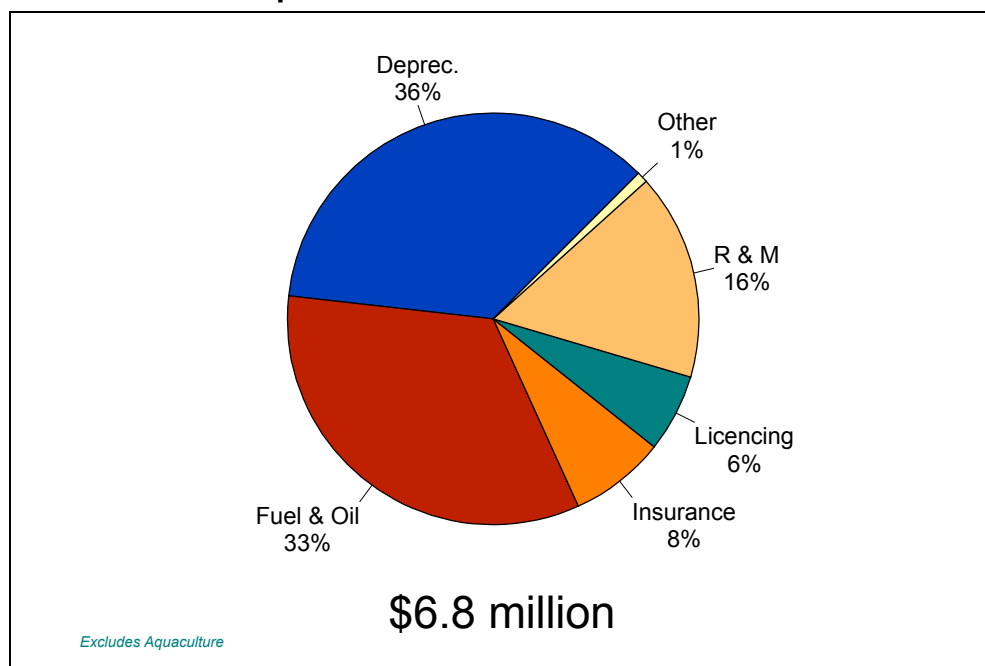
Depreciation accounted for the largest proportion of motor vehicle expenses, totalling $2.3 million or 36% of total motor vehicle expenses. Fuel and oil was also a significant expense accounting for $2.2 million or 33% of total motor vehicle expenses.

Office Operation Expenses

Office expenses were reported by 73% of respondents. Where no expenses were listed all categories of office expenses were assumed to be zero.

Total office expenses of $11.2 million are split by category in Figure 4-12 below.

Figure 4-12. Office Operating Expenses
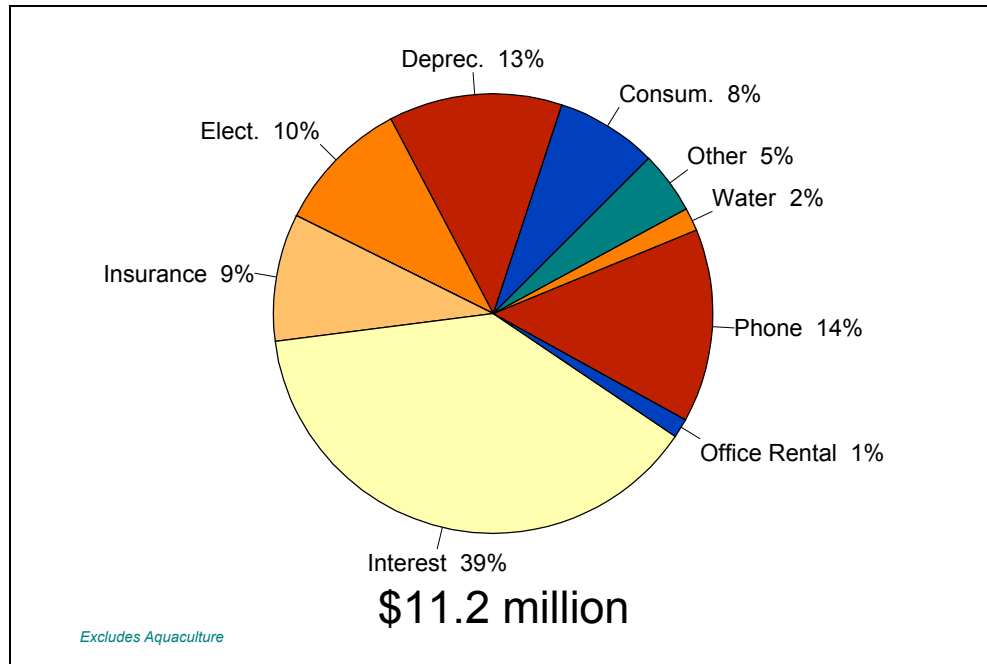
Interest was the largest component of operating expenses accounting for $4.3 million.

Office expenses are shown by fishery in Figure 4-13 below.

Figure 4-13. Office Operating Expenses by Fishery

$11.2 million

Includes Aquaculture
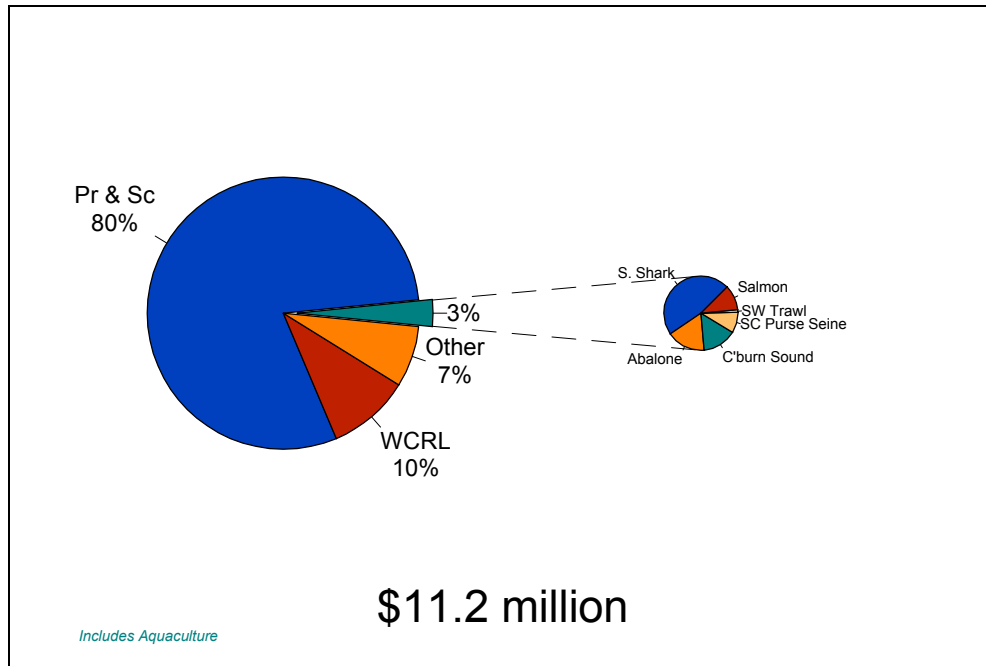
The majority of the total office expenses were made within the Prawn and Scallop fisheries accounting for $9.0 million.

Wages and Salaries

Wages and Salaries are estimated to account for 38% of operating expenses or $113.0 million in 1991/92. As can be seen in Figure 4-14 below the majority of this was payments to skipper and crew ($96.5 million). Employment is discussed in more detail below.

Figure 4-14. Wages and Salaries

$113.0 million

Excludes Aquaculture
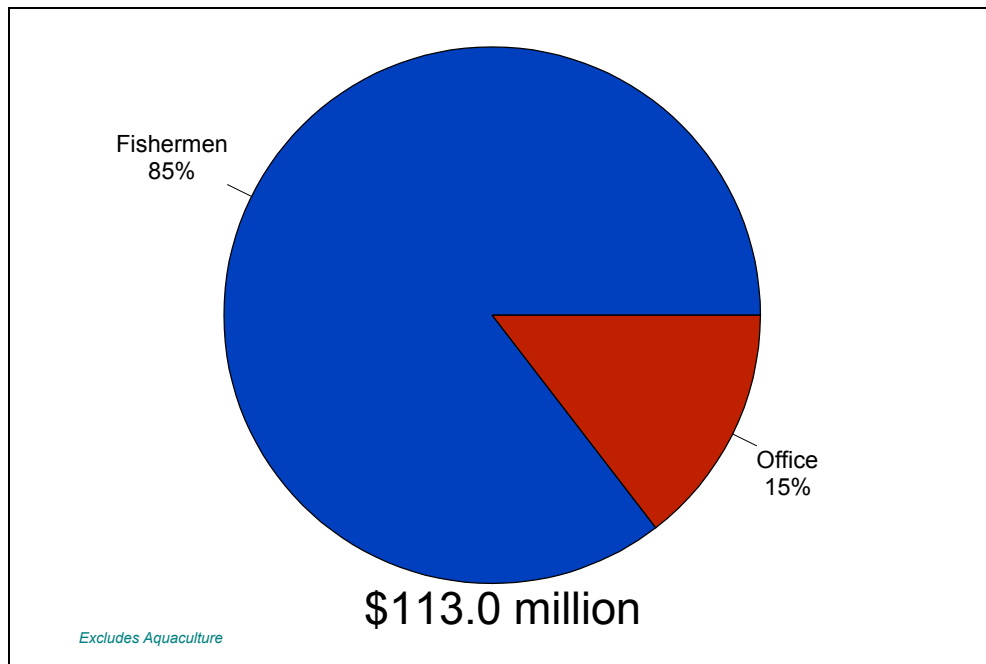
Northern Prawn Operating Expenses

Operating expenses in the Northern Prawn fishery were estimated to total $66.3 million.

Basic operating expenses were estimated to be $45.4 million. Repairs and maintenance accounted for $15.7 million and fuel and oil accounted for $15.2 million.

Depreciation was the largest component of Motor Vehicle expenses accounting for 43% of the total $77,000.

Office costs of $2.2 million major component was interest accounting for 39%.

Wages and salaries totalled $18.6 million of which $15.6 million was paid to fishermen and the remainder to office staff.

Aquaculture Operating Expenses

Operating expenses in the aquaculture industry are estimated to be $1.5 million. Basic expenses accounted for $568,000, wages and salaries $691,000, motor vehicle expenses $192,000 and office expenses $87,000.

Employment

The number of people employed in the commercial fishing industry can be described in a number of ways:

1. total jobs (giving equal weight to part time and full time employees)

2. full time equivalents assuming that a part time worker is half a full time worker.

3. full time equivalents taking into account the proportion of the year both part time and full time people worked. This is possible for fishermen as the number of weeks worked was reported.

The first measure above, giving an estimate of the total number of people employed in the commercial fishing industry, provides a figure of 4,852 people. A further 657 people were estimated to be employed in the Northern Prawn fishery.

An estimate of 4,002 full time equivalents was made assuming a part time employee works exactly half the time of a full time employee. For the Northern Prawn fishery the estimate was 595 persons.

Employment by fishery is shown in Figure 4-15 below.

Figure 4-15. Full Time Equivalent Employees

WCRL
50%

16%

Aquaculture

S. Shark

Salmon

SW Trawl

SC Purse Seine

RL - nec.

C'burn Sound

Abalone

Other
7%

Prawn & Scallop
27%

4,002 persons

Includes Aquaculture
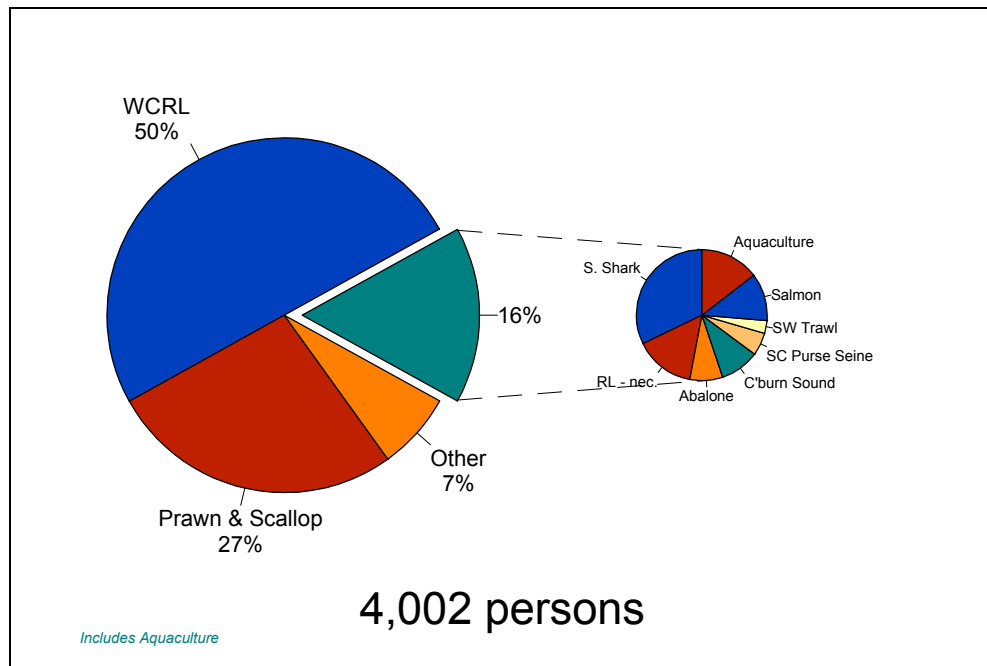
An estimate was also made of the number of full time equivalent weeks worked by fishermen assuming that a part time worker worked half the time of a full time worker and that a full time person works 52 weeks in the year (including holidays, sick leave etc). This analysis resulted in an estimate of 1,701 fishermen working 52 weeks of the year. A further 84 persons were estimated in the Northern Prawn fishery.

Regional Estimates

Income

Based on the local area of operation, income from commercial fishing activities can be analysed by region. Figure 4-16 below shows income by region for all fisheries except Nothern Prawn.

Figure 4-16. Total Income by Region
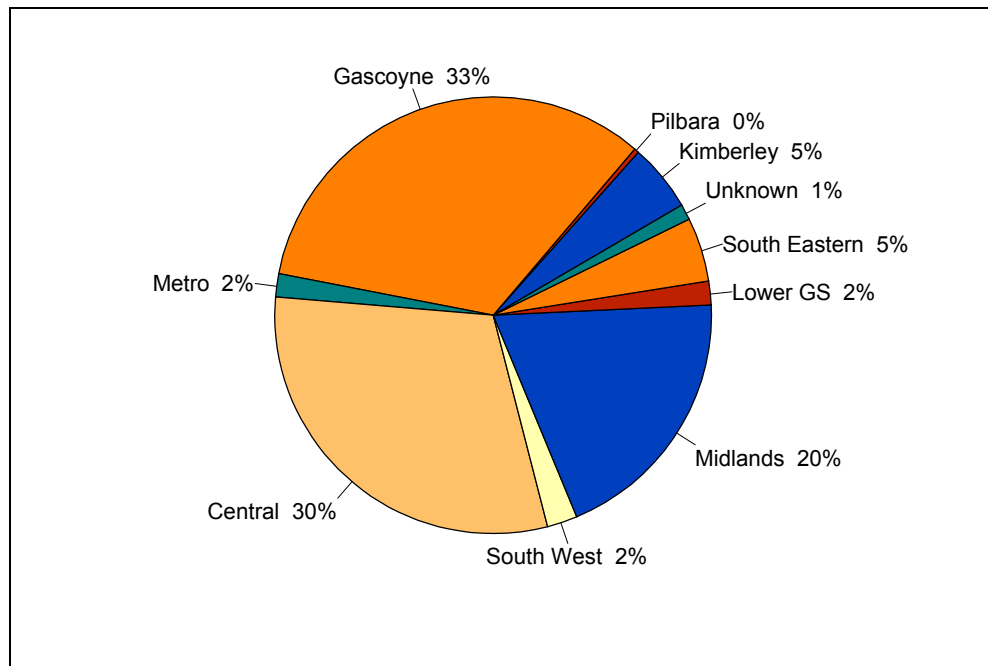
The majority of the fishing income is earnt by fisheries operating in the central coast regions of Western Australia. The Gascoyne, Midlands and Central regions accounted for 83% of the income.

5 Economic Impact Analysis

Introduction

The analysis in chapter 2 provides a detailed overview of the structure and operations of the commercial fishing industry in Western Australia. Chapter 4 summarised the results of the survey of commercial fishing licence holders carried out as part of this study.

The analysis in those chapters indicated the extent to which the economic impact associated with commercial fishing in Western Australia would be dominated by the rock lobster and prawn fisheries. In this chapter the magnitude of the economic impact associated with commericial fishing activity is documented.

Estimates are first made of the direct output, employment and income effects associated with commercial fishing based on the survey data collected and previously presented in Chapter 4. Flow on effects from the commercial fishing activity are then estimated using an input output model of the Western Australian economy and commercial fishing activity multipliers derived using the survey results.

Measuring Economic Impacts

The measurement of economic impacts in this study concentrates on employment and income impacts which flow from the operation of the commercial fishing industry in Western Australia.

These impacts can be classified into three distinct categories. These are:

i.   Direct Effects;

ii. Production Induced Effects; and

iii. Consumption Induced Effects.

The direct impacts on income and employment flow from the economic activity which is directly related to commercial fishing activity. As already noted, the scope of the direct impacts will be related to the definition chosen for the commercial fishing industry. Briefly, the analysis of direct impacts must take account of those activities which are directly related to catching fish for sale to the next stage of production, either locally or overseas.

Flowing on from these direct impacts are indirect impacts on income and employment which are generated because of the backward linkages between the individuals and firms directly involved in the commercial harvesting of fish in Western Australia and firms in the rest of the economy who supply them. These are the production induced effects.

Additional impacts flow from the fact that the expenditure generated as part of the commercial fishing activity, together with the production of goods and services in industries supplying commercial fishing operators, gives rise to additional household incomes being generated in the economy. This income will be spent on goods and services generally but can be attributed to the operations of the commercial fishing sector. This is the consumption induced effect.

These indirect impacts give rise to the concepts of employment and income multipliers. The magnitude of these multipliers depends on the particular set of inter-industry relationships that exists in the economy.

Measuring Direct Impacts: Economic Surveys

The nature of the commercial fishing industry means that the expenditure data needed is not readily available from secondary sources. Consequently the primary expenditure and employment data needed had to be collected through the mail back surveys described in Chapter 4. This survey data is used to estimate the economic impact associated with commercial fishing activity in the following sections.

Measuring Indirect Impacts: Multiplier Analysis

The direct impact associated with commercial fishing activity will give rise to further impacts in the form of flow on effects. These arise as a result of the additional output, income and employment generated in those industries supplying the goods and services to those involved in commercial fishing. The increased household incomes generated in this process will cause increases in general consumption expenditure thereby inducing further production, income and employment increases.

In order to estimate the flow on effects associated with a given activity, a multiplier is applied to the direct impact estimates. This multiplier has the effect of scaling the direct impact estimate up to a level which accounts for the flow on effects generated. The multiplier therefore expresses the ratio of flow on output/income/employment to direct output/income/employment for the industry under consideration, commercial fishing in the current study.

Multiplier estimates for specific industries can be derived from input-output analysis as set out in Appendix A. It is common to define multipliers at two levels. The Type I multiplier = (direct + indirect effects)/direct effect, while the Type II multiplier = (direct + indirect + induced effects)/direct effect. The Type II multiplier, because it accounts for induced consumption effects, is larger.

The use of input-output multipliers requires certain assumptions to be accepted. Available input-output tables are usually several years old. It is necessary to assume that the payments structure of individual industries has not changed significantly in the period since the table was produced. In the treatment of consumption a fixed ratio of consumption to income is used in these models. This amounts to the assumption that the income elasticity of demand is unity for all goods and as discussed in Appendix A, this almost certainly means that the Type II multiplier overstates estimated impacts.

For Western Australia the most recent available input-output tables are based on the Australian table and relate to 1982/83 output, income and employment values for Western Australia. These tables are the source of the multipliers used below.

The Western Australian table has 50 industry sectors and a version is available for the Perth metropolitan region. The multipliers for the 50 industries are reproduced in Appendix B.

A variety of ways exist to analyse a given industry using input-output multipliers. If the industry is already defined in the table, the appropriate multipliers can be applied directly to it. On the other hand if the industry to be analysed is not separately defined, one of two approaches can be adopted depending on the detail and quality of data available on the industry. If sufficient data are available the table can be modified to include the industry of interest as a separate entity. If sufficient data are not available then the existing multipliers must be used.

The existing table contains a fishing sector. However, changes in fishing activity patterns and the desire to disaggregate the analysis by sub sector where possible, meant that separate analysis of individual fisheries was required. The survey approach adopted for this study enabled expenditure profiles to be obtained from a sample of firms in the major commercial fishering sectors.

Using the survey data, the estimated direct expenditure impacts have been broken down by main fishing activity. These have been allocated to industry sectors in the input-output table to build a column for each fishing activity. This has been used to estimate the relevant multipliers for output, incomes and employment.

Estimated Economic Impact of the Commercial Fishing Industry in Western Australia

This section presents the results of applying the impact methodology discussed in the previous sections to the results obtained in the surveys of firms related to commercial fishing activities in Western Australia.

Tables 5.1 to 5.3 summarise the output, household income and employment impacts associated with commercial fishing across the major areas of activity identified. The tables give a low and a high estimate based on the population estimates derived in Chapter 3 [8].

Direct Impacts

The survey results give a direct value of output estimate of $424.3 million based on the low population estimate for number of vessels. Rock lobster accounts for 60 per cent of this commercial fishing output.

The commercial fishing activity is estimated to generate approximately 4,002 full time equivalent jobs. These are jobs that can be attributed directly to commercial fishing operations and firms and agencies whose activity is directly linked to the commercial fishing. Again rock lobster dominates the aggregate employment estimate.

In conjunction with the employment impact the fishing activity generates significant income impacts. The total wages and salaries expenditure associated with the direct employment impact is estimated to be approximately $113.7 million. This implies an average wage/salary and supplements across the total estimated direct employment of around $30,000. per annum.

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[8] Refer to Table 3-1 where the high estimates relate to total licences and low estimates relate to operational licences.

Table 5-1a. **Output Effects - Low Estimates**

		Output Multipliers		Output Impact Estimates	
	Direct Output Estimate	Type I	Type 2	Type I	Type 2
West Coast Rock Lobster	252,944,155	1.55	2.20	392,063,440	556,477,141
Prawns/Scallops	108,079,775	1.71	2.38	184,816,416	257,229,866
Aquaculture/Pearling	22,838,843	1.16	1.36	26,493,057	31,060,826
Southern Shark	14,686,549	1.53	2.23	22,470,420	32,751,005
Rock Lobster - nec.	8,486,585	1.58	2.23	13,408,804	18,925,084
Abalone	3,940,592	1.44	1.92	5,674,453	7,565,937
Cockburn Sound	1,922,692	1.72	3.09	3,307,031	5,941,119
SC Purse Seine	1,754,500	1.81	2.53	3,175,645	4,438,884
SW Trawl	793,871	1.89	2.80	1,500,416	2,222,838
Salmon	1,396,431	1.79	2.59	2,499,612	3,616,757
Wetlining	3,473,552	2.18	3.08	7,572,343	10,698,539
Other	3,970,952			7,394,188	10,770,503
Aggregate Fishing	**424,288,497**	**1.58**	**2.22**	**670,375,825**	**941,698,500**
Northern Prawn	*97,773,068*	*1.71*	*2.38*	*167,191,946*	*232,699,901*

Table 5-1b. **Output Effects - High Estimates**

		Output Multipliers		Output Impact Estimates	
	Direct Output Estimate	Type I	Type 2	Type I	Type 2
West Coast Rock Lobster	252,944,155	1.55	2.20	392,063,440	556,477,141
Prawns/Scallops	141,144,764	1.71	2.38	241,357,547	335,924,538
Aquaculture/Pearling	29,825,960	1.16	1.36	34,598,114	40,563,306
Southern Shark	19,179,625	1.53	2.23	29,344,826	42,770,563
Rock Lobster - nec.	11,082,897	1.58	2.23	17,510,977	24,714,860
Abalone	5,146,143	1.44	1.92	7,410,446	9,880,594
Cockburn Sound	2,510,904	1.72	3.09	4,318,755	7,758,693
SC Purse Seine	2,291,256	1.81	2.53	4,147,174	5,796,878
SW Trawl	1,036,741	1.89	2.80	1,959,440	2,902,874
Salmon	1,823,643	1.79	2.59	3,264,322	4,723,236
Wetlining	4,536,220	2.18	3.08	9,888,960	13,971,558
Other	5,185,790			7,334,796	14,035,760
Aggregate Fishing	**476,708,098**	**1.58**	**2.22**	**753,198,795**	**1,059,520,002**

Table 5-2a. **Employment Effects - Low Estimates**

	Employment Multipliers		Employment Impact Estimates	

	Direct Employment Estimate	Type I	Type 2	Type I	Type 2
West Coast Rock Lobster	2,001	1.88	3.28	3,762	6,564
Prawns/Scallops	1,076	2.13	3.42	2,293	3,681
Aquaculture/Pearling	140	2.15	3.77	301	527
Southern Shark	204	1.48	2.34	303	478
Rock Lobster - nec.	96	1.65	2.63	159	254
Abalone	50	1.45	2.11	72	105
Cockburn Sound	63	1.28	1.99	81	126
SC Purse Seine	36	1.49	2.09	54	76
SW Trawl	20	1.49	2.10	30	42
Salmon	74	1.27	1.63	94	120
Wetlining	124	1.43	1.87	177	231
Other	117			159	202
Aggregate Fishing	**4,002**	**1.87**	**3.10**	**7,484**	**12,406**
Northern Prawn	*595*	*2.13*	*3.42*	*1273*	*2035*

Table 5-2b.   Employment Effects - High Estimates

	Direct Employment Estimate	Employment Multipliers		Employment Impact Estimates	
		Type I	Type 2	Type I	Type 2
West Coast Rock Lobster	2,001	1.88	3.28	3,762	6,564
Prawns/Scallops	1,406	2.13	3.42	2,994	4,807
Aquaculture/Pearling	183	2.15	3.77	393	689
Southern Shark	267	1.48	2.34	395	625
Rock Lobster - nec.	126	1.65	2.63	208	331
Abalone	65	1.45	2.11	94	137
Cockburn Sound	83	1.28	1.99	106	164
SC Purse Seine	47	1.49	2.09	70	99
SW Trawl	26	1.49	2.10	39	55
Salmon	96	1.27	1.63	122	157
Wetlining	162	1.43	1.87	231	302
Other	153			214	374
Aggregate Fishing	**4,614**	**1.87**	**3.10**	**8,628**	**14,304**

Table 5-3a. Income Effects - Low Estimates

	Direct Income Estimate	Income Multipliers		Income Impact Estimates	
		Type I	Type 2	Type I	Type 2
West Coast Rock Lobster	71,452,075	1.58	2.32	112,894,279	165,768,815
Prawns/Scallops	27,835,321	1.93	2.83	53,722,170	78,773,959
Aquaculture/Pearling	1,914,368	1.63	2.39	3,120,420	4,575,339
Southern Shark	4,879,583	1.45	2.14	7,075,395	10,442,307
Rock Lobster - nec.	2,376,228	1.59	2.34	3,778,203	5,560,374
Abalone	788,175	1.67	2.45	1,316,253	1,931,030
Cockburn Sound	1,405,075	1.29	1.90	1,812,547	2,669,643
SC Purse Seine	452,026	1.93	2.84	872,411	1,283,755
SW Trawl	282,098	1.77	2.59	499,313	730,633
Salmon	258,007	1.72	2.52	443,773	650,179
Wetlining	947,516	2.26	3.33	2,141,385	3,155,227
Other	1,078,817			2,650,087	2,948,499
Aggregate Fishing	**113,669,290**	**1.67**	**2.45**	**190,326,235**	**278,489,760**
Northern Prawn	*18,651,867*	*1.93*	*2.83*	*35,998,103*	*52,784,784*

Table 5-3b. Income Effects- High Estimates

	Direct Income Estimate	Income Multipliers		Income Impact Estimates	
		Type I	Type 2	Type I	Type 2
West Coast Rock Lobster	71,452,075	1.58	2.32	112,894,279	165,768,815
Prawns/Scallops	36,351,018	1.93	2.83	70,157,464	102,873,380
Aquaculture/Pearling	2,500,033	1.63	2.39	4,075,054	5,975,079
Southern Shark	6,372,400	1.45	2.14	9,239,980	13,636,936
Rock Lobster - nec.	3,103,191	1.59	2.34	4,934,074	7,261,467
Abalone	1,029,303	1.67	2.45	1,718,936	2,521,792
Cockburn Sound	1,834,932	1.29	1.90	2,367,062	3,486,371
SC Purse Seine	590,316	1.93	2.84	1,139,309	1,676,496
SW Trawl	368,400	1.77	2.59	652,068	954,156
Salmon	336,940	1.72	2.52	579,537	849,089
Wetlining	1,237,390	2.26	3.33	2,796,502	4,120,509
Other	1,408,860			1,397,613	1,008,812
Aggregate Fishing	**126,584,858**	**1.67**	**2.45**	**211,951,878**	**310,132,902**

Indirect Impacts

Tables 5.1 to 5.3 also show the flow on effects attributable to the estimated direct output, employment and income generation associated with the operations of the commercial fishing industry in Western Australia. The calculation in this table is based on assigning the direct employment and income impacts associated with the fishing activities to the industry sectors of the Western Australian input-output table to which they most closely relate.

For each major fishery, the tables show the direct output, income and employment impacts, the Type I and Type II employment multipliers and the total estimated impact on output, employment and incomes implied by the application of these multipliers to the direct impact estimates.

The aggregate direct employment of 4,002 is estimated to increase to 7,484 when the Type I multiplier is used. This impact flow on accounts for the direct plus production induced effects associated with the industry. If we allow for the induced consumption effects, that is use the Type II multiplier, the total employment impact increases to 12,406. The breakdown of this employment by fishery is shown in Figure 5.1.

Figure 5-1. Total Employment by Main Fisheries
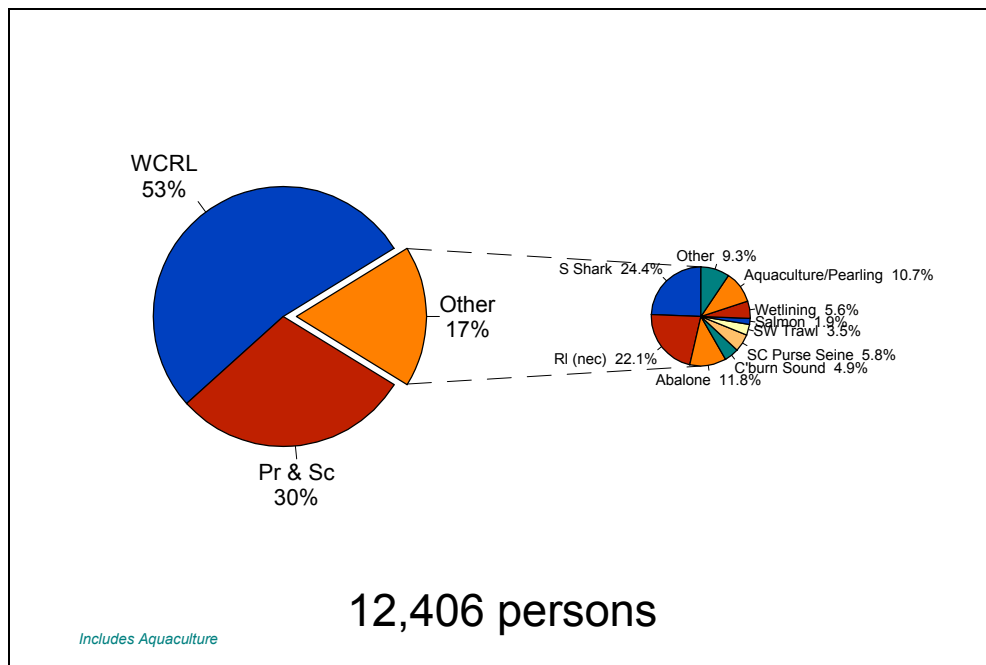
The direct wages and salaries of $113.7 million becomes $190.3 million using the Type I multiplier and $278.5 million using the Type II multiplier. The income impacts for the Type II multiplier are shown by fishery in Figure 5.2.

Figure 5-2. Total Output by Main Fisheries

WCRL
60%

Ag/Pe 13.5% Other 8.7%
Wetlining 9.3%
Salmon 1.9%
SW Trawl 2.2%
SC Purse Seine 3.8%
C'burn Sound 7.9%
Abalone 5.7%
Rl (nec) 16.4%

Other
12% S Shark 30.8%

Pr & Sc
28%

$278.5 million

Includes Aquaculture
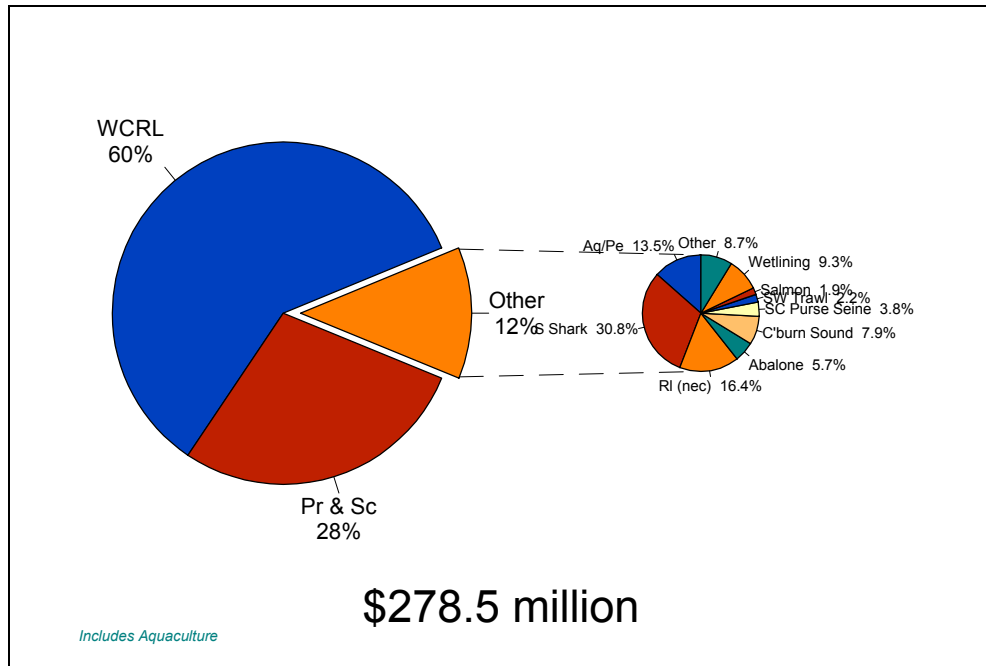
The estimated direct output impact of $424.3 million becomes $670.4 million using the Type I multipliers and $941.7 million using the Type II multipliers. The output impacts for the Type II multiplier are shown by fishery in Figure 5.3.

Figure 5-3. Total Output by Main Fisheries

WCRL
59%

Aquaculture/Pearling 24.3%
Other 8.4%
Wetlining 8.4%
Salmon 2.8%
SW Trawl 1.7%
SC Purse Seine 3.5%
C'burn Sound 4.6%
Abalone 5.9%
Rl (nec) 14.8%

Other
14%

S Shark 25.6%

Pr & Sc
27%

$941.7 million

Includes Aquaculture
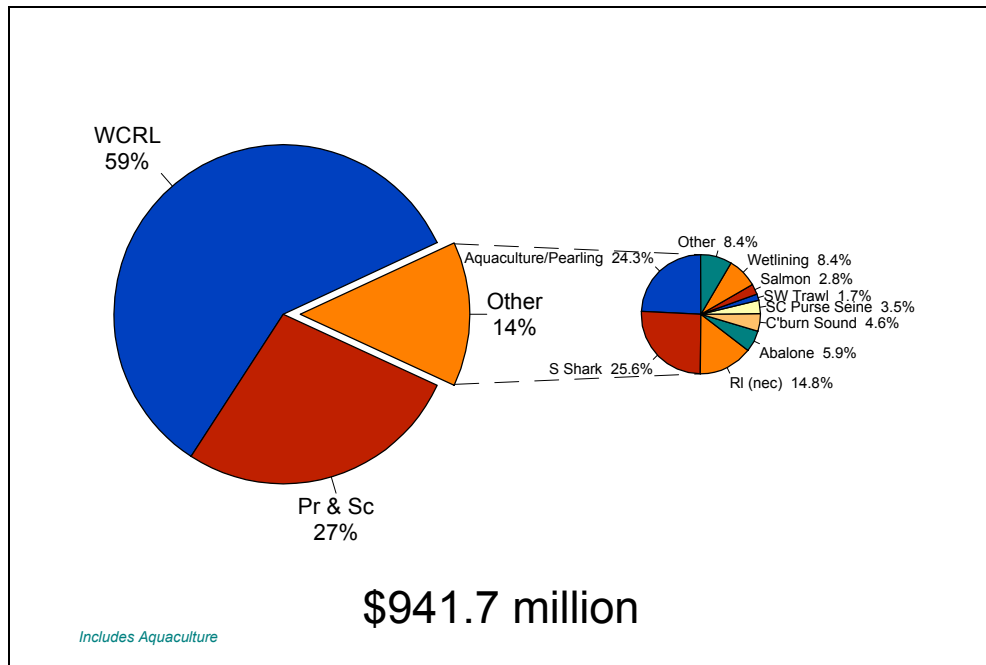
The higher population estimates combined with the Type II multipliers give total impact estimates of $1059.5 million for output , $310.1 million for incomes and 14,304 for employment.

Distribution of Impacts Across Industries

Table 5.4 indicates the industry groups most affected by the economic activity associated with the operation of commercial fishing. Appendix B contains a full glossary to the abbreviations used for industry groups in Table 5.4.

The flow on impact is distributed widely across the industry groups. Table 5-4 indicates that some 38 of the industry groups have employment impacts in excess of 10 persons.

Table 5-4. **Distribution of Employment Impacts**

	Inital Effect	Production Induced Effect	Consumption Induced Effect	Total Effect	Flow On
SHEEP	0	2	7	10	10
GRAIN	0	0	3	4	4
BEEF	0	1	11	12	12
MILK C	0	0	7	7	7
POULT	0	0	6	6	6
OTH AGR	0	5	109	114	114
S AGR	0	0	2	2	2
FORSTRY	0	1	5	6	6
COMM FISH	4002	167	119	4,255	286
FE ORE	0	0	0	0	0
OTH ORE	0	5	3	8	8
COAL	0	6	2	8	8
S MIN	0	0	0	1	1
OTH MIN	0	1	1	2	2
MEAT P	0	4	38	41	41
MILK P	0	1	23	23	23
BREAD	0	1	61	62	62
BEVERS	0	2	29	31	31
FOOD P	0	16	97	113	113
IAS	0	36	21	57	57
NFBMP	0	8	4	13	13
OFSMP	0	61	82	144	144
T EQUIP	0	645	56	701	701
O EQUIP	0	187	102	290	290
TEXTS	0	3	19	21	21
CL&F	0	8	38	46	46
WOOD P	0	18	188	206	206
PAPER P	0	53	75	128	128
CHEM P	0	230	22	252	252
NMMP	0	6	45	51	51
PLASTS	0	13	10	21	21
OTH MAN	0	258	43	301	301
ELECT	0	29	59	88	88
GAS	0	1	4	4	4
WATER	0	13	19	32	32
RES CON	0	1	461	462	462
OTH CON	0	22	16	38	38
W SALE	0	125	156	281	281
RETAIL	0	715	1,567	2,283	2,283
TRANS	0	109	112	222	222
COMM	0	59	101	160	160
FINANCE	0	191	95	286	286
BUSPNS	0	168	261	429	429
ADMIN	0	275	25	300	300
DEFENCE	0	0	0	0	0
HEALTH	0	2	209	212	212
EDUC	0	1	45	46	46
WELF	0	11	13	22	22
ENT	0	14	154	168	168
HOTEL	0	17	418	435	435
TOTAL	**4,002**	**3,491**	**4,948**	**12,406**	**8,437**

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Appendix A

The Input - Output Model

A The Input - Output Model and the Derivation of the Impact Multipliers

The standard format of an input-output table arranges the available information into four quadrants to represent a "Transactions Table" as shown below.

Allocation of production to intermediate usage		Allocation of production to final demand
Allocation of primary inputs to intermediate usage		Allocation of primary inputs to final demand

Using the 50 industry input-output table we can express the relationship between the total output of an industry and the inputs it needs from other industries as follows

$$Q_i = A_{ij} Q_j + F_i \qquad i = 1, ..., 31.$$

where Q_i is the total output of industry i, A_{ij} is the input-output coefficient indicating the value of input from industry i needed to produce a unit of output in industry j. Q_j is the total output of industry j. Put in matrix notation the above equation becomes

$$Q = AQ + F$$

where Q is the 50x1 vector of total outputs, A is the 50x50 matrix of input-output coefficients and F is the 50x1 vector of final demands.

Solving this equation for Q yields

$$Q = (I - A)^{-1} F$$

which gives total output solely in terms of final demand. $(I - A)^{-1}$ is known as the Leontief inverse and gives the direct and indirect effects of a unit increase in final demand. The sum of the elements of the industry column in the Leontief inverse gives the output multiplier when we account for direct and indirect effects on production.

With final demand defined to include household demand, the $(I-A)^{-1}$ matrix represents a set of "multipliers" which indicate the magnitude of the impact of a dollar of extra sales to final demand for each product on the output level of each product. The aggregate of these individual product multipliers gives the aggregate output multiplier for extra sales to final demand for each product. This type of multiplier where there is no indirect effect on household demand of the extra sales is called a "Type I multiplier".

It is possible to expand the matrix of input-output coefficients by allowing for the proportion of total household consumption devoted to good i, W_i and for the value of the primary labour input needed to produce a unit of output in industry i, L_i. Therefore W is a 50x1 vector of consumption proportions and L is a 1x50 vector of labour input coefficients. Using an equivalent analysis to that above we can obtain the Leontief inverse based on the augmented input-output matrix A^*, that is $(I - A^*)^{-1}$. Each element of this matrix gives the effect on the output or sales of industry in response to a unit

change in the output of industry j after all direct, indirect and induced consumption effects are allowed for.

This modification yields an alternative set of multipliers called "Type II multipliers" which are larger than Type I multipliers by virtue of the inclusion of the indirect effects of any change in final demand on household demand.

In addition to these output multipliers it is a straightforward matter to use the information on primary inputs in the transactions table to produce equivalent multipliers for employment and household income. In this way it is possible to develop a comprehensive picture of the impact of an industry on the level of output and employment in the economy.

A number of caveats must always be borne in mind when using input-output analysis. At the most general level, it must be emphasised that a number of restrictive assumptions need to be made before an input-output table can be used for this sort of analysis. Perhaps the most restrictive assumption is that there is no scope in input-output analysis for any substitutability or complimentarity either in the pattern of inputs to production or in the composition of demand for output. On the input side this assumption implies a fixed coefficients production technology and requires the pattern of inputs to be unaffected by changes in the relative price of inputs. Similarly, on the demand side the pattern of output demands is required to be unaffected by changes in the relative prices of outputs. A related assumption is that relative levels of economic activity are unaffected by changes in the exchange rate - the levels of exports are fixed and imports are combined in fixed proportions with other inputs to production. Finally, it is assumed that there are no supply constraints to the expansion of activity in any industry. It should be noted that the validity of all these assumptions depends in part on the magnitude of the development in question - the smaller the development relative to the State's economy the less likely it is to affect relative prices or to encounter supply constraints.

At a more specific level, it should be recognized that if the multipliers are used for impact analysis then both Type I and Type II multipliers represent only an upper bound of the purported quantity changes brought about by the project. The actual quantity changes will be smaller to the extent that the impact of any industry expansion of project is manifested instead as price changes (inflation). This effect depends on the size of the industry change relative to the state's economy.

A further criticism which applies to Type II multipliers concerns the implications for household behaviour of incorporating household demands into the fixed coefficients technological structure of the state's economy. In particular, Type II multipliers implicitly assume that all households maintain their consumption patterns regardless of their income level - thereby eliminating the distinction between luxuries and necessities in expenditure. It should be noted that a recent study by Threlfall (1986) indicates this assumption leads to an overestimate of between five and seven percent in the magnitude of Type II multipliers compared with a more realistic specification of consumption behaviour.

Appendix B

Multipliers

Total OUTPUT Multipliers:
Western Australian Transactions Table 1982/83 ($000's)

SECTOR	Initial	First	Indust	Cons	Total	Type 1A	Type 1B	Type 2A	Type 2B
Sheep	1	0.47	0.21	0.65	2.33	1.47	1.68	2.33	1.33
Grain	1	0.48	0.2	0.69	2.37	1.48	1.68	2.37	1.37
Beef	1	0.64	0.37	0.79	2.8	1.64	2.01	2.8	1.8
Milkc	1	0.49	0.26	0.86	2.61	1.49	1.74	2.61	1.61
Poult	1	0.61	0.38	0.8	2.79	1.61	2	2.79	1.79
Oth Agr	1	0.42	0.16	0.93	2.51	1.42	1.58	2.51	1.51
S Agr	1	0.13	0.06	0.3	1.49	1.13	1.19	1.49	0.49
Forstry	1	0.33	0.16	0.7	2.18	1.33	1.49	2.18	1.18
Fishing	1	0.38	0.2	0.69	2.28	1.38	1.58	2.28	1.28
Fe Ore	1	0.36	0.19	0.39	1.94	1.36	1.55	1.94	0.94
Oth Ore	1	0.26	0.14	0.46	1.85	1.26	1.39	1.85	0.85
Coal	1	0.26	0.17	0.36	1.79	1.26	1.43	1.79	0.79
S Min	1	0.53	0.39	0.69	2.61	1.53	1.92	2.61	1.61
Oth Min	1	0.74	0.36	0.81	2.9	1.74	2.1	2.9	1.9
Meatp	1	0.41	0.25	0.52	2.18	1.41	1.66	2.18	1.18
Milkp	1	0.46	0.29	0.54	2.29	1.46	1.75	2.29	1.29
Bread	1	0.32	0.17	0.61	2.1	1.32	1.49	2.1	1.1
Bevers	1	0.52	0.29	0.54	2.36	1.52	1.82	2.36	1.36
Foodp	1	0.42	0.23	0.67	2.32	1.42	1.66	2.32	1.32
Ias	1	0.45	0.27	0.66	2.38	1.45	1.72	2.38	1.38
Nfbmp	1	0.66	0.39	0.5	2.55	1.66	2.05	2.55	1.55
Ofsmp	1	0.43	0.28	0.61	2.32	1.43	1.71	2.32	1.32
T Equip	1	0.32	0.18	0.68	2.18	1.32	1.5	2.18	1.18
O Equip	1	0.43	0.26	0.62	2.31	1.43	1.68	2.31	1.31
Texts	1	0.42	0.23	0.65	2.31	1.42	1.66	2.31	1.31
Cl&F	1	0.23	0.09	0.67	1.99	1.23	1.32	1.99	0.99
Wood P	1	0.37	0.18	0.6	2.14	1.37	1.55	2.14	1.14
Paper P	1	0.22	0.09	0.6	1.92	1.22	1.31	1.92	0.92
Chem P	1	0.47	0.27	0.49	2.23	1.47	1.74	2.23	1.23
NmmP	1	0.39	0.2	0.65	2.25	1.39	1.59	2.25	1.25
Plasts	1	0.29	0.14	0.51	1.94	1.29	1.43	1.94	0.94
Oth Man	1	0.3	0.14	0.48	1.92	1.3	1.44	1.92	0.92
Elect	1	0.37	0.19	0.59	2.15	1.37	1.56	2.15	1.15
Gas	1	0.3	0.14	0.48	1.91	1.3	1.43	1.91	0.91
Water	1	0.19	0.1	0.63	1.92	1.19	1.29	1.92	0.92
Res Con	1	0.49	0.27	0.91	2.68	1.49	1.76	2.68	1.68
Oth Con	1	0.4	0.23	0.85	2.48	1.4	1.63	2.48	1.48
Wsale	1	0.23	0.08	0.55	1.86	1.23	1.31	1.86	0.86
Retail	1	0.29	0.1	0.86	2.25	1.29	1.4	2.25	1.25
Trans	1	0.37	0.17	0.85	2.39	1.37	1.54	2.39	1.39
Comm	1	0.11	0.04	0.6	1.75	1.11	1.15	1.75	0.75
Finance	1	0.23	0.08	0.73	2.04	1.23	1.31	2.04	1.04
Buspns	1	0.22	0.08	0.61	1.91	1.22	1.3	1.91	0.91
Admin	1	0.27	0.11	1.09	2.47	1.27	1.38	2.47	1.47
Defence	1	0.33	0.16	0.97	2.46	1.33	1.5	2.46	1.46
Health	1	0.2	0.08	0.9	2.18	1.2	1.28	2.18	1.18
Educ	1	0.14	0.06	0.7	1.9	1.14	1.2	1.9	0.9
Welf	1	0.22	0.09	0.64	1.95	1.22	1.31	1.95	0.95
Ent	1	0.31	0.14	0.58	2.03	1.31	1.45	2.03	1.03
Hotel	1	0.21	0.08	0.5	1.79	1.21	1.29	1.79	0.79

Total INCOME Multipliers:
Western Australian Transactions Table 1982/83 ($000's)

SECTOR	Initial	First	Indust	Cons	Total	Type 1A	Type 1B	Type 2A	Type 2B
Sheep	0.27	0.12	0.06	0.21	0.66	1.46	1.68	2.46	1.46
Grain	0.3	0.12	0.06	0.22	0.7	1.42	1.61	2.37	1.37
Beef	0.26	0.18	0.11	0.26	0.8	1.7	2.12	3.11	2.11
Milkc	0.38	0.15	0.07	0.28	0.88	1.39	1.58	2.32	1.32
Poult	0.27	0.17	0.11	0.26	0.81	1.63	2.02	2.97	1.97
Oth Agr	0.49	0.11	0.05	0.3	0.94	1.21	1.31	1.92	0.92
S Agr	0.15	0.04	0.02	0.1	0.3	1.29	1.41	2.07	1.07
Forstry	0.33	0.1	0.05	0.23	0.71	1.3	1.44	2.11	1.11
Fishing	0.31	0.12	0.06	0.23	0.71	1.38	1.57	2.31	1.31
Fe Ore	0.12	0.09	0.05	0.13	0.4	1.77	2.21	3.24	2.24
Oth Ore	0.2	0.08	0.04	0.15	0.46	1.38	1.58	2.32	1.32
Coal	0.13	0.07	0.05	0.12	0.37	1.53	1.89	2.78	1.78
S Min	0.21	0.15	0.12	0.22	0.7	1.71	2.25	3.31	2.31
Oth Min	0.23	0.22	0.1	0.26	0.82	1.95	2.4	3.52	2.52
Meatp	0.17	0.12	0.07	0.17	0.53	1.68	2.1	3.09	2.09
Milkp	0.16	0.13	0.08	0.18	0.55	1.78	2.3	3.38	2.38
Bread	0.28	0.09	0.05	0.2	0.62	1.33	1.5	2.21	1.21
Bevers	0.15	0.15	0.08	0.17	0.55	2	2.57	3.77	2.77
Foodp	0.27	0.12	0.07	0.22	0.68	1.45	1.69	2.48	1.48
IAS	0.26	0.12	0.08	0.21	0.67	1.47	1.76	2.59	1.59
Nfbmp	0.11	0.14	0.1	0.16	0.51	2.23	3.16	4.64	3.64
Ofsmp	0.24	0.11	0.07	0.2	0.62	1.44	1.75	2.58	1.58
T Equip	0.33	0.09	0.05	0.22	0.69	1.27	1.42	2.08	1.08
O Equip	0.25	0.11	0.07	0.2	0.63	1.43	1.71	2.51	1.51
Texts	0.26	0.12	0.07	0.21	0.66	1.46	1.71	2.51	1.51
CL&F	0.36	0.07	0.03	0.22	0.68	1.19	1.27	1.86	0.86
Woodp	0.25	0.11	0.05	0.19	0.61	1.43	1.63	2.4	1.4
Paper P	0.32	0.07	0.03	0.2	0.61	1.22	1.3	1.91	0.91
Chem P	0.16	0.11	0.07	0.16	0.49	1.69	2.15	3.15	2.15
Nmmp	0.27	0.12	0.06	0.21	0.66	1.44	1.66	2.44	1.44
Plasts	0.24	0.08	0.04	0.17	0.52	1.33	1.5	2.2	1.2
Oth Man	0.22	0.08	0.04	0.16	0.49	1.36	1.55	2.28	1.28
Elect	0.26	0.1	0.05	0.19	0.6	1.36	1.56	2.29	1.29
Gas	0.21	0.08	0.04	0.16	0.49	1.36	1.54	2.27	1.27
Water	0.35	0.06	0.03	0.2	0.64	1.17	1.25	1.84	0.84
Res Con	0.41	0.14	0.08	0.3	0.93	1.34	1.53	2.24	1.24
Oth Con	0.41	0.11	0.06	0.28	0.86	1.27	1.43	2.09	1.09
Wsale	0.28	0.08	0.03	0.18	0.56	1.27	1.36	2.01	1.01
Retail	0.46	0.1	0.03	0.28	0.87	1.21	1.28	1.88	0.88
Trans	0.41	0.12	0.05	0.27	0.86	1.29	1.41	2.08	1.08
Comm	0.36	0.04	0.01	0.19	0.61	1.1	1.14	1.67	0.67
Finance	0.4	0.08	0.02	0.24	0.74	1.2	1.26	1.85	0.85
Buspns	0.32	0.07	0.02	0.2	0.62	1.23	1.3	1.92	0.92
Admin	0.63	0.09	0.03	0.35	1.11	1.15	1.2	1.77	0.77
Defence	0.51	0.11	0.05	0.31	0.98	1.21	1.31	1.92	0.92
Health	0.54	0.06	0.02	0.29	0.92	1.12	1.16	1.71	0.71
Educ	0.41	0.05	0.02	0.23	0.71	1.13	1.17	1.72	0.72
Welf	0.34	0.08	0.03	0.21	0.65	1.22	1.3	1.91	0.91
Ent	0.26	0.1	0.04	0.19	0.59	1.37	1.52	2.23	1.23
Hotel	0.25	0.07	0.02	0.16	0.5	1.26	1.36	1.99	0.99

Total EMPLOYMENT Multipliers (/$m):
Western Australian Transactions Table 1982/83 ($000's)

SECTOR	Initial	First	Indust	Cons	Total	Type 1A	Type 1B	Type 2A	Type 2B
Sheep	16.68	9.11	4.01	18.94	48.74	1.55	1.79	2.92	1.92
Grain	18.45	9.54	3.79	20.16	51.94	1.52	1.72	2.82	1.82
Beef	42.9	19.27	8.53	23.07	93.76	1.45	1.65	2.19	1.19
Milkc	26.52	12.82	5.01	25.23	69.58	1.48	1.67	2.62	1.62
Poult	19.12	14.32	7.97	23.35	64.76	1.75	2.17	3.39	2.39
Oth Agr	120.83	8.82	3	27.18	159.83	1.07	1.1	1.32	0.32
S Agr	5.61	2.88	1.15	8.72	18.37	1.51	1.72	3.27	2.27
Forstry	20.93	7.34	3.01	20.37	51.64	1.35	1.49	2.47	1.47
Fishing	19.09	7.66	3.93	20.33	51	1.4	1.61	2.67	1.67
FE Ore	4.7	5.89	3.47	11.42	25.48	2.25	2.99	5.42	4.42
Oth Ore	7.7	4.74	2.61	13.37	28.43	1.62	1.95	3.69	2.69
Coal	4.73	4.24	3.14	10.55	22.66	1.9	2.56	4.79	3.79
S Min	6.76	10.46	7.74	20.24	45.2	2.55	3.69	6.68	5.68
Oth Min	20.06	14.93	6.74	23.56	65.29	1.74	2.08	3.25	2.25
Meatp	8.26	8.3	5.4	15.16	37.11	2.01	2.66	4.49	3.49
Milkp	10.08	8.47	6	15.88	40.43	1.84	2.43	4.01	3.01
Bread	24.49	6.17	3.36	17.92	51.94	1.25	1.39	2.12	1.12
Bevers	7.88	10.3	5.43	15.77	39.38	2.31	2.99	4.99	3.99
Foodp	14.65	8.86	4.48	19.46	47.45	1.6	1.91	3.24	2.24
IAS	16.33	7.02	4.67	19.22	47.24	1.43	1.72	2.89	1.89
NFBMP	3.86	6.26	6.04	14.7	30.87	2.62	4.18	7.99	6.99
OFSMP	17.96	6.9	4.47	17.82	47.15	1.38	1.63	2.63	1.63
T Equip	20.74	6.1	3.09	19.94	49.87	1.29	1.44	2.4	1.4
O Equip	19.53	7.45	4.26	18.22	49.46	1.38	1.6	2.53	1.53
Texts	27.5	9.83	4.7	18.99	61.02	1.36	1.53	2.22	1.22
CL&F	43.63	6.2	1.97	19.52	71.32	1.14	1.19	1.63	0.63
Woodp	23.75	7.62	3.45	17.45	52.28	1.32	1.47	2.2	1.2
Paper P	22.42	4.46	1.8	17.67	46.35	1.2	1.28	2.07	1.07
Chem P	8.71	6.45	4.58	14.26	34	1.74	2.27	3.9	2.9
NMMP	14.9	7.02	3.81	19.15	44.89	1.47	1.73	3.01	2.01
Plasts	13.5	4.92	2.52	14.98	35.92	1.36	1.55	2.66	1.66
Oth Man	34.75	5.94	2.64	14.15	57.47	1.17	1.25	1.65	0.65
Elect	13.05	4.98	3.01	17.41	38.44	1.38	1.61	2.94	1.94
Gas	10.49	4.23	2.49	14.05	31.25	1.4	1.64	2.98	1.98
Water	22.14	3.79	1.72	18.33	45.98	1.17	1.25	2.08	1.08
Res Con	34.04	9.27	5.05	26.68	75.05	1.27	1.42	2.2	1.2
Oth Con	34.04	7.34	4.13	24.89	70.4	1.22	1.34	2.07	1.07
Wsale	20.83	5.1	1.66	16.04	43.63	1.24	1.32	2.09	1.09
Retail	66.49	6.52	2.09	25.02	100.11	1.1	1.13	1.51	0.51
Trans	20.92	8.78	3.23	24.76	57.69	1.42	1.57	2.76	1.76
Comm	22.72	2.47	0.78	17.47	43.44	1.11	1.14	1.91	0.91
Finance	21.69	5.18	1.61	21.47	49.95	1.24	1.31	2.3	1.3
Buspns	17	4.81	1.58	17.89	41.28	1.28	1.38	2.43	1.43
Admin	42.8	5.85	2.13	31.9	82.68	1.14	1.19	1.93	0.93
Defence	42.78	7.33	3.1	28.27	81.47	1.17	1.24	1.9	0.9
Health	50.28	4.09	1.52	26.38	82.26	1.08	1.11	1.64	0.64
Educ	34.94	3.42	1.2	20.47	60.04	1.1	1.13	1.72	0.72
Welf	37.48	5.21	1.75	18.8	63.24	1.14	1.19	1.69	0.69
Ent	20.44	7.19	2.64	17.01	47.29	1.35	1.48	2.31	1.31
Hotel	33.16	4.04	1.61	14.51	53.32	1.12	1.17	1.61	0.61

Key to Industries in the Input-Output Model

Abbreviation	Full Industry Name
SHEEP	Sheep
GRAIN	Cereal grains
BEEF	Meat cattle
MILKC	Milk, cattle and pigs
POULT	Poultry
OTHER AGR	Other agriculture
S AGR	Services to agriculture
FORSTRY	Forestry and logging
FISHING	Fishing and hunting
FE ORE	Ferrous ores
OTH ORE	Non-ferrous metal ores
COAL	Coal, ore, gas
S MIN	Services to mining
OTH MIN	Other mining
MEATP	Meat products
MILKP	Milk products
BREAD	Bread, cakes, biscuits
BEVERS	Beverages and malt
FOODP	Other food products
IAS	Basic iron and steel
NFBMP	Non-ferrous metal products
OFSMP	Other fabricated and structural metal products
T EQUIP	Transport and equipment
O EQUIP	Machinery and equipment
TEXTS	Textiles
CL & F	Clothing and footwear
WOODP	Wood and furniture products
PAPER P	Paper products and printing
CHEM P	Chemical products
NMMP	Non-metallic mineral products
PLASTS	Plastic and related products
OTH MAN	Other manufacturing
ELEC	Electricity
GAS	Gas
WATER	Water
RES CON	Residential construction
OTH CON	Other construction
WSALE	Wholesale trade
RETAIL	Retail trade
TRANS	Transport
COMM	Communication
FINANCE	Finance
BUSANS	Business and personal services
ADMIN	Public administration
DEFENCE	Defence
HEALTH	Health
EDUC	Education
WELF	Welfare
ENT	Entertainment
HOTEL	Restaurants, hotels

Appendix C

Questionnaires

Appendix D

Detailed Background Data

Table 1. **Total Commercial Catch - Western Australia (Tonnes)**

Year	Tonnes
75-76	21,791
76-77	21,077
77-78	27,157
78-79	25,506
79-80	25,916
80-81	26,289
81-82	27,634
82-83	36,966
83-84	36,106
84-85	31,857
85-86	31,602
86-87	29,609
87-88	37,065
88-89	35,392
89-90	34,850
90-91	39,724
91-92	55,385

Table 2. **Total Commercial Catch - Western Australia (Value)**

Year	Value ($000's)
75-76	137,290
76-77	163,545
77-78	190,050
78-79	144,420
79-80	125,902
80-81	115,029
81-82	144,339
82-83	179,283
83-84	185,728
84-85	213,561
85-86	182,987
86-87	207,985
87-88	276,763
88-89	238,156
89-90	222,514
90-91	275,333
91-92	373,864

Table 3.   **Commercial Catch by Species 1991/92 (Tonnes)**

Species	Tonnes
Lobster	12,202
Prawns	3,085
Scallops	20,539
Pilchards	7,327
Other Fish	11,445
Other	784

Table 4.   **Commercial Catch by Species - 1991/92 (Value)**

Species	Value
Lobster	252,150
Prawns	25,158
Scallops	57,510
Pilchards	3,945
Other Fish	25,143
Other	9,960

Table 5.   **Rock Lobster Catch (Tonnes)**

Year	Tonnes
75-76	8,757
76-77	9,297
77-78	10,773
78-79	11,461
79-80	10,738
80-81	9,956
81-82	10,509
82-83	12,482
83-84	10,721
84-85	9,095
85-86	7,391
86-87	7,718
87-88	10,873
88-89	11,776
89-90	9,949
90-91	9,262
91-92	12,202

Table 6. **Rock Lobster Catch (Value)**

Year	Value ($000's)
75-76	90,805
76-77	116,893
77-78	127,399
78-79	102,275
79-80	91,315
80-81	79,439
81-82	108,848
82-83	132,464
83-84	126,255
84-85	156,828
85-86	116,516
86-87	140,665
87-88	189,580
88-89	174,787
89-90	160,307
90-91	197,484
91-92	252,150

Table 7. **Rock Lobster Average Value**

Year	Ave Value per Tonne
75-76	$10.37
76-77	$12.57
77-78	$11.83
78-79	$8.92
79-80	$8.50
80-81	$7.98
81-82	$10.36
82-83	$10.61
83-84	$11.78
84-85	$17.24
85-86	$15.76
86-87	$18.23
87-88	$17.44
88-89	$14.84
89-90	$16.11
90-91	$21.32
91-92	$20.66

Table 8. **Rock Lobster Catch Effort**

Year	Pot Lifts - Nominal	Nominal Catch/Pot Lift	Pot Lifts - Standardised	Standardised Catch/Pot Lift
75-76	10,202,107	0.89	10,830,804	0.84
76-77	10,861,023	0.86	11,669,611	0.80
77-78	10,594,101	1.00	11,520,507	0.92
78-79	10,842,124	1.12	11,933,029	1.01
79-80	10,724,109	1.03	11,946,301	0.92
80-81	10,896,576	0.95	12,285,852	0.84
81-82	11,255,412	0.98	12,844,784	0.86
82-83	11,625,290	1.11	13,428,470	0.96
83-84	11,214,423	1.01	13,111,858	0.87
84-85	11,601,466	0.83	13,730,046	0.71
85-86	10,831,979	0.75	13,025,961	0.63
86-87	11,352,555	0.75	13,872,037	0.61
87-88	12,884,033	0.94	16,014,922	0.75
88-89	12,318,953	1.00	15,594,214	0.79
89-90	12,092,738	0.85	15,590,052	0.66
90-91	12,025,476	0.77	15,789,742	0.58
91-92	12,795,166	0.95	17,007,714	0.72

Table 9. **Rock Lobster Fishing Effort (Tonnes)**

Year	Man Mths	Boat Mths	Catch/Man Mth	Catch/Boat Mth
76-77	15,611	6,941	0.60	1.34
77-78	16,466	7,131	0.65	1.51
78-79	15,006	6,179	0.76	1.85
79-80	15,033	6,115	0.71	1.76
80-81	14,675	6,018	0.68	1.65
81-82	13,992	5,779	0.75	1.82
82-83	14,516	5,913	0.86	2.11
83-84	14,491	5,858	0.74	1.83
84-85	14,388	5,774	0.63	1.58
85-86	13,300	5,506	0.56	1.34
86-87	13,446	5,555	0.57	1.39
87-88	13,745	5,480	0.79	1.98
88-89	14,201	5,607	0.83	2.10
89-90	14,491	5,858	0.69	1.70

Table 10. **Rock Lobster Fishing Effort (Value)**

Year	Man Mths	Boat Mths	Catch/Man Mth	Catch/Boat Mth

76-77	15,611	6,941	7,488	16,841
77-78	16,466	7,131	7,737	17,865
78-79	15,006	6,179	6,816	16,552
79-80	15,033	6,115	6,074	14,933
80-81	14,675	6,018	5,413	13,200
81-82	13,992	5,779	7,779	18,835
82-83	14,516	5,913	9,125	22,402
83-84	14,491	5,858	8,713	21,553
84-85	14,388	5,774	10,900	27,161
85-86	13,300	5,506	8,761	21,162
86-87	13,446	5,555	10,461	25,322
87-88	13,745	5,480	13,793	34,595
88-89	14,201	5,607	12,308	31,173
89-90	14,491	5,858	11,062	27,365

Table 11.   **Rock Lobster Pot Values**

Year	Low	High
84-85	4,157	5,490
85-86	5,228	6,245
86-87	4,620	6,601
87-88	8,625	11,090
88-89	7,687	10,326
89-90	6,354	8,260
90-91	6,249	8,567
91-92	8,000	12,000

Table 12.   **Prawn Catch (Tonnes)**

Year	Value ($000's)
75-76	4432
76-77	3047
77-78	3940
78-79	3471
79-80	3387
80-81	3083
81-82	2801
82-83	3115
83-84	3325
84-85	3180
85-86	2896
86-87	2845
87-88	3314
88-89	3160
89-90	2988
90-91	3152
91-92	3085

Table 13.   **Prawn Catch (Value)**

Year	Value ($000's)
75-76	33746
76-77	32661
77-78	42706
78-79	28800
79-80	19726
80-81	18504
81-82	18328
82-83	23916
83-84	29057
84-85	28318
85-86	29067
86-87	28443
87-88	39704
88-89	28552
89-90	22388
90-91	26084
91-92	25158

Table 14.   **Prawn Average Value**

Year	Ave Value per Tonne
75-76	$7.61
76-77	$10.72
77-78	$10.84
78-79	$8.30
79-80	$5.82
80-81	$6.00
81-82	$6.54
82-83	$7.68
83-84	$8.74
84-85	$8.91
85-86	$10.04
86-87	$10.00
87-88	$11.98
88-89	$9.04
89-90	$7.49
90-91	$8.28
91-92	$8.15

Table 15.   **Hours Trawled in the Exmouth Gulf Fishery**

Year	Hours Trawled
1963	1799
1964	2063
1965	8380
1966	11097
1967	16651
1968	17667
1969	26245
1970	28764
1971	29706
1972	45039
1973	47296
1974	41478
1975	45066
1976	49726
1977	51035
1978	54388
1979	51097
1980	52710
1981	46712
1982	42183
1983	37948
1984	38487
1985	43108
1986	44570
1987	45959
1988	42718
1989	39531
1990	36008
1991	36182

Table 16. **Prawn Trawling Effort (Weight)**

Year	Man Mths	Boat Mths	Catch/Man Mth	Catch/Boat Mth
76-77	3,535	975	0.86	3.13
77-78	3,607	1,013	1.09	3.89
78-79	4,146	1,206	0.84	2.88
79-80	4,549	1,322	0.74	2.56
80-81	4,224	1,198	0.73	2.57
81-82	3,868	1,117	0.72	2.51
82-83	3,527	1,011	0.88	3.08
83-84	3,440	1,018	0.97	3.27
84-85	3,482	1,053	0.91	3.02
85-86	3,214	973	0.90	2.98
86-87	3,169	945	0.90	3.01
87-88	3,870	1,137	0.86	2.91
88-89	3,530	1,043	0.90	3.03

Table 17. **Prawn Trawling Effort (Value)**

Year	Man Mths	Boat Mths	Catch / Man Mth	Catch / Boat Mth
76-77	3,535	975	9,239	33,498
77-78	3,607	1,013	11,840	42,158
78-79	4,146	1,206	6,946	23,881
79-80	4,549	1,322	4,336	14,921
80-81	4,224	1,198	4,381	15,446
81-82	3,868	1,117	4,738	16,408
82-83	3,527	1,011	6,781	23,656
83-84	3,440	1,018	8,447	28,543
84-85	3,482	1,053	8,133	26,893
85-86	3,214	973	9,044	29,873
86-87	3,169	945	8,975	30,099
87-88	3,870	1,137	10,259	34,920
88-89	3,530	1,043	8,088	27,374

Table 18.   **Salmon Catch (Tonnes)**

Year	Value ($000's)
75-76	1128
76-77	1173
77-78	750
78-79	1133
79-80	1221
80-81	1188
81-82	1407
82-83	2289
83-84	3687
84-85	2587
85-86	2064
86-87	1538
87-88	1315
88-89	1433
89-90	1711
90-91	2119
91-92	1306

Table 19.   **Salmon Catch (Value)**

Year	Value ($000's)
75-76	1087
76-77	817
77-78	674
78-79	783
79-80	855
80-81	998
81-82	999
82-83	1593
83-84	1743
84-85	999
85-86	924
86-87	935
87-88	813
88-89	825
89-90	617
90-91	785
91-92	483

Table 20. **Salmon Average Value**

Year	Ave Value per Tonne
75-76	$0.96
76-77	$0.70
77-78	$0.90
78-79	$0.69
79-80	$0.70
80-81	$0.84
81-82	$0.71
82-83	$0.70
83-84	$0.47
84-85	$0.39
85-86	$0.45
86-87	$0.61
87-88	$0.62
88-89	$0.58
89-90	$0.36
90-91	$0.37
91-92	$0.37

Table 21. **Salmon Fishing Effort (Weight)**

Year	Man Mths	Boat Mths	Catch/Man Mth	Catch/Boat Mth
76-77	332	100	3.53	11.73
77-78	168	80	4.46	9.38
78-79	310	92	3.65	12.32
79-80	296	84	4.13	14.54
80-81	353	109	3.37	10.90
81-82	368	102	3.82	13.79
82-83	466	123	4.91	18.61
83-84	363	95	10.16	38.81
84-85	301	78	8.59	33.17
85-86	253	63	8.16	32.76
86-87	311	77	4.95	19.97
87-88	230	69	5.72	19.06
88-89	303	78	4.73	18.37

Table 22.   **Salmon Fishing Effort (Value)**

Year	Man Mths	Boat Mths	Catch/Man Mth	Catch/Boat Mth
76-77	332	100	2,462	8,172
77-78	168	80	4,011	8,422
78-79	310	92	2,525	8,507
79-80	296	84	2,888	10,177
80-81	353	109	2,828	9,158
81-82	368	102	2,714	9,792
82-83	466	123	3,418	12,949
83-84	363	95	4,802	18,348
84-85	301	78	3,318	12,806
85-86	253	63	3,652	14,668
86-87	311	77	3,006	12,142
87-88	230	69	3,536	11,786
88-89	303	78	2,722	10,575