PATTERNS OF FUTURE DEVELOPMENT IN THE SOUTH-WEST MARINE REGION

Julian Clifton, Maria Olejnik, Bryan Boruff and Matthew Tonts

Institute for Regional Development

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THE UNIVERSITY OF WESTERN AUSTRALIA

School of Earth & Geographical Sciences

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LIST OF ABBREVIATIONS

AAPMA	Australian Association of Ports and Maritime Authorities
ABARE	Australian Bureau of Agricultural and Resource Economics
ABS	Australian Bureau of Statistics
AFMA	Australian Fisheries Management Authority
APPEA	Australian Petroleum Production and Exploration Association
BTRE	Bureau of Transport and Regional Economics
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DEW	Department of Environment and Water Resources*
DoIR	Department of Industry and Resources
DPI	Department for Planning and Infrastructure
DTRS	Department of Transport and Regional Services
FRDC	Fisheries Research and Development Corporation
OECD	Organisation for Economic Co-operation and Development
OGRA	Oil and Gas Resources of Australia
PESA	Petroleum Exploration Society of Australia
PIRSA	Department of Primary Industries and Resources South Australia
WAFIC	Western Australian Fishing Industry Council
WAPC	Western Australian Planning Commission

* The Department of Environment and Water Resources was renamed the Department of the Environment, Water, Heritage and the Arts in late 2007 after the report was commissioned.

EXECUTIVE SUMMARY

This Report has been commissioned by the Department of the Environment and Water Resources* as part of the process of producing a Marine Bioregional Plan for the South-west Marine Region, which constitutes one of the five marine bioregions in Australian Commonwealth waters. The Report utilises the Driving force-Pressure-State-Impact-Response model to project the development of pressure indicators associated with various categories of human activity within and adjacent to the South-west Marine Region. The broader macro socio-economic scenario for these projections is characterised by a moderation in the rates of economic and population growth but a continuation of the current healthy economic climate.

The projected trends in population growth in areas adjoining the South-west Marine Region influence many of the pressure indicators examined in this Report. These display marked regional variation, with Western Australia's population growth rates exceeding those of South Australia, the population of Perth growing at a faster rate than that of Adelaide and the population of coastal districts overall increasing at a faster rate than inland districts. Both urban areas are projected to undergo expansion but the rate and extent of Perth's growth is manifest in increased linkages in terms of housing development and economic activity with the coastal districts to the north and in particular the south-western coastal districts of the State, with a concomitant increased pressure on transport infrastructure.

Table A provides a summary of overall trends in indicators derived for the sectors of human activity considered in this Report through reference to sub-regions of the coastline adjacent to the South-west Marine Region. Urban development is closely associated with projected trends in population growth, with increases in the extent of urban areas along the coastline adjacent to the South-west Marine Region, particularly in the vicinity of Perth, Adelaide and the south-west of Western Australia. More remote stretches of coastline such as sub-region 6 from Esperance to Ceduna in Western Australia may experience isolated development, whilst indicators point to a declining rate of population growth in rural areas of South Australia from Ceduna to Yorketown (sub-regions 7 and 8). In terms of economic activity, the oil and gas sector

is projected to experience a decline in exploration activity throughout the study area, reflecting the overall poor prospectivity of the offshore basins, availability of reserves elsewhere and the possibility of future economic conditions mitigating against investment in frontier basins. The rate of port activity is projected to increase in terms of volume and continue to diversify into containerised as well as bulk produce. The smaller ports along the west and south coastline of Western Australia in sub-regions 3 to 5 are forecast to increase at a faster rate as greater volumes of produce aside from minerals are exported. New port development over the medium term will involve greater pressure on road and rail links in the Perth and Geraldton areas in sub-regions 1 and 2. Analysis of commercial fishing in Commonwealth and State waters within and adjacent to the Region indicates a stable or declining scenario in the short to medium term, primarily as a result of catch restrictions, fuel costs and labour shortages. Some State managed fisheries service high value overseas niche markets which enable returns to be maintained despite lower catch volumes, although overseas competitors are increasingly targeting these markets which could reduce profitability owing to the high value of the Australian dollar. Rock lobster and abalone fishing in State waters are forecast to be increasingly focused on the more productive and accessible locations along the west and south coast of Western Australia. The development of the aquaculture sector is shown to have particular significance for rural areas in South Australia in sub-regions 7 and 8 where production has hitherto been concentrated. This relatively new sector offers positive prospects for growth in the medium term as knowledge and innovations are developed but there are constraints imposed by licensing regulations, labour availability, dependence on fluctuating overseas market prices and the availability of sites for cultivation. These are to some extent unpredictable but the evidence of investment and innovation points towards this sector reinforcing its economic stability and increasing its productivity.

This Report also examines indicators associated with recreational activity in areas within and adjacent to the South-west Marine Region. The recreational fishing sector is of prime importance in this regard, given its popularity throughout the study area. Projections based on various indicators of this activity all point towards an increasing level of participation and effort in the short, medium and long term, particularly in proximity to the urban areas of Perth and Adelaide in association with population and income levels, but also in more rural regions such as the south-west of Western

Australia, particularly sub-regions 3 and 4 and sub-region 9 which includes the Spencer Gulf in South Australia. However, there are no data which enable an assessment of the impact of current recreational fishing activity on target species. This deficiency merits urgent attention in order that this sector can be sustainably managed into the future. Tourism throughout the study area is subject to a range of strategic initiatives which are designed to capitalise upon natural assets whilst maintaining their quality into the future and attempting to spread the distribution of visitors away from urban centres. These policies could have an impact in the short to medium term, with the effect that visitor numbers increase in areas such as the central western coast of Western Australia (sub-region 1) and the Peninsula regions of South Australia (sub-regions 7 and 8). Elsewhere, the short term projections are for visitor numbers to continue to increase in rural hotspots such as the south-west Peninsula of Western Australia (sub-region 4) and Kangaroo Island in South Australia (sub-region 9), with plans being in place to carefully manage the impacts in these locations. However, the majority of visitors throughout the study area are concentrated in Perth and Adelaide and it is unlikely that this situation will change over the foreseeable future, adding to pressures on coastal areas identified elsewhere in this Report such as housing development, transport congestion and recreational fishing pressure. The marine mammal watching sector is different in this regard as it is focused on more rural areas and is less consumptive in nature and this indicator is considered to offer strong growth potential into the future. Other indicators of tourism activity suggest that the demand for marina developments will continue to increase, with evidence detailing the current level of investment in marinas close to Perth and Adelaide but also further afield throughout the study area. This not only reflects tourism trends but also disposable income and lifestyle choices of residents within the Region, as well as the wider functions which marinas can play in regional development. However, there are environmental constraints on marina sites in this regard and these are complicated by the fact that no planning strategy for marinas exists in either State which would be essential for appropriate management of this sector.

* The Department of the Environment and Water Resources was changed to the Department of the Environment, Water, Heritage and the Arts in late 2007.

Table A: Summary of projected trends in pressure indicators in sub-regions adjacent to the SMWR

	Short	Medium	Long
1) Kalbarri to Yanchep			
Increasing rate of urban development in south and around existing towns			
Declining rate of offshore oil and gas exploration			
Increased port activity at Geraldton and new port at Oakajee			
Stable or declining commercial fishing			
Population-led increase in recreational fishing			
Increasing coastal tourism at selected hotspots with marina expansion			
2) Yanchep to Mandurah			
Rapid increase in urban development, particularly towards south of sub-region			
Industrial expansion concentrated in south of sub-region			
Continued industrial and domestic discharges to water			
Increasingly severe transport congestion, particularly to south			
Declining rate of offshore oil and gas exploration			
Expansion of port activity, possible stabilisation medium to long term			
Stable or declining commercial fishing			
Rapid population-led increase in recreational fishing			
Increase in tourism activity all along the coast			
Extension of marinas and continued pressure for more development			
Stable or declining minor aquaculture towards south of sub-region			
3) Mandurah to Busselton			
Rapid increase in urban development, particularly towards north of sub-region			
Industrial expansion to north of sub-region			
Acute transport problems particularly in north of sub-region			
Declining rate of offshore oil and gas exploration			
Expansion of port activity			
Stable or declining commercial fishing			
Rapid population-led increase in recreational fishing			
Increase in tourism activity along the coast			
Extension of marinas and continued pressure for more development			
Stable or declining minor aquaculture			
4) Busselton to Albany			
Constant increase in urban development, particularly in coastal districts			
Declining rate of offshore oil and gas exploration			
Stable or declining commercial fishing			
Increase in recreational fishing			
Increase in tourism and whale watching activity all along coast			
Ongoing gazettal of marine conservation areas			
Stable or declining minor aquaculture			
5) Albany to Esperance			
Constant increase in urban development, particularly in urban districts			
Expansion of industrial activity within urban areas			
Declining rate of offshore oil and gas exploration			
Expansion of port activity			
Stable or declining commercial fishing			
Slight growth in recreational fishing effort, focused in urban districts			
Increase in coastal tourism activity, principally near urban districts			
Ongoing gazettal of marine conservation areas			

	Short	Medium	Long
6) Esperance to Ceduna			
Stable degree of urban development, declining in remote districts			
Declining rate of offshore oil and gas exploration			
Stable or declining recreational fishing focused around settlements			
Localised tourism development in association with marinas			
Gazettal of marine conservation areas			
7) Ceduna to Port Augusta			
Stable or declining rate of urban development, particularly in rural districts			
Declining rate of offshore oil and gas exploration			
Steady commercial fishing in specific locations			
Slow increase in recreational fishing activity			
Expansion of small-scale nature tourism into coastal and rural areas			
Extension of marinas and continued pressure for more development			
Expansion of aquaculture in specific locations			
Gazettal of marine conservation areas			
8) Port Augusta to Yorketown			
Stable or declining rate of urban development, particularly in rural districts			
Declining rate of offshore oil and gas exploration			
Steady commercial abalone fishing in specific locations			
Slight decline recreational fishers but sustained high effort and catch			
Expansion of small-scale nature tourism into coastal and rural areas			
Likely pressure to add new marinas around coastline			
Expansion of aquaculture into new locations			
Gazettal of marine conservation areas			
9) Yorketown to Cape Jervis including Kangaroo Island			
Increase in urban development in inner Adelaide, slow or stable elsewhere			
Industrial expansion in metropolitan Adelaide			
Continued industrial and domestic discharges to water			
Increasing traffic congestion at locations along interstate corridor			
Declining rate of offshore oil and gas exploration			
Expansion of port activity			
Steady commercial abalone fishing in specific locations			
Increasing recreational fishing activity, particularly in northern Gulf			
Continued expansion of tourism, particularly on Kangaroo Island			
Extension of marinas and intense pressure for more development			
Gazettal of marine conservation areas			

KEY

Likely

Probable

Unknown

1 INTRODUCTION

1.1 BACKGROUND AND PROJECT RATIONALE

The launch of Australia's Oceans Policy in 1998 signalled the Australian Government's commitment to ensuring the sustainable management of ocean resources. A central feature of the Oceans Policy was to implement a programme of marine planning which would integrate conservation and ecologically sustainable development priorities. This was refocused in 2005 by bringing the planning programme under section 176 of the *Environment Protection and Biodiversity Act 1999*. This development provided a statutory link between marine planning and the Minister for Environment and Water Resources, reflecting the Australian Government's view that the quality of the marine environment and the conservation of its biological diversity is of national significance.

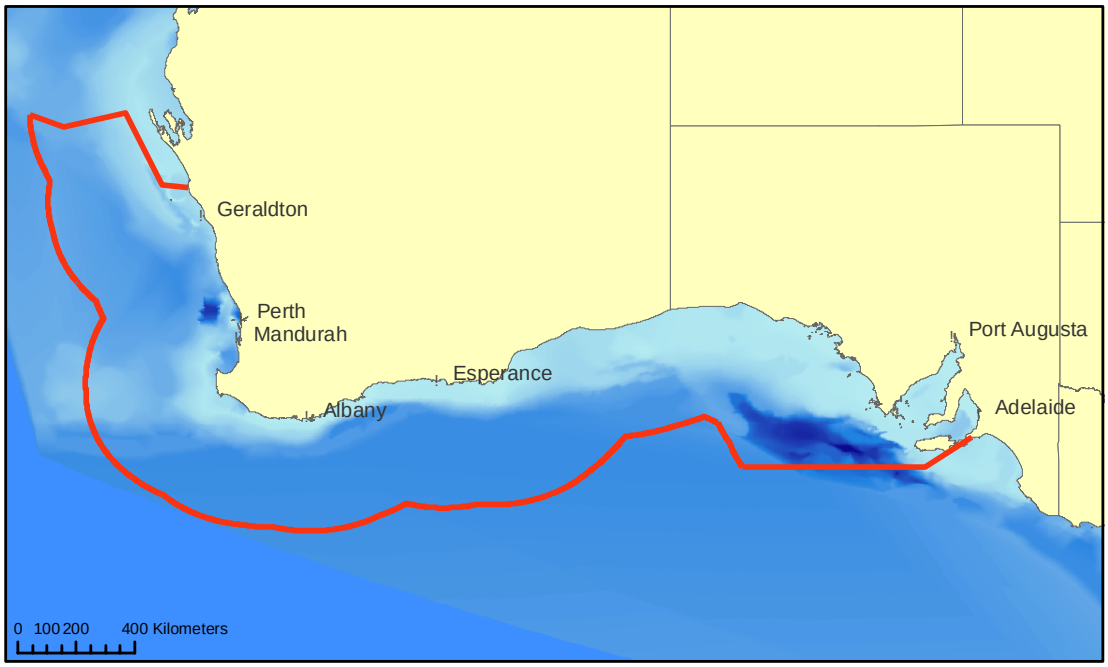
Marine Bioregional Planning is concerned with Commonwealth waters which generally begin three nautical miles from the law water mark and extend to the outer limit of the Exclusive Economic Zone 200 nautical miles offshore. This Report has been produced to identify the extent of current and future human impacts on the coastal environment adjacent to and within the South-west Marine Region, which encompasses Commonwealth waters from Kangaroo Island in South Australia to Shark Bay in Western Australia. It is intended that this process will enable the National Oceans Office to identify current and future trends in key socio-economic sectors relating to coastal activity.

Although this report is primarily focussed on current and future trends in the Commonwealth waters of the South-west Marine Region, consideration of trends in adjacent coastal regions and State waters is included. As coastal, near shore and deep ocean environments are inextricably linked it is important to consider pressures, trends and changes in adjacent regions as they will invariably affect adjoining areas.

1.2 DESCRIPTION OF THE SOUTH-WEST MARINE REGION

The South-west Marine Region includes Commonwealth waters extending from the easternmost tip of Kangaroo Island in South Australia to a point level with Cape Inscription on the outer coast of Shark Bay in Western Australia. The total area of the South-west Marine Region is approximately 1 million square kilometres.

Figure 1.1 Location of the South-west Marine Region



The waters within the South-west Marine Region are primarily influenced by the warm Leeuwin Current flowing south along the Western Australian coast and into the Great Australian Bight. This extends the range of many tropical species which, coupled with the isolation of the Australian continent, results in a unique mix of communities and an unusually high degree of endemism in marine fauna. The relatively small human population has contributed towards the Region being characterised by large areas of coastline which are relatively undisturbed and have high conservation values.

The two State capitals of Perth and Adelaide are by far the most significant centres of population, representing 49% and 36% respectively of the total estimated population

in coastal Statistical Local Areas lying adjacent to the South-west Marine Region in 2007 (ABS, 2006). The marine-based economic activities of this area include oil and gas exploration, port and shipping activity, commercial fishing, recreational fishing, tourism and aquaculture, all of which are analysed in this Report. There are additional sectors of economic activity relating to the defence industry and ship construction and maintenance which have not been considered in this Report owing to data restrictions and the highly localised nature of these industries. For a detailed analysis of the social and economic geography of the Region, the reader is referred to Gardner *et al*. (2005).

1.3 STRUCTURE OF REPORT

This Report utilises the Driving force-Pressure-State-Impact-Response model to categorise human activities impacting upon the coastal environment. These activities are contextualised in Chapter 2 through a description of the future trends in population growth and macro socio-economic drivers operating at the global and national level. Chapters 3 to 9 focus upon specific sectors of human activity which are of significance to the waters and adjacent surroundings of the South-west Marine Region. These comprise urban development, the oil and gas sector, ports and shipping activity, commercial fishing, recreational fishing, tourism and aquaculture. For each of these seven sectors, a range of indicators were chosen and a detailed analysis of their current status and future trends with respect to the South-west Marine Region is presented in each chapter. These trends were supplemented and verified where possible through interviews and discussion with peak bodies and industry representatives. The sectors, driving forces and associated pressure indicators discussed in this Report are summarised in Table 1.1.

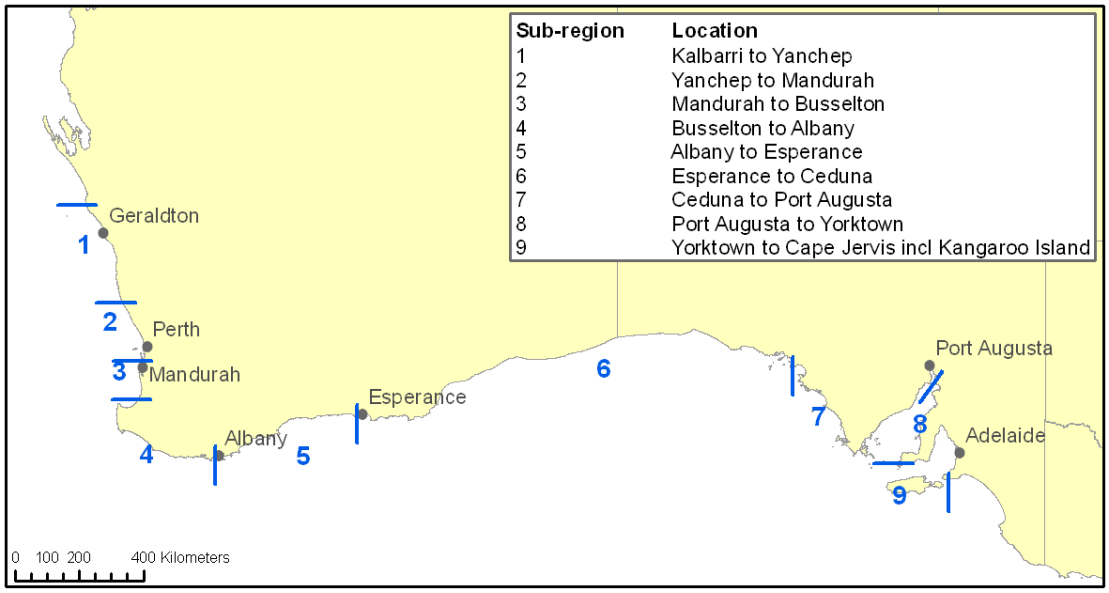
Table 1.1 Sectors, driving forces and pressure indicators for the South-west Marine Region

SECTOR	DRIVING FORCES	PRESSURE INDICATORS
Urban development	Urban growth and expansion	Employment Industrial development Transport
Oil and gas	Existing sector activity	Acreage release Drilling activity
	Economic value of sector	Annual oil and gas production
	Future activity	Estimated reserves and prospectivity Projected price trends
Ports and shipping	Growth and change in shipping	Total tonnage throughput
	Changes in industry structure	Total port calls
	Patterns of imports and exports	Bulk and containerised cargo trends International trading links
Commercial fishing	Demand for produce	Catch data for individual fisheries Effort data for individual fisheries
	Expansion of sector	Number of licences Location of activity Employment
	Profitability of sector	Gross value product of catch
Recreational fishing	Population growth and participation	Number of recreational fishers Distribution of fishing effort Number and distribution of privately owned boats Number and distribution of chartered boat operators Total catch and species catch
Tourism	Growth in tourism sector	Numbers and location of tourism activity
	Marina facilities	Trends in demand for marina berths
	Nature-based tourism growth	Status of marine mammal watching industry
	Gazettal of marine protected areas	Marine nature reserves and sanctuary zones
Aquaculture	Demand for product	Trends in volume of production of key species
	Expansion of sector	Number and location of licences
	Profitability of sector	Gross value of product Projected price trends

In order to describe and summarise the trends associated with all of the above sectors, reference is made to nine sub-regions of the coastline adjacent to the South-west Marine Region. These are illustrated in figure 1.2 and comprise the stretches of coastline from Kalbarri to Yanchep (sub-region 1), Yanchep to Mandurah (sub-region 2), Mandurah to Busselton (sub-region 3), Busselton to Albany (sub-region 4), Albany to Esperance (sub-region 5), Esperance to Ceduna (sub-region 6), Ceduna to Port Augusta (sub-region 7), Port Augusta to Yorketown (sub-region 8) and Yorketown to Cape Jervis including Kangaroo Island (sub-region 9). Each chapter

concludes with a diagram summarising the projected trends in activity for each sub-region with reference to short (0-5 yr), medium (5-10 yr) and long (10-15 yr) timescales, along with an evaluation of the level of confidence accorded to each projection.

Figure 1.2 Coastal sub-regions adjacent to the South-west Marine Region



2 KEY MACRO-ECONOMIC DRIVERS

2.1 INTRODUCTION

This Report will utilise the Driving force-Pressure-State-Impact-Response (DPSIR) framework to analyse and project trends in human activity with reference to the natural environment of the South-west Marine Region. The DPSIR and related models such as the Condition-Pressure-Response (CPR) framework are often adopted in research evaluating human impacts on the environment as they provide a basis for systematic analysis of the socio-economic and socio-cultural driving forces which result in environmental pressures, the nature of these pressures and their effects on the natural environment and the policy responses designed to address these dynamics (European Environment Agency, 2005; Australian and New Zealand Environment and Conservation Council, 2000).

The identification of appropriate driving forces and associated pressure indicators is predicated upon the selection of those economic sectors which are deemed representative of human activity in the coastal and nearshore environment. In this Report, these sectors comprise urban development, the oil and gas industry, port activity, commercial fishing, recreational fishing, tourism and aquaculture. All of these sectors are themselves dependent to some extent upon macro socio-economic drivers reflecting the population characteristics of coastal areas and the consumption of natural resources by these populations. Therefore, this chapter will outline the current and projected characteristics of key macro-economic drivers underpinning economic activity in the coastal areas adjacent to the SWMR. These are referred to and elaborated upon in subsequent chapters dealing with individual economic sectors.

The primary macro socio-economic driver is population growth, which will evidently influence all aspects of natural resource use and consumption in the marine environment and which is therefore discussed in some detail. Oil prices are also considered as a macro socio-economic driver of activity, as fluctuations in oil prices influence domestic inflation rates, demand for products and employment as well as the more obvious direct effects in terms of oil exploration and production being in part dependent upon oil prices. Gross Domestic Product (GDP), as the most

commonly used indicator of overall economic activity at the national level, is also considered as a macro socio-economic driver as it reflects a combination of indices relating to government, investment and consumer spending and is therefore relevant to the sectors under consideration in this Report. The strength of the Australian dollar is inextricably linked to the value of imports and exports as well as the possible inflationary effect of higher oil prices and therefore both these drivers are discussed in this chapter. Finally, it is appropriate to consider the role of global geopolitical developments in that they will influence trading and other economic relationships at the international level which could impact upon the sectors discussed in this Report. With the possible exception of population growth projections, the future trajectory of many of these driving forces is uncertain and prone to debate, particularly when medium to long term projections in excess of five years into the future are being considered. This chapter therefore provides an overview of likely trends rather than an in-depth analysis of future scenarios for each driving force.

2.2 POPULATION GROWTH IN AUSTRALIA

2.2.1 Recent trends in population

Over the last decade for which detailed census data are available, Australia's population has grown at an average rate of 1% per annum. There have been significant variations in growth between states, with Western Australia and South Australia experiencing annual growth rates of 1.4% and 0.45% respectively (Table 2.1). In 2005-06, the population of South Australia increased by 12,560, equivalent to a rise of 0.8%, and Western Australia witnessed a population increase of 39,920 people, equivalent to a rise of 2.0%. The major urban centres of Perth and Adelaide have again experienced divergent growth with Perth growing at a faster rate than Adelaide. The growth of regional centres has been slow in comparison to the national average, whilst the declining population in more remote and rural settlements categorised as 'other settlements' in both States reflect the trend of migration towards regional centres and capital cities.

Table 2.1 Recent population trends at national and regional level, 1991-2001

	1991	*2001*	*Absolute change 1991-2001*	*Percent change 1991-2001*
Australia	16,849,561	18,969,610	2,120,049	11.2
South Australia	1,400,622	1,467,261	66,639	4.5
Western Australia	1,586,825	1,851,252	264,427	14.3
Adelaide	1,022,818	1,072,585	49,767	4.6
Perth	1,143,249	1,339,993	196,744	14.7
Regional centres	168,632	174,698	6,066	3.5
Other settlements	154,384	148,764	-5,620	-3.8

(Source: ABS, 2002)

2.2.2 Projected population trends at the State and national level

Population projections published by the ABS provide estimates of population numbers for the period 2004-2101 at the national level and for the period 2004-2051 for regions within Australia (ABS, 2006a). These projections are based upon estimated resident population in 2004 and utilise three alternative scenarios reflecting differing assumptions relating to total fertility rates, net migration and life expectancy. For the purposes of this report, the median scenario (Series B) has been selected. It should be noted that evidence presented from the latest population projections in 2006 indicates that Australia's population has tended to follow the scenario of Series A, which could be termed the higher rate of population growth. However, there are relatively little variations in terms of population projections between the three scenarios in the timescale of interest in this report.

Table 2.2 summarises the projected population at the State level under the B scenario. It should be noted that these forecasts are based on census statistics from 2001, hence the baseline population data for 2007 are predicted rather than actual values. These projections indicate that the national projected population total is 24 million in 2022, representing a growth of 15.8% from the projected population in 2007. The population of South Australia increases at an overall rate of 5% over this time period to just over 1.6 million, equivalent to an annual rate of increase declining from 0.41% in 2007-08 to 0.24% in 2021-22. The population of Western Australia is projected to increase by 22% to just over 2.5 million over the fifteen year time period, with annual rates of increase declining from 1.53% in 2007-08 to 1.17% in 2021-22. Consequently, the proportion of residents in South Australia compared to the national total declines overall from 7.5% in 2007 to 6.8% in 2022. Conversely, the population

of Western Australia relative to the national total is projected to increase from 10% in 2007 to 10.5% in 2022.

Table 2.2 Projected population totals, 2007-2022

Year	*South Australia*	*Western Australia*	*Australia*
2007	1,552,006	2,071,628	20,785,977
2012	1,581,782	2,227,190	21,924,280
2017	1,607,724	2,379,723	23,025,313
2022	1,629,056	2,527,495	24,077,698

(Source: ABS, 2006a)

2.2.3 Projected population trends adjacent to the SWMR

Projected population growth rates in cities and other settlements adjacent to the SWMR exhibit differences at the State level and between urban, regional and remote areas, as indicated in Table 2.3.

Table 2.3 Projected population trends adjacent to the SWMR, 2007-2022

	2007	*2012*		*2017*		*2022*	
	population	*Population*	*% change 2007-12*	*Population*	*% change 2012-17*	*Population*	*% change 2017-22*
Australia	20,785,977	21,924,280	5.2	23,025,313	4.9	24,077,698	4.4
SMWR coastline	3,092,176	3,232,228	4.3	3,366,397	4.0	3,494,558	3.7
Metropolitan Perth	1,517,543	1,621,510	6.4	1,723,999	5.9	1,824,753	5.5
Metropolitan Adelaide	1,137,376	1,155,234	1.5	1,170,513	1.3	1,183,464	1.1
Coastal SLAs	207,422	216,594	4.2	225,007	3.7	232,581	3.3
Inland SLAs	229,835	238,890	3.8	246,878	3.2	253,760	2.7

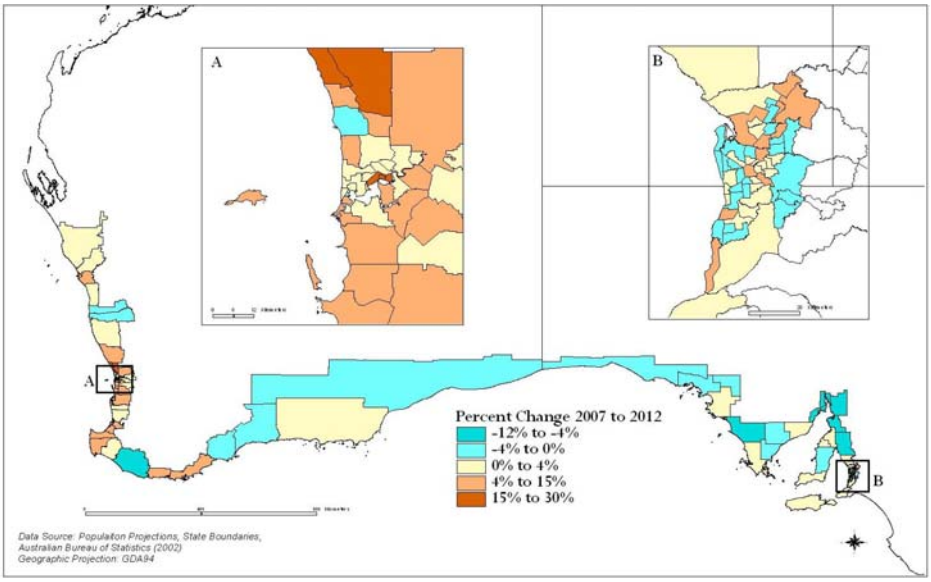
(Source: ABS, 2006a)

Overall, the national population is projected to grow at a gradually declining rate, with annual growth rates in the order of 1.1% in the 2007-12 period, declining to 1.0% from 2012-17 and further declining to 0.9% in the 2017-22 period. Overall, the projected population growth rate in districts adjacent to the study area is below that of the nation as a whole, declining to 0.8% per annum in the 2017-22 period. The slowest growth rates in locations adjacent to the SWMR are projected in metropolitan Adelaide, whose population is forecast to increase at an annual rate of 0.3% from 2007-12, 0.26% from 2012-17 and 0.22% from 2017-22. By contrast, the population

of metropolitan Perth is projected to increase at an average annual rate of 1.4% from 2007-12, 1.26% from 2012-17 and 1.17% from 2017-22. Coastal SLAs are projected to experience growth rates in excess of those projected for inland SLAs.

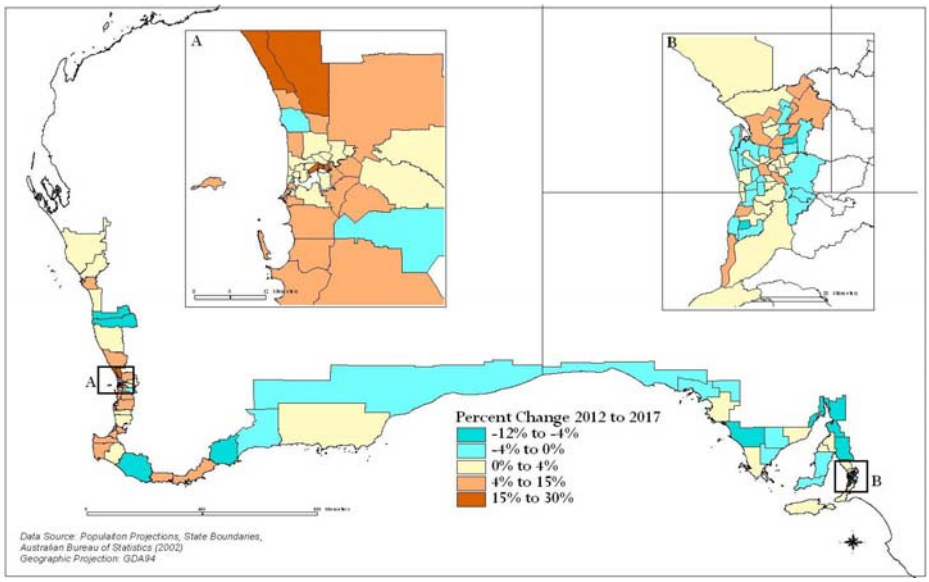
Figures 2.1 to 2.3 illustrate these projections through showing the predicted percentage change over the three five year periods for each coastal SLA adjacent to the SWMR. The metropolitan area of Adelaide is shown to exhibit higher rates of growth in the order of 4-15% in each five year period in the north-east, central and south-west suburbs, the eastern and western districts being characterised by growth rates varying between –4 to 4%. Similarly, the highest growth rates in Perth are projected to be in the far northern suburbs and central eastern districts, with growth rates in the order of 15-30% in each five year period. It is also evident that far more suburbs within the Perth area are characterised by higher positive growth rates than those of Adelaide. Outside of these metropolitan areas, growth rates are projected to be generally higher along the west coast than the south coast, with a string of SLAs from Geraldton to the south-west peninsula being characterised by growth rates predominantly in the 4-15% range for each five year period. Positive population growth projections along the south coast are restricted to the Esperance SLA and selected SLAs in the Eyre and Fleurieu Peninsulas.

Figure 2.1 Projected change in population by SLA, 2007-2012



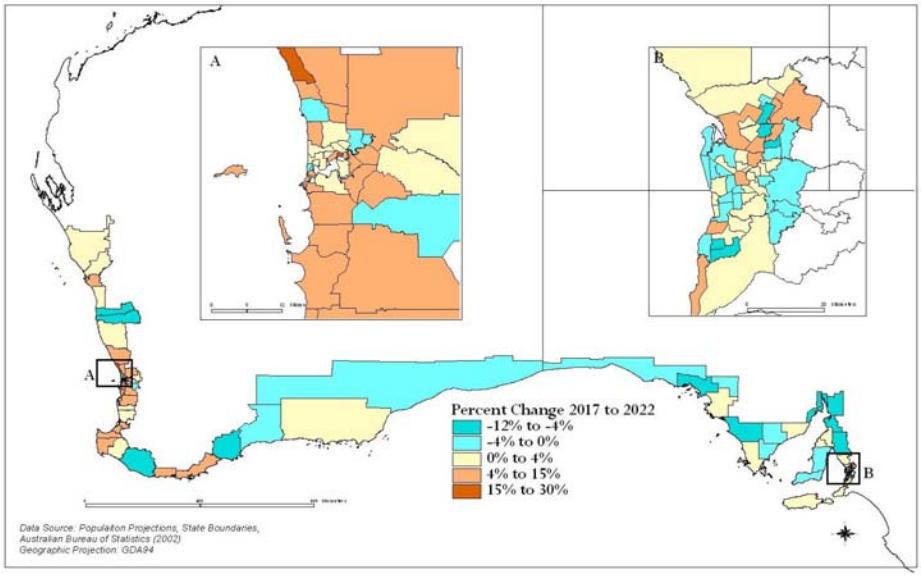
(Source: ABS, 2006a)

Figure 2.2 Projected change in population by SLA, 2012-2017



(Source: ABS, 2006a)

Figure 2.3 Projected change in population by SLA, 2017-2022



(Source: ABS, 2006a)

2.2.4 Discussion

A major contributory factor affecting the demographic and population characteristics of Australia is the declining total fertility rate, which refers to the average number of children per female. This declined rapidly from around 3 to 2 children per female from the mid 1960s to mid 1970s, reflecting a combination of factors such as

contraceptive availability, changes to abortion law and increasing participation of women in the labour force. The current total fertility rate of 1.81 (ABS, 2007a) is similar to other developed countries such as the UK and Sweden and is projected to decline gradually to around 1.4 by the year 2050. In combination with increasing life expectancy, the decline in total fertility rate results in a reduction in the growth rate of the working age population and the overall ageing of the national population profile.

This process has to some extent been offset by the patterns of migration into Australia. The numbers of permanent and long term arrivals have been approximately double the number of permanent and long term departures at the national level from 2000-01 to 2005-06, resulting in a net total of 261,180 permanent arrivals and 568,595 long term arrivals over this time period. In the year 2005-06, net overseas migration accounted for 51% of national population growth. An increasing proportion of migrants enter Australia under the Skill Stream of the Government's Migration Programme, which facilitates the entry of relatively young individuals possessing skills deemed to be in demand in the Australian economy. The demographic characteristics of permanent migrants are therefore different from the Australian population profile as whole, with 72% of permanent arrivals in 2003-04 being in the 15-34 age group compared with 28% of the resident population.

Within Australia, the movement of retirees towards the coast coupled with overall increasing life expectancy has resulted in significant changes to demographic characteristics. In the intercensal period 1996-2006, Australia experienced an overall increase of 23% in the proportion of the population aged 65 and over. The rate of increase in South Australia was below this national figure at 15% but in Western Australia the rate of increase amounted to 33%. The major cities of Adelaide and Perth experienced an increase in the proportion of those aged 65 and over in the order of 12% and 29% respectively.

2.3 OIL PRICES

2.3.1 Recent trends in oil prices

World oil prices have been increasing steadily since the post-September 2001 low of around $20 a barrel, with cuts in production from OPEC and other countries causing prices to rise above $35 a barrel by early 2003. More recently, a growing demand from the US and Asian countries including China in particular, along with the weakening in the value of the US dollar served to boost prices further to above $65 a barrel by mid 2006.

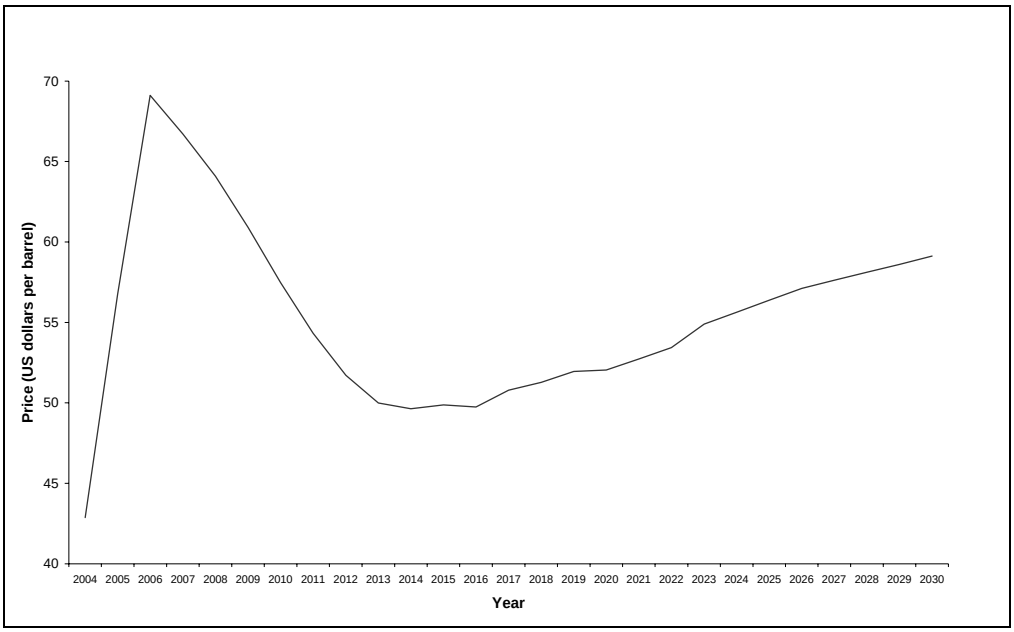
2.3.2 Current and future trends in oil prices

Oil prices are currently at a historic high, approaching $100 a barrel in late November 2007, reflecting a combination of factors including shortages of skilled labour, political instability in some major oil producing countries and strong sustained demand associated with economic growth in consumer countries such as China.

Whilst there is general consensus that there will be a decline in oil prices in the near future, the nature and magnitude of this trend differs amongst analysts. Figure 2.4 reproduces the reference case predicted trends in oil prices published by the US Energy Information Administration in February 2007, which express crude oil prices in dollars per barrel of imported light, low-sulphur crude oil paid by US refiners.

In this analysis, oil prices are predicted to decline from 2006 through to 2015 as previous investment in exploration brings new supplies to the market. By the year 2015, this is expected to result in crude oil prices levelling out at around $50 dollars per barrel. Increasing prices thereafter are projected under this scenario in association with increasing levels of demand causing higher cost supplies being brought to market. This overall projection is in line with other publicly available long-term predictions, although the onset and rate of predicted oil price increases after around 2010 varies.

Figure 2.4 Projected trends in world crude oil prices, 2004-2030



Source: Energy Information Administration, 2007). NB Data from 2006 onwards are projections

If the reference case described above is followed, there are certain issues relevant to this Report which should be cited. Currently, Australian production of both oil and gas is declining, with the trade deficit in crude petroleum amounting to $6.6 billion in 2006, which is predicted to increase to a value between $12 and $27 billion by 2015 (APPEA, 2007; Department of Foreign Affairs and Trade, 2007). Under the scenario of declining crude oil prices, economic effects in the domestic economy would include an improvement in the balance of payments, low inflation rates and a net increase in real national incomes. Whilst the full impact of high oil prices has been cushioned by domestic industrial activity, it is likely that a moderation of growth in GDP combined with rising oil prices after around 2015 would result in inflationary pressures, lower exchange rates and a generally less optimistic economic outlook.

At a more detailed level, the price of petroleum-based products largely follows the trend set by crude oil prices and petroleum accounts for around 97% of Australia's transport needs. Therefore, should the above projections eventuate, the price paid by consumers for fuel products including petrol would be expected to decrease from their current high levels over the next ten years or so. This would have significant implications for many sectors of interest in this Report, including transport projections

and tourism and, to a lesser extent, port industries and the recreational and commercial fishery sectors.

However, the above projections have yet to be reflected in world oil prices, with average crude oil prices ranging from US$79 to US$81 per barrel in early October 2007 (Natural Resources Canada, 2007). Long term factors contributing towards the sustained high price of oil include the weak US dollar and the ongoing tensions between the United States and Iran. Furthermore, the projected increase in output from oil producers envisaged by the Energy Information Administration has yet to materialise, mainly as a result of technical difficulties (Natural Resources Canada, 2007). These have been bolstered by more recent concerns over the relationship between Turkey and Iraq, with fears of a conflict in oil-producing areas of northern Iraq, whilst the lower than expected reported inventories of US oil in late October 2007 pushed up oil prices on international markets by around 6%. Evidently, a further deterioration in the political situation between the United States and Iran or other Middle Eastern countries would result in higher oil prices which are not included in the above projections. These concerns are reflected in the recent increase in crude oil futures prices, with Nymex crude oil for December delivery trading at over US$90 a barrel on United States markets towards the end of October 2007, prompting speculation that further increases to over $100 a barrel were likely (Associated Press, 2007).

The prospect of sustained high oil prices into 2008 is therefore increasingly likely, with the potential outcome of delaying or offsetting the projected decline in prices illustrated in Figure 2.4. If this situation were to be prolonged or exacerbated, the ongoing high price of oil could generate inflationary pressures in many economies including that of Australia. This would also result in deterioration in the balance of payments, higher fuel prices and a lowering of net national incomes, which would alter the prospects for economic activity significantly. The tourism sector would be one area of prime concern. A continued appreciation in the value of the Australian dollar would theoretically deter international arrivals, whilst also enabling Australians to take advantage of the high currency value by taking more overseas holidays, thereby also diminishing the scale of interstate and intrastate tourist arrivals. The price of exports moved through Australian ports would be affected by both sustained high

fuel prices as well as the projected continued high value of the Australian dollar, which is predicted by the NAB and the Commonwealth Bank of Australia to increase to around US0.95 by the middle of 2008. However, as outlined elsewhere in this Report, exports moved through the ports adjacent to the South-west Marine Region tend to be either price inelastic low value bulk commodities such as iron ore, grain and minerals or high value niche food products such as rock lobster, the demand for which in East Asian markets and elsewhere may not be significantly affected by increased costs of production. It is inevitable, however, that increased oil prices will be reflected in higher domestic fuel prices which could impact in various ways upon the regional economy adjoining the South-west Marine Region.

However, it must be stressed that predictions of crude oil prices are subject to many unpredictable factors including access to resources and the political factors governing access, the cost and availability of substitutes and the technical uncertainties associated with the extent of reserves and their prospectivity. It therefore remains to conclude that the somewhat optimistic outlook over the short term associated with a reduction in crude oil prices described above may need to be tempered with a realisation that any decline in oil prices has been delayed and could yet be offset by political or economic developments.

2.4 AUSTRALIAN GROSS DOMESTIC PRODUCT

2.4.1 Recent trends in gross domestic product

The Australian economy has been marked by a constant increase in the annual real Gross Domestic Product (GDP) in recent years, growing at an annual rate of 3.1% from 2000-2005, which compares to the OECD average of 2.4%. However, this also represents a decline from the previous five years which saw the Australian GDP increase by an average rate of 4.3% (OECD, 2007). Over the 2000-2005 time period, the value of imports and exports increased by 68% to US$286 billion, representing a strong and sustained period of growth in the economy, which augurs well for the near future.

2.4.2 Current and future trends in gross domestic product

Current independent opinion holds that the growth in GDP will stabilise over the next five years at around 3% (The Economist, 2007). However, Government papers indicate that a decline in GDP to around 2% over the period 2010-2040 is likely. This is principally due to the ageing of the workforce and consequent decrease in participation of the population in employment, which is expected to peak at around 64% in 2006-07 and decline to 57% by 2040 (Government of Australia, 2006).

2.5 AUSTRALIAN FOREIGN EXCHANGE RATES

2.5.1 Recent trends in Australian foreign exchange rates

Over the period 2000-2007, the value of the Australian dollar appreciated steadily against the United States dollar from a value of US$0.58 to US$0.90. This arose mainly due to the boom in commodity prices, with the sustained high demand for steel in China, which is heavily reliant on iron ore imports owing to the low grade quality of domestic iron ore, driving iron ore prices upwards. Other factors in the international currency markets served to maintain the low value of the US dollar, causing the Australian dollar to appreciate significantly over this time period.

2.5.2 Current and future trends in Australian foreign exchange rates

Recent forecasts project a gradual depreciation in the value of the Australian dollar to US$0.64 by 2011 as a result of falling interest rates, the current account deficit and projected declines in commodity prices as the supply of iron ore to the market increases (The Economist, 2007). Nevertheless, forecasting future trends in exchange rates are subject to a wide range of driving forces, as illustrated by the fact that the value of the Australian dollar in 2007 has been increasing constantly to the current (October 2007) value of US$0.91 which is far above the predicted average of US0.77 for 2007, underlying the need for caution when interpreting these data.

Whilst it is beyond the scope of this report to discuss the details of factors affecting the exchange rate, in basic terms the strength of exports versus imports, the level of foreign investment in Australian industry and currency speculators banking on a continued rise in the value of the Australian dollar will all serve to increase demand

for Australian currency on the international markets, leading to an appreciation in the value of the dollar. It should also be mentioned that a perceived or actual depreciation in the value of another currency will also be perceived as instability or weakness, which could be of significance in relation to the currently poor performance of the US dollar against other perceived 'stable' currencies such as the Australian dollar and the British pound sterling.

2.6 IMPORTS AND EXPORTS

2.6.1 Recent trends in imports and exports

The balance of the total value of imports and exports has altered in favour of imports since 2001-02, when exports exceeded imports by $1.46 billion, to a situation where the value of imports exceeded exports by a record value of $22.8 billion in 2004-05. This was driven largely by the rate of increase of imported products such as machinery and transport equipment, principally from the United States, and mineral fuels and lubricants, which together accounted for over half of the total value of imports in 2004-05 (ABS, 2006b). Coal and iron ore accounted for around 20% by value of total exports in 2004-05, both of which increased in value by over 50% from the preceding year.

2.6.2 Current and future trends in imports and exports

In 2005-06, the trade deficit narrowed to $15.8 billion, reflecting the increased value of mineral exports such as coal, iron ore, gold, gas and aluminium, which together amounted to $57.8 billion in 2005-06, representing an increase of 35% on the preceding year. Imports were dominated by crude petroleum oils and passenger vehicles, which together accounted for around 15% of total imports by value (ABS, 2007b).

Future trends in imports and exports will be conditioned to some extent by a combination of the above macro-economic forces. A situation of gradual reduction in the rate of economic growth will theoretically result in a gradual decrease in the volume of trade. However, the forecast weakening of the Australian dollar should benefit the export of Australian products as they are more competitive on the

international market, with a converse impact on the quantity of imports. This will be subject to a certain extent by the price elasticity of imports and exports, ie the extent to which demand is governed by changes in the price of a product. However, raw materials and unprocessed goods which dominate the Australian export market generally have low price elasticity. Taken together with the burgeoning demand for Australian exports of natural resources such as coal, gas and iron ore to the East Asian and principally Chinese markets, it is not surprising that the volume of exports have to date been little affected by the fluctuations in the value of the dollar. These factors will be referred to where appropriate in the ensuing discussion.

2.7 GEOPOLITICAL CONTEXT

Whilst the significance of the exchange rate is evidently important with respect to economic activity, it is also essential to bear in mind the wider political environment affecting Australian trade. Some Government authorities (Harcourt, 2007) feel that fluctuations in the exchange rate are of minor significance when compared to the growth in the world economy and in particular Australia's Asia Pacific trading partners in terms of the demand for Australian exports. Free Trade Agreements (FTAs) which eliminate tariffs and other trade barriers have been agreed between Australia and the US, Thailand, Singapore and New Zealand and FTA negotiations are underway with China, Malaysia and South Korea, amongst others. Australian exports of iron ore and petroleum gas and rural exports such as wool, cotton and beef have contributed to the rapid growth of China as an export market. An FTA which removed tariff and non-tariff costs would dramatically increase the terms of trade for these and other products, whilst further facilitating the import of relatively cheap Chinese textiles and other products.

This will be a factor influencing the economies of coastal regions in the medium to long term if agreement is reached. However, such positive prospects must be tempered to an extent with the uncertain geopolitical situation in East Asia and further afield. It is not worthwhile to speculate on where and when conflict, civil disturbances or acts of terrorism may take place and their possible consequences on the topics discussed in this report. However, past experience has shown that, whilst the impacts

of such events are acute, as for example with the downturn in world tourism following the events of September 2001 and the SARS outbreak in 2003, these are not long-lived and, following a period of interruption, a resumption of the previous trends takes place. Few reports forecasting future trends in socio-economic activity attempt to take such events into account and this report will accordingly note the possibility of their existence but will not take this speculation any further.

2.8 CONCLUSION

This chapter has described recent trends and future projections for underlying macro socio-economic forces which underpin activity in the sectors of the economy under consideration in this Report for the South-west Marine Region. In the short term, ie over the next five years or so, the national socio-economic outlook is one characterised by a steady decline in oil prices, albeit from their current twenty year high, a stable but healthy annual increase in GDP, a gradual decline in the value of the dollar from its current high and a stable balance of imports and exports.

In the medium to long term, from five to fifteen years hence, oil prices are predicted to experience a slow but steady increase to around $55 dollars per barrel and a moderation in annual GDP growth to around 2% is forecast. It should be remembered that this projected increase in oil prices takes place in the context of previous high values, hence is unlikely to have a significant impact on the national economy. Currency exchange rates and balance of trade projections are lacking over this timescale, but it is possible that these conditions would result in stable or slightly lower exchange rates, whilst, provided that the minerals sector continues its current growth trend, the value of exports will continue to outweigh imports.

3 URBAN DEVELOPMENT

3.1 INTRODUCTION

The rate and extent of urban development is of prime concern in managing coastal environments throughout Australia and particularly in South and Western Australia which have experienced urban expansion in coastal areas within both the major urban centres and regional centres. This chapter will therefore focus upon urban growth and expansion as a driving force with pressure indicators relating to employment, industrial development and transport (Table 3.1).

Table 3.1 Pressure indicators for urban development

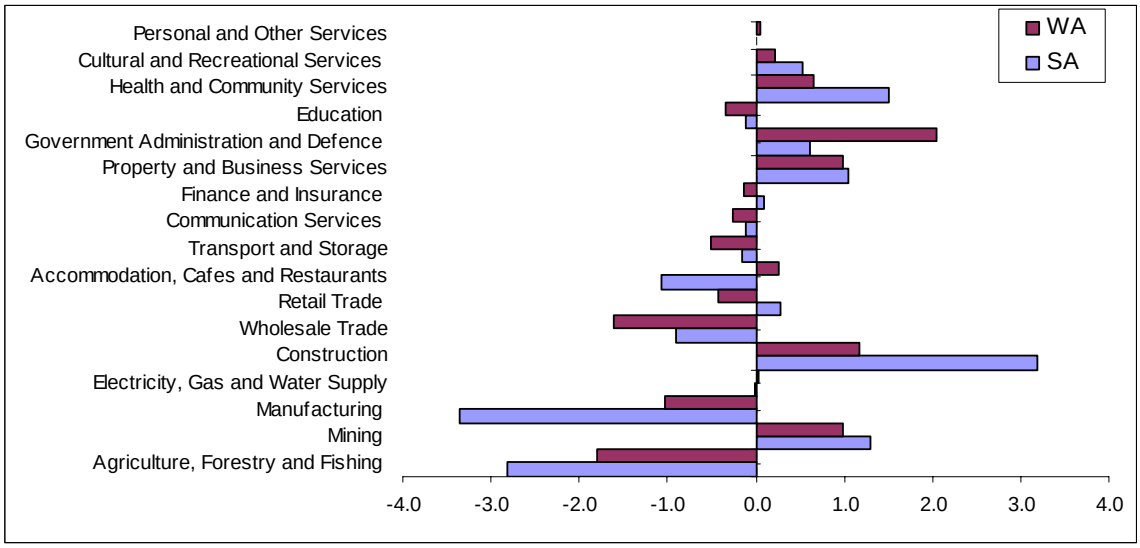
Driving forces	*Pressure indicators*
Urban growth and expansion	Employment Industrial development Transport

3.2 CURRENT STATUS OF PRESSURE INDICATORS

3.2.1 Employment

Analysis of the percentage change in employment by industry type over the past ten years underlines some key trends affecting both South Australia and Western Australia. These are illustrated in Figure 3.1 for all industries in both States whilst Table 3.2 highlights the changing percentage employed in key industries in both States. Overall, South Australia's workforce has undergone the more dramatic shifts in employment structure, particularly with regard to the magnitude of the declines in the manufacturing and agriculture, forestry and fishing sectors and the increase in employment in the construction sector. The most notable alterations in the Western Australian employment structure involve declines in the two areas of wholesale trade, transport and storage and agriculture, forestry and fishing, whilst increases in employment in tertiary industries such as government administration and defence and property and business services are evident, along with increases in the construction and mining sectors.

Figure 3.1 Percentage change in employment by sector, 1997-2007



(Source: ABS, 2007a)

Table 3.2 Percentage of working population in key industries, 1997-2007

Sector	*South Australia (%)*			*Western Australia (%)*		
	1997	*2002*	*2007*	*1997*	*2002*	*2007*
Agriculture, forestry and fishing	7.7	6.2	4.8	5.9	4.8	4.1
Construction	5.2	6.7	8.4	9.0	8.3	10.1
Government admin and defence	3.9	4.1	4.5	2.9	4.4	5.0
Property and business services	9.1	10.4	10.1	11.1	10.2	12.1
Mining	0.4	0.5	1.7	3.8	3.9	4.8
Manufacturing	15.4	13.8	12.0	10.3	9.5	9.3

(Source: ABS, 2007a)

To determine if the labour force structure of the States is comparative to the labour force structure of coastal statistical local areas adjacent to the SWMR, location quotients were calculated. Location quotients (LQ) indicate the degree of an area's share of a particular activity. If the LQ value is higher than one (LQ >1) or less than one (LQ <1), this represents a higher and lower concentration respectively of the labour force comparative to the national or State average, whilst if the LQ value equals one, there is a proportionate share. Table 3.3 shows the LQ values for the statistical local areas adjacent to the South-west Marine Region relative to Western Australian and South Australian state totals using 2007 employment statistics (ABS, 2007a). This shows that the two primary extractive sectors of agriculture, forestry and fishing and mining are characterised by LQs below unity in coastal statistical local

areas adjacent to the Region, reflecting both the primary inland location of these industries and their declining significance in employment terms. By contrast, tertiary service sectors are shown to have location quotients in excess of unity, underlining the growth of these sectors in terms of employment in coastal areas adjacent to the SWMR. It is to be expected that these sectors are concentrated more in coastal areas, given the concentration of population and value of land and property in coastal and metropolitan districts.

Table 3.3 Location quotients for coastal SLAs adjacent to the SWMR

Sector	*LQ*
Agriculture, Forestry and Fishing	0.5
Mining	0.6
Manufacturing	1.0
Electricity, Gas and Water Supply	1.0
Construction	1.0
Wholesale Trade	1.0
Retail Trade	1.0
Accommodation, Cafes and Restaurants	1.0
Transport and Storage	1.0
Government Administration and Defence	1.0
Education	1.0
Health and Community Services	1.0
Personal and Other Services	1.0
Communication Services	1.1
Finance and Insurance	1.1
Property and Business Services	1.1
Cultural and Recreational Services	1.1

3.2.2 Industrial development

Industrial development in areas adjacent to the SWMR can be evaluated in a number of ways. The method used in this study was the National Pollution Inventory (NPI), which was selected as it enables the mapping of quantitative data over a period of years relating to industrial activity. The NPI is a monitoring system under which industry, business and environmental agencies report estimated discharges of pollutants to air, land and water. Reporting is required if there is a breach of a threshold level of a listed substance, with over 90 recorded substances on the inventory. Larger industrial facilities are required to determine if they need to report estimates of their emissions. Smaller facilities that do not breach threshold levels are not required to report emissions. However, in cases where there are significant levels in a particular region, state environment authorities estimate the emissions and record

these on the database (DEW, 2006). Furthermore, household and transport related emissions are also estimated by state environment authorities for inclusion in the database. At the national level, nitrogen is the dominant emission followed by ammonia, phosphorus and sulphuric acid (DEW, 2007).

Facilities in South Australia and Western Australia recording emissions into water over the period 1998-99 to 2003-04 were identified from the NPI and classified as to their proximity to the coastline as indicated in Table 3.4. This shows that, whilst the number of facilities located offshore remains very low, the total number of facilities recording emissions has more than doubled over this period. However, this does not necessarily indicate a greater volume of emissions, as it may reflect greater awareness and compliance with the NPI (DEW, 2007). It must also be remembered that an increasing number of facilities recording emissions does not automatically correspond to increased levels of contamination or pollution in the marine environment, as the toxicity of each substance differs greatly and is not discussed in the NPI monitoring programme.

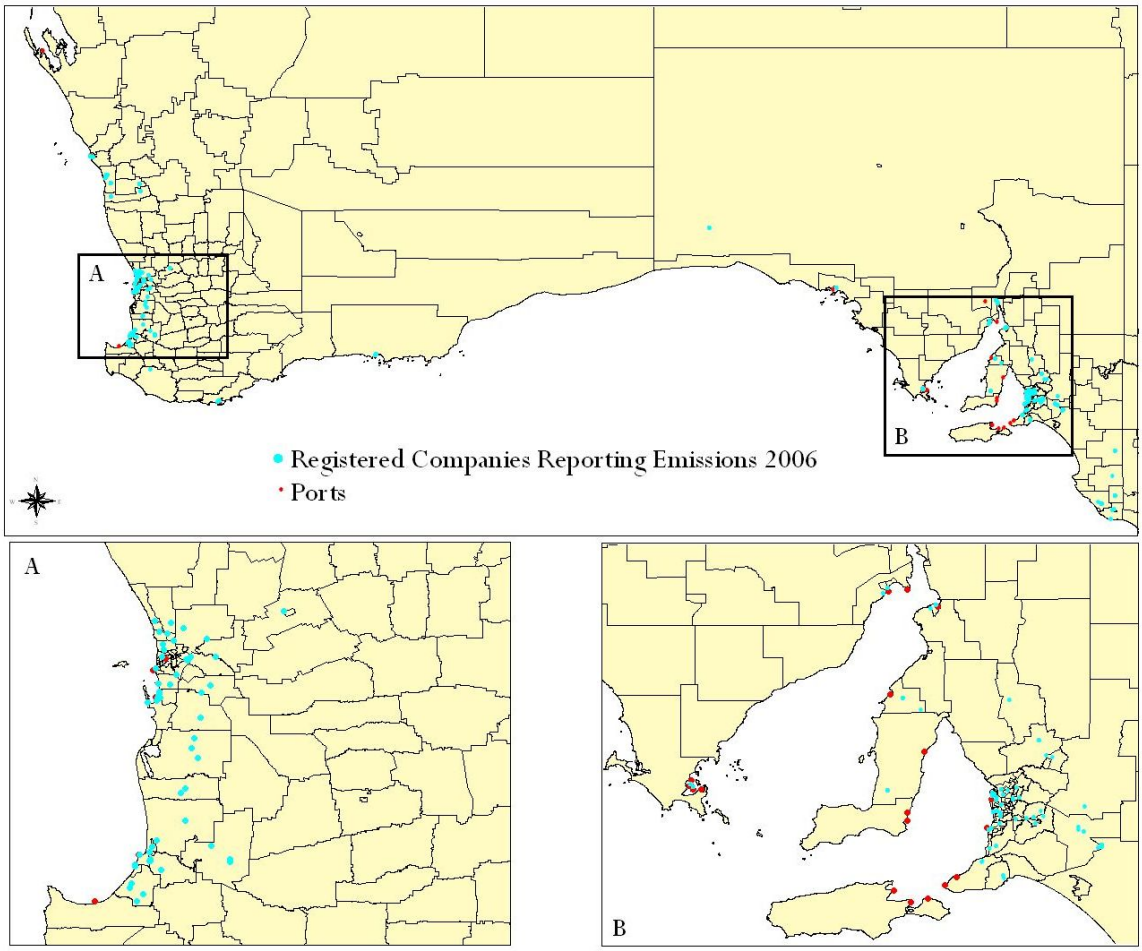
Table 3.4 Number of facilities reporting emissions to the NPI in Western Australia and South Australia, 1998-99 to 2003-04

Location of emitter	1998-99	1999-00	2000-01	2002-02	2002-03	2003-04
Zone 1: offshore	10	23	33	37	36	32
Zone 2: coastline to 10km inland	400	686	826	956	1090	1142
Zone 3: 10-50km inland	297	551	691	906	1047	1123
Zone 4: more than 50km inland	492	707	824	1073	1223	1332
Total	**1199**	**1967**	**2374**	**2972**	**3396**	**3629**

(Source: DEW, 2006)

The location of all emitters within 50km of the coastline adjoining the SWMR as reported in the 2006 NPI is illustrated in Figure 3.2. This demonstrates the expected clustering of emission sources in the urban areas of Perth and Adelaide, along with the effect of industrial areas adjacent to these urban centres. The presence of agricultural processing activities and sewage treatment plans further away from the urban centres is also visible. These clusters of emitters are located within sub-regions 2, 3 and 9 illustrated previously in Figure 1.2.

Figure 3.2 Companies located within 50km of the SWMR coastline reporting emissions to water, 2006



(Source: DEW, 2006)

The most commonly reported emissions to water for those companies illustrated in Figure 3.2 are shown in Table 3.5. This shows that fluoride compounds, volatile organic compounds and chromium are discharged from the highest total of sources. These are more frequently located in Western Australia, whilst South Australia is characterised by a greater number of ammonia-emitting sources.

Table 3.5 Commonly reported emissions from companies within 50km of the SWMR coastline, 2006

SWMR	*No. of emitters*	*South Australia*	*No. of emitters*	*Western Australia*	*No. of emitters*
Fluoride compounds	45	Ammonia	27	Chromium	28
Total Volatile Organic Compounds	45	Fluoride compounds	17	Fluoride compounds	28
Chromium	40	Total Volatile Organic Compounds	17	Total Volatile Organic Compounds	28
Ammonia	38	Total Phosphorus	13	Chlorine	22
Chlorine	30	Chromium	12	Toluene (methylbenzene)	18

(Source: DEW, 2006)

Table 3.6 lists the top ten most frequently emitted substances by weight and the number of emitters from companies located within 50km of the SWMR coastline as recorded by the NPI in 2001 and 2006. These show that the quantity of nitrogen and fluoride compounds released has declined by approximately 50% over this period, despite the number of emitters remaining relatively constant, whilst methanol released from one source in 2001 is not recorded in 2006.

Table 3.6 Most frequently emitted substances by weight from companies located within 50km of the coastline in the SWMR, 2001-2006

2001			*2006*		
Substance	*Kg emitted*	*No of emitters*	*Substance*	*Kg emitted*	*No of emitters*
Nitrogen	6,746,423	18	Nitrogen	3,988,032	17
Phosphorus	1,532,821	22	Ammonia	2,187,556	38
Methanol	1,029,665	1	Phosphorus	1,564,070	23
Fluoride compounds	195,047	37	Sulphuric acid	581,600	8
Sulphuric acid	39,440	8	Volatile organic compounds	164,214	45
Chlorine	33,043	5	Copper & compounds	86,660	27
Ammonia	30,029	5	Fluoride compounds	86,155	45
Phosphoric acid	16,188	3	Chlorine	77,318	30
Lead & compounds	14,051	26	Boron & compounds	49,383	6
Boron & compounds	3,799	6	Zinc & compounds	23,010	23

(Source: DEW, 2006)

Some categories such as volatile organic compounds are emitted from a large number of sources in 2006 which were not recorded in 2001, whilst emissions of others such as sulphuric acid and ammonia increase by a factor of 15 and 70 respectively over the 2001-06 time period.

In order to clarify the areas adjacent to the SWMR associated with the highest volumes of emissions, Table 3.7 lists in rank order the top five Local Government Areas in terms of sources associated with the five most frequently emitted categories identified in Table 3.6 in 2001 and in 2006. All LGAs are listed in cases where a category was associated with less than five LGAs.

Table 3.7 LGAs associated with key categories of emissions adjacent to the SWMR, 2001 and 2006

	2001	*2006*
Nitrogen	Cockburn (WA); Salisbury (SA); Joondalup (WA); Charles Stuart (SA); Nedlands (WA)	Joondalup (WA); Port Adelaide (SA); Cockburn (WA); Salisbury (SA); Rockingham (SA)
Ammonia	Kwinana (WA); Rockingham (WA); Albany (WA)	Port Adelaide (SA); Joondalup (WA); Rockingham (WA); Unincorp Whyalla (SA); Cockburn (WA)
Phosphorus	Cockburn (WA); Joondalup (WA); Nedlands (WA); Salisbury (SA); West Torrens (SA)	Joondalup (WA); Cockburn (WA); Salisbury (SA); Nedlands (WA); West Torrens (SA)
Methanol	Wattle Range (SA)	
Sulphuric acid	Marion (SA)	Mt Barker (SA); Unincorp Western (SA)

(Source: DEW, 2006)

Table 3.7 indicates that the majority of emissions derive from a relatively restricted number of LGAs. These often involve suburban areas where sewer and surface runoff treatment is required, generating nitrogen and phosphorus emissions, whilst fertiliser manufacturing in industrial areas is associated with ammonia emissions. Accordingly, they are concentrated in sub-regions 2, 3 and 9 illustrated in Figure 1.2. Emissions of sulphuric acid are associated with diverse industries such as mining in Mt Barker and vehicle manufacturing in Marion.

3.2.3 Transport

The 2006 Motor Vehicle Register (ABS, 2006a) showed that South Australia and Western Australia were the state of registration for 7.9% and 11.1% of the national

fleet respectively, the majority of which were passenger vehicles (Table 3.8). With regard to levels of vehicle ownership, the 2006 survey indicated a national average of 699 vehicles per 1000 resident population. At the State level, Western Australia recorded the highest rate of ownership, with 784 vehicles per 1000 population whilst South Australia ranked in fourth position behind Tasmania and Victoria with 730 vehicles per 1000 resident population. Furthermore, Western Australia recorded the second fastest growth in the total numbers of registered vehicles between 2002-06, increasing at a rate of 3.5% per annum. In contrast, South Australia displayed the lowest increase of 1.7% per annum over this period.

Table 3.8 Registered motor vehicles in South Australia and Western Australia, 2006

	South Australia		*Western Australia*	
Vehicle class	*Number*	*% of national total*	*Number*	*% of national total*
Passenger	915,059	8.2	1,205,266	10.8
Light commercial	145,643	6.9	254,164	12.0
Truck	34,994	7.4	63,316	13.3
Other	42,261	7.3	77,820	13.4
TOTAL	**1,137,957**	**7.9**	**1,600,566**	**11.1**

(Source: ABS, 2006a)

These data can be disaggregated into statistical divisions based on the vehicle owner postcode and are expressed in Table 3.9 as a percentage distribution of the total of each vehicle class within statistical divisions adjacent to the SWMR. The distribution of vehicle ownership clearly reflects population concentration in the Adelaide and Perth metropolitan areas, which together account for 80% of passenger vehicle registrations and 77% of registrations in the 'Other' category, which includes camper vans, buses and motorcycles. However, divisions outside these two metropolitan areas account for around 40% of light commercial and truck registrations.

Table 3.9 Distribution of vehicle registrations in statistical divisions adjacent to the SWMR, 2006

Statistical division	*Vehicle class (%)*			
	Passenger	*Light commercial*	*Truck*	*Other*
		South Australia		
Adelaide	33.7	20.6	21.1	31.1
Outer Adelaide	3.8	5.1	5.0	4.0
Yorke & Lower North	1.3	2.7	3.0	1.6
Eyre	0.9	2.2	1.8	1.1
Northern	2.0	3.1	2.5	2.2
		Western Australia		
Perth	46.2	42.2	37.9	45.6
South West	6.2	9.9	8.2	6.9
Lower Great Southern	1.5	3.4	4.4	1.9
Midlands	1.4	4.0	8.1	2.0
South Eastern	1.7	3.2	3.6	1.6
Central	1.4	3.6	4.4	1.9

(Source: ABS, 2006a)

In terms of total kilometres travelled, South Australia and Western Australia accounted for 7% and 10.5% of the national total of 206,383 million kilometres in 2005 (ABS, 2006b). Over the 2001-05 period, the total kilometres travelled in South Australia declined by an average of 0.9% per annum, in comparison to Western Australia where an increase of 4% per annum exceeded the national average increase of 2.1% per annum from 2001-05. Data relating to total kilometres travelled within the SWMR is derived from Bureau of Transport and Regional Economics statistics covering the period 1990-2002 (BTRE, 2003a) and is summarised in Table 3.10.

Table 3.10 Vehicle kilometres travelled by class of vehicle in metropolitan and non-metropolitan areas adjacent to the SWMR, 1990-2002 (million kilometres)

Region	*Passenger*		*Light commercial*		*Truck*		*Other*	
	2002	*% change 1990-2002*	*2002*	*% change 1990-2002*	*2002*	*% change 1990-2002*	*2002*	*% change 1990-2002*
Adelaide	8310	27.8	1280	33.3	320	-5.9	140	7.7
Non-metropolitan SA	4230	25.5	530	-36.9	490	4.3	80	0.0
Perth	10250	28.3	2480	52.1	580	9.4	160	14.3
Non-metropolitan WA	5400	24.1	950	-23.4	790	6.8	220	15.8

(Source: BTRE, 2003a)

Table 3.10 again demonstrates the dominance of passenger vehicles as a mode of transport, accounting for 78% of vehicle kilometres travelled in 2002, and also illustrates the scale of increasing passenger vehicle use in the metropolitan and non-metropolitan areas adjacent to the SWMR. This table also indicates the extent to which light commercial vehicle use has declined over the 1990-2002 period in non-metropolitan areas, which will partly reflect recent technological developments facilitating the use of larger articulated vehicles (BTRE, 2003b).

In metropolitan areas, the passenger vehicle is often the only form of transport available for commuters residing in the extensive suburban developments characteristic of both Adelaide and Perth. This reliance on the passenger vehicle is accentuated in all areas by a combination of economic growth and population increase, the latter being particularly significant in the case of Western Australia.

At the national level, the usage of public transport grew at around 1.1% per annum between 1985 and 2005, reflecting approximately the rate of population growth over this period. However, the modal share of public transport is estimated to have declined from 12% to 7% over the period 1973-2003 (Australasian Railway Association, 2006). Within urban areas adjacent to the SWMR, the importance of urban light rail and tram networks is significant, with total boardings on TransPerth and TransAdelaide routes in the year 2005-06 amounting to 98.5 million and 13.8 million in metropolitan Perth and Adelaide respectively. These reflect an annual increase of around 3.8% in both cases (Public Transport Authority, 2006; TransAdelaide, 2006). The numbers of domestic air passengers increased by 7.6% from 37,853 passenger departures in 2004 to 40,736 in 2005. The principal airports of Adelaide and Perth recorded increases in domestic passenger movements from 2004 to 2005 in the order of 8.6% and 7.2% respectively, with Adelaide recording a total of 5.3 million and Perth a total of 4.8 million domestic passengers. However, the number of international passenger movements through Perth airport of around 2 million in 2005 was more than double that for Adelaide (ABS, 2007b).

3.3 MACRO-ECONOMIC DRIVERS AT THE INTERNATIONAL AND NATIONAL LEVEL

The nature of urban expansion in coastal districts adjoining the SWMR reflects drivers affecting both the capital cities and the regional towns of the area. The preceding discussion has outlined the status of indicators reflecting urban growth and expansion, highlighting the growing primacy of the capital cities and also the strengthening links between these centres and adjacent regions. The capital cities of both South Australia and Western Australia enjoy a high degree of primacy, illustrated by the fact that the population of metropolitan Adelaide and Perth both comprise 73% of the respective estimated State population in 2007 (Tables 2.2 and 2.3). This metropolitan primacy reflects certain historical factors including the economic advantages of locating in urban over rural areas during the twentieth century, the inability of many rural environments to support high population densities and the limited scale of industrial development in rural regions dominated by the export of raw materials (Burnley and Murphy, 2004). More recently, the expansion of the Western Australian economy based on the minerals sector has supported the growth of Perth as the administrative and employment centre of the State, supplemented by increased domestic and international tourism as well as migration. The metropolitan area of Adelaide has experienced growth at the expense of surrounding rural areas primarily as a result of changes in agricultural practices, improvements in transport and communications and the need for increased economies of scale (Department for Environment and Heritage, 2004).

Future planning for the growth of Perth recognises the need to combine an approach which provides for more service provision in the suburbs whilst giving priority to new housing in established urban areas through infill, regeneration and intensification of under-utilised urban land (WAPC, 2006a). A broadly similar strategy exists for Adelaide, with an emphasis on reducing the rate of greenfield site development, increasing the density of residential housing within the urban boundary and planning for retirement villages and similar accommodation (Planning South Australia, 2006).

Outside of the capital cities, there are cultural as well as economic forces which result in the expansion of urbanised areas which have collectively been referred to

elsewhere as the 'Sea Change' phenomenon (Burnley and Murphy, 2004). This phrase reflects the recent recognition of factors contributing towards the growth of non-metropolitan settlements along the Australian coast. According to these authors, coastal settlements can be categorised on the basis of distance from the State capital and the size and socio-demographic characteristics of their population. Table 3.11 summarises this with examples drawn from coastal settlements adjacent to the South-west Marine Region.

Table 3.11 Categories of coastal communities

Category	*Description*	*Example*
Coastal Commuters	Suburbanised satellite communities in peri-metropolitan or exurban locations within 1.5hrs drive from the state capital city	Mandurah; Wanneroo, WA
Coastal Getaways	Small to medium sized towns within 3hrs drive from the state capital city	Victor Harbor; Yorke Peninsula, SA Bunbury; Busselton, WA
Coastal Cities	Substantial urban conurbations (population >100,000) beyond state capital city	No examples within areas adjacent to the SWMR. Examples elsewhere include Cairns, QLD; Newcastle, NSW
Coastal Lifestyle Destinations	Tourism and leisure-focused communities more than 3hrs drive from the state capital city	No examples within areas adjacent to the SWMR. Examples elsewhere include Byron, NSW; Mackay, QLD
Coastal Hamlets	Small towns or grouping of villages more than 3hrs drive from the state capital city	Augusta-Margaret River, WA

(Source: Gurran *et al*., 2005)

Factors contributing towards the growth of each settlement will vary according to local circumstances, but these commonly include increased housing costs in capital cities as a 'push' factor and employment opportunities and the perceived amenity value of coastal destinations as 'pull' factors. Housing prices may be a particularly significant driver in the case of Western Australia, with Perth recording an increase of 15.3% in established house prices from June 2006 to June 2007, exceeding that of Adelaide (11.7%) and the national average of all capital cities of 9.2% (ABS, 2007c). The ability to work from home will also be a significant driver for certain categories of workers. Other cultural and personal drivers include perceptions about a sense of place, family connections, health considerations and prior holiday experience of a coastal destination as influential factors determining the growth of certain settlements. Taken together, these economic, social, technological and cultural drivers are significant drivers of population growth and expansion outside of the capital cities.

3.4 FUTURE TRENDS WITHIN THE SOUTH-WEST MARINE REGION

3.4.1 Employment

The most recently published national projections indicate that the ageing of the population and declining birth rates will be reflected in a declining rate of growth in the Australian civilian labour force, which is defined as the population aged 15 years and over. These projections indicate an average rate of growth in the labour force around 0.8% in the period 1998-2016, in comparison to 1.9% from 1978-98 (ABS, 1999). By the year 2015-2016, the annual growth rate of the labour force is projected to be 0.4%. Furthermore, 80% of the growth in the labour force from 1998 to 2016 is projected to occur in age groups of 45 years and over.

More detailed projections relating to labour force growth are not published for South Australia but data relating to Western Australia are available for the period 2006-2016 which are summarised in Table 3.12. These demonstrate that overall Western Australia is projected to experience growth rates in the labour force above the national average, although these are predicted to decline over time. Lowest growth rates are forecast in the Central division, whilst the highest growth rates are projected for the South West division.

Table 3.12 Projected annual percentage growth in labour force by statistical division within Western Australia, 2006-2016

	Western Australia	*Perth*	*South West*	*Lower Great Southern*	*Midlands*	*South Eastern*	*Central*
2006 – 2011	1.5	1.4	2.7	1.4	2.8	1.9	1.1
2011 - 2016	1.2	1.1	2.0	1.0	2.4	1.5	0.8

(Source: DPI, 2002)

Participation rates are defined as the total proportion of the workforce engaged in full time or part time employment. At the national level, these are predicted to decline from a peak of 63.7% in 1990 to 60.6% by 2016, again reflecting the ageing of the population overall (ABS, 1999). Within Western Australia, more recent projections detailed in Table 3.13 reflect this overall trend, with an overall decline of around 2% in the participation rate between 2006 and 2016.

Table 3.13 Projected labour force participation rates by statistical division within Western Australia, 2006 – 2016 (%)

	Western Australia	*Perth*	*South West*	*Lower Great Southern*	*Midlands*	*South Eastern*	*Central*
2006	64.0	63.6	59.5	61.3	65.4	72.9	65.7
2011	63.1	62.8	58.8	60.6	65.2	72.0	65.0
2016	61.9	61.5	57.5	59.7	64.8	70.7	64.3

(Source: DPI, 2002)

With regard to the area adjacent to the SWMR, the projected declines in labour force and participation rates, combined with the overall ageing of the population, have serious implications for the mineral resources sector in particular. In order to achieve predicted increases in output, it is estimated that around 70,000 more employees will need to be recruited in this sector over the 2006-2015 period, with around two thirds of these being needed in Western Australia and 5,000 in South Australia (Lowry *et al*., 2006). The majority of these shortages will be in non-professional occupations such as tradespersons and semi-skilled workers, and are predicted to be most acute in the period 2006-2010 as a result of forecasted trends in output in the mineral sector. Policies to encourage female and indigenous participation as well as recruitment from the manufacturing sector are recommended, although issues relating to location, training and retention of staff and female perception of the minerals sector are raised.

With regard to changes in individual sectors, the trends illustrated in Table 3.12 for employment in key industries over the period 1997-2007 can be projected forward by five years to generate a picture of employment under the present conditions. These projections are summarised in Table 3.14.

These tentative projections indicate that there is likely to be some degree of convergence in terms of employment by sector between the two states adjacent to the SWMR. Construction and manufacturing will increase and decrease respectively to the extent that they each employ a similar proportion of the workforce in both states by 2012. The tertiary services sector will employ an increasingly significant majority of the workforce in Western Australia, with rapid growth particularly forecast for the government administration and defence sector. The primary industries of agriculture, forestry and fishing are projected to employ a very small minority of the workforce in

both states. The mining sector is set to continue to expand in both states, although a greater proportion of the sector is employed in Western Australia.

Table 3.14 Percentage of working population in key industries 1997-2007 projected to 2012

Sector	*South Australia (%)*				*Western Australia (%)*			
	1997	*2002*	*2007*	*2012*	*1997*	*2002*	*2007*	*2012*
Agriculture, forestry and fishing	7.7	6.2	4.8	1.6	5.9	4.8	4.1	2.3
Construction	5.2	6.7	8.4	11.6	9.0	8.3	10.1	11.2
Government admin and defence	3.9	4.1	4.5	5.1	2.9	4.4	5.0	7.1
Property and business services	9.1	10.4	10.1	11.1	11.1	10.2	12.1	13.1
Mining	0.4	0.5	1.7	3	3.8	3.9	4.8	5.8
Manufacturing	15.4	13.8	12.0	8.6	10.3	9.5	9.3	8.3

These data can be compared to projections of future trends in employment by each sector at the national level over the period 2007-2012 (DEW, 2007). The mining sector is predicted to experience the most rapid growth in employment nationally at 3% per annum, followed by property and business services (2.1%), construction (1.7%) and government administration and defence (1.2%). Employment in agriculture, forestry and fisheries is projected to be static at around 0.1%, whilst employment in the manufacturing sector is projected to decline at the rate of 0.6% per annum. Employment in the property and business service and construction sectors is closely associated with centres of population nationally, whilst 24% and 11% of all jobs in the mining sector are located in Perth and regional Western Australia respectively.

These projections reflect some fundamental shifts in the economic base of regions adjacent to the SWMR over the past ten years which, provided that current economic conditions do not alter dramatically, will be manifest in a continued trend away from primary towards tertiary industries and the mining and construction sectors. The association of tertiary services with urban centres reinforces the trends indicated with respect to population movements, whilst the projected increases in construction and mining will be interlinked to the effect that population in a restricted number of

regional mineral resource-dependent communities is also likely to continue to increase.

3.4.2 Industrial Development

This discussion has focused upon the NPI inventory as a means of quantifying economic activity throughout the coastal area adjoining the SWMR. The key emission sources have been shown to relate to sewage treatment in urban areas, which are certain to increase as a result of the projected population growth. However, it could be the case that continued water shortages would lead to the adoption of procedures already in place in Europe, where sewage contamination is minimised through greater investment in sewage treatment facilities and recycling of sewage water is thereby rendered possible. With regard to contamination of the marine environment, the capacity of the receiving water body to disperse waste is crucial, which partly depends upon the nature of the contaminant and also on the physical characteristics of the receiving environment. Sheltered water bodies such as estuaries and bays are more prone to accumulating contaminants, leading to concerns that increased population pressure in the Perth and, to a lesser extent, the Adelaide area could result in increased levels of contaminants in the adjacent estuaries and coastal environments. This has already been shown to be the case in Cockburn Sound, which underwent a dramatic decline in seagrass extent in association with greater industrial activity. However, again, it is difficult to predict the consequences of industrial activity with respect to the marine environment other than highlighting potential contamination hotspots in proximity to urban areas predicted to experience continued population growth.

Analysis of land release data helps to identify where these locations may lie at present and into the future. As these data are derived from State planning documents, they will vary in detail and timescales. The most recently published data relating to use and availability of industrial land inside the Perth Metropolitan Area is included in the Industrial Land Use Survey (Ministry of Planning, 1997), which details the extent of occupied and vacant land in industrial complexes from 1988 to 1997. This shows that the total area of industrial complexes increased by 12% to around 11,000ha between 1988 and 1997. Over this time, the percentage of industrial complexes occupied remained fairly static, varying between 61% and 68%. Based on the average take up

rate measured over this time period, it was estimated that enough land remained to satisfy demand for the next 25 years, ie up to the year 2022.

However, since these predictions were made, it is evident that the sustained rate of economic growth in the country as a whole and Western Australia in particular has placed increased pressure on the need to sustain supply of industrial land. The focus of this activity has moved to the south-west of the city in the Kwinana Industrial Area (KIA), rather than smaller dispersed sites in the more central urban areas. The future development of the KIA was the focus of a longstanding planning process resulting in the Fremantle Rockingham Industrial Area Strategy (FRIARS) being published in 2000. This document envisaged the growth of the KIA to include expansion of heavy industry in the Hope Valley and other general industrial land development to its north and east. This proposal received Ministerial approval in 2006 under the name Latitude 32, comprising 1,400ha zoned predominantly for general industrial and transport use. The nature of the industries expressing an interest in Latitude 32 is not yet clear but it is evident that the development of the south west corridor between Fremantle and Rockingham, comprising Latitude 32, Fremantle Port, Cockburn Sound, the Kwinana Industrial Area, the Australian Marine Complex at Henderson and East Rockingham Industrial Park located in sub-regions 2 and 3 of Figure 1.2 will continue to represent the principal industrial complex along the coastline adjacent to the SWMR.

In regional Western Australia, the Country Land Development Programme annual reviews provide summaries of proposed industrial building activity in the planning regions (WAPC, 2006b). The most recently published full review dating from 2005 indicated that the south-west planning region accounted for all but two of the 36 anticipated lot releases for industrial development in 2005-06. These were predominantly located within 10km of the coast and were centred in the Augusta-Margaret River, Busselton and Manjimup local government areas in sub-region 4 of Figure 1.2. However, Esperance recorded the highest number of projected industrial lot releases over the period 2005-06 to 2009-10 with an average of 10 releases per annum. The recent review for 2006 is not yet fully available, but the chapters released indicate that Albany's projected industrial unit releases over this timeframe have increased from a total of 10 to 25, whilst those for Esperance have increased from 40 to 71. It is reasonable to assume that the number of projected industrial lot releases in

the south-west region will have increased similarly. This underlies the extent to which the economic conditions within Western Australia are being manifest in increasing industrial investment in smaller towns and ports, particularly in the south-west of the state, a process which is reflected in many other indicators of growth discussed in this Report.

With regard to South Australia, the main source of information regarding industrial development in metropolitan Adelaide is the most recent Metropolitan Adelaide Industrial Land Strategy (Planning South Australia, 2007). This document identified the strategy for supplying industrial land to meet the expected demand of around 85ha per annum, which is to maintain a rolling supply of between 400-600ha of development-ready land with an additional 200ha in an advanced stage of development should it be required. Three areas were prioritised on economic, planning and other grounds, comprising DSTO / Edinburgh Parks to the north-east, Le Fevre Peninsula / Gillman in the docks area and Lonsdale on the coast to the south-west of the city as the prime sites for meeting the requirement for development-ready land, all of which are primarily owned by the State. Future sites to meet longer-term demand were recognised as potentially needed but are not identified, with the implication that the foreseeable demand can be accommodated within these locations.

The implications of these industrial developments with regard to the marine environment are difficult to predict, as they will reflect the actual nature and extent of industrial activity in these areas. As the planning for industrial development in both metropolitan areas involves State-owned land, the potential for adverse marine impacts should be reduced by the ability to build suitable treatment facilities and the emphasis on development and infill of new industrial sites theoretically may allow a greater degree of planning and control over discharges.

3.4.3 Transport

The AusLink National Network was established in 2004 to provide a unified hierarchical framework at the national level for planning and funding land transport links within Australia. An element of this network involves the identification of inter-state corridors which, within the study area, comprise the Adelaide-Perth corridor and the Perth-Bunbury corridor, with urban corridors in metropolitan Adelaide and Perth

also being present. AusLink 1 covered the period 2004-05 and involved the commitment of $12 billion on a range of projects, with $0.78 billion and $1.3 billion being spent in South Australia and Western Australia respectively over this period. AusLink2 will extend the funding allocation over the period 2008-09 to 2013-14, involving a higher overall total of $22.3 billion (DTRS, 2007a).

The Adelaide-Perth corridor serves a multiple range of functions, operating as an export route for agricultural and mining products, linking remote communities as well as the two metropolitan centres and also shares some routes with the north-south corridor connecting Adelaide to Darwin. The Perth-Bunbury corridor is much shorter but acts as a vital suburban link, particularly with regard to the expanding southern suburbs. It connects Perth to nearby urban areas in Mandurah and Bunbury in sub-region 3 and facilitates the movement of agricultural and industrial goods as well as large numbers of tourists between Perth and the south-western areas of the State.

Anticipated annual growth rates in freight movements from 1999 to 2025 are higher for the Perth-Bunbury corridor for all modes of transport, particularly by road, which is projected to account for 55% of freight movements by 2025 (Table 3.15), reflecting the increasing integration and economic development of the south-west region in Western Australia. By 2025, the Adelaide-Perth corridor is projected to carry approximately a tenth of the total freight movements passing along the Perth-Bunbury Corridor. Rail is projected to carry around 70% of all freight movements along the Adelaide-Perth Corridor by 2025.

Table 3.15 Actual and projected freight movements by Auslink Corridor, 1999-2025

	Adelaide – Perth Corridor			Perth – Bunbury Corridor		
	1999 (‘000)	2025 (‘000)	Annual average %	1999 (‘000)	2025 (‘000)	Annual average %
Road	213	339.6	2.3	1,482.2	5,721.4	11.0
Rail	633.5	1,355.2	4.4	1,565	4,615.1	7.5
Coastal shipping	149.3	222.1	1.9	19.2	52.3	6.6
Air	6	8.6	1.7	0	0	n/a
TOTAL	**1001.8**	**1,925.5**	**3.6**	**3,066.4**	**10,388.8**	**9.2**

(Source: BTRE, 2006)

Passenger transport projections for these two corridors are detailed in Table 3.16. With regard to the Adelaide-Perth corridor, air travel increases its projected modal share of passenger movements from 70% in 1999 to 88% in 2025, mostly at the expense of car travel which declines from 17% in 1999 to 6% in 2025. Car travel remains the overwhelming mode of transport along the Perth-Bunbury corridor, accounting for 97% of passenger movements by 2025 and increasing in total volume by over 150% over the 1999-2025 period.

Table 3.16 Actual and projected passenger transport movements by Auslink Corridor, 1999 - 2025

	Adelaide – Perth Corridor			Perth – Bunbury Corridor		
	1999 (‘000)	2025 (‘000)	Annual increase %	1999 (‘000)	2025 (‘000)	Annual increase %
Air	201.3	572.2	7.1	0.5	1.3	6.2
Bus	9.1	11.4	1.0	193.5	309.6	2.3
Car	47.9	38.9	-0.7	5,504.7	14,093	6.0
Rail	14.1	20.4	1.7	24	40.1	2.6
Other	15.2	7.4	2.0	19.2	32.6	2.7
TOTAL	**287.6**	**650.3**	**4.9**	**5,741.9**	**14,476.6**	**5.9**

(Source: BTRE, 2006)

The future use patterns of the Adelaide-Perth corridor are forecast to reflect increasing demand for movement of goods in and out of Western Australia as population and economic activity continues to rise in that State and the continued need for land transport of non-bulk imported goods from Sydney and Melbourne to national centres such as Perth and Adelaide (DTRS, 2007b). There are particular pressure points along the corridor, including the road stretches between Northam and Perth in sub-region 2 and from Adelaide to Port Augusta in sub-regions 8 and 9. Future developments likely to increase local pressure on the corridor include the possible doubling of population in Roxby Downs north of Adelaide (sub-region 9) should the proposed expansion of the Olympic Dam mining project proceed. Furthermore, there is an ongoing need for investment in road maintenance throughout the corridor. The interstate rail network is considered capable of meeting the projected freight task, whilst sea freight could take a greater share of containerised cargo, lessening the demand on rail to some extent.

The rapid forecasted increase in car passenger vehicles along the Perth-Bunbury corridor in sub-regions 2 and 3 is exacerbated by the temporal increase in demand by

commuters, weekend and tourist traffic (DTRS, 2007c). These increases reflect the growth rates of Bunbury and surrounding areas serviced by the corridor, bringing increased demand for general road freight as well as increased container movements in association with the planned development of Fremantle port. The new 71km extension of the Perth-Bunbury Highway to join the Old Coast Road south of Lake Clifton, which is expected to be completed in 2009, will alleviate traffic and tourist pressure on Mandurah through providing a faster route from Perth to the south-west of the state.

Turning to the two urban corridors of Perth and Adelaide, the former comprises 70km of road and 130km of rail connecting the inter-state corridors to Fremantle Port and the industrial areas of Kewdale, Canning Vale and Kwinana. The current trend of increasing passenger traffic pressure on the Kwinana Freeway is predicted to increase with the expansion of the southern suburbs, although the opening of the Perth to Mandurah railway in October 2007 is a major investment that is intended to reduce peak traffic congestion by approximately 25,000 vehicles. Commercial vehicle pressure is currently heaviest along the Leach and Roe Highways connecting Fremantle to the Kewdale/Welshpool industrial estates. The planned expansion of Fremantle inner harbour envisages a doubling of freight throughput by 2015, with a target of 30% of container freight being transported by rail by 2013 to alleviate pressure on road traffic, although the attainment of this target is uncertain. Road freight activity within the Perth urban corridor is projected to increase by 3-4% per annum from 2007 to 2018 and by 2-3% per annum from 2018-2025. Together with the projected increases in population, it is considered that the Perth urban corridor will continue to experience more acute congestion, loss of amenity, increased travel times, cost in delays and greater incidence of fatalities (DTRS, 2007d).

The Adelaide urban corridor is facing pressure associated with the expansion of population in the outer northern and southern suburbs combined with industrial activity mainly in association with the DSTO/Edinburgh Parks industrial area. It is estimated that over the period 2005-25, passenger travel in terms of vehicle kilometers will increase by 30%, intra-urban freight distribution will increase by 60% and interstate and intrastate freight will double in volume (DTRS, 2007e). Key measures to alleviate congestion take the form of new expressways (the Port River and Northern

Expressways) and significant investment in increasing the efficiency of movement through the city through road widening and upgrading the rail network to enable more cost-effective round the clock movement of freight.

These data reflect the future pressure points in terms of population and economic activity in areas adjacent to the SWMR. It is evident that most investment in terms of new transport infrastructure is taking place with regard to the Perth-Bunbury corridor, which faces challenges resulting from increased residential development and industrial activity, placing pressure on both road and rail links. The $630 million extension of the Perth-Bunbury Highway demonstrates the pressure on road traffic in this region, which will inevitably act to strengthen the links between Perth, the residential and industrial areas of the south-west metropolitan area and the south-west of the state in terms of economic activity, tourism and residential development. The planned new town of Keralup (formerly Amarillo) 10km north-east of Mandurah is further evidence of this, comprising an anticipated 60,000-90,000 residents on a 4,000ha site. The highway extension will not be completed until 2009, meaning that in the short term there will be continued acute traffic congestion along most of the road links between Perth and the south-west. Rail traffic is likely to experience greater pressure in the medium term following the planned expansion at Fremantle inner harbour which is expected to be completed by around 2015, generating more container and bulk traffic on both road and rail connections. Furthermore, should the planned new port at Kwinana proceed, this will further increase the freight task in the medium to long term. Investment in other sections of the AusLink network within the Region generally involve improvements, upgrades and maintenance rather than large scale new projects, reflecting the fact that spare capacity exists in sections of the AusLink network and that population growth or economic activity is not projected to result in an exceeding of this capacity.

3.5 CONCLUSION

This section has highlighted a number of distinct and emerging trends relating to indicators of urban development adjacent to the South-west Marine Region. Chapter 2 has highlighted that in terms of overall demographics, the rate of national population

growth will decline over the next fifteen years, but this will be more acute in South Australia than Western Australia, with both states experiencing migration towards larger urban settlements and coastal regions generally experiencing higher rates of growth than inland. Over the next fifteen years, this will result in the highest growth rates outside the two metropolitan areas being focused along the west and south-west coast of Western Australia in sub-regions 3 and 4, with positive rates of growth on the south coast being restricted to Esperance (sub-region 6) and the Eyre and Fleurieu Peninsulas (sub-regions 7-9).

In terms of employment, the ageing of the population will result in a decrease in participation rates throughout the Region, with particular implications for the mineral resources industry. Employment trends indicate a distinct shift towards a tertiary service sector economy in both states being evident by 2012 alongside a concurrent decline in primary industries, with the obvious exception of mining. This process is more advanced in Western Australia but similar trends are observed in South Australia.

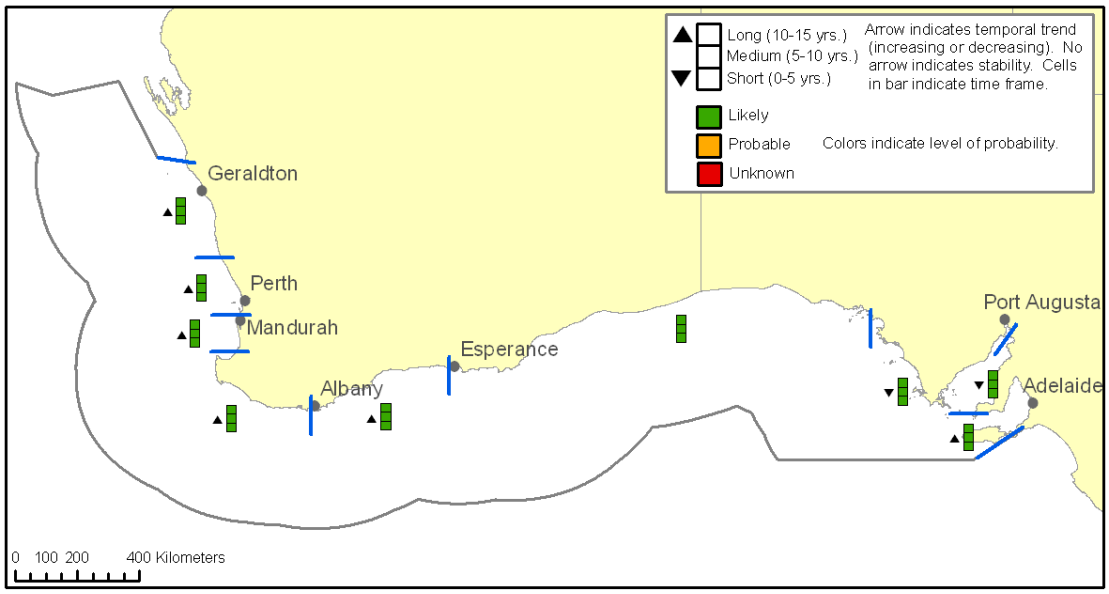
Industrial activity is highly planned within the metropolitan areas, with the emergence of distinct industrial precincts benefiting from transport and land availability. Macro-economic indicators point towards the likelihood that there will continue to be an expansion of industrial activity within areas adjoining the SWMR, as indicated by the rates of lot release over the next five years in regional Western Australia as well as the metropolitan areas. It is, however, difficult to comment on the impacts with regards to the marine environment, as the NPI inventory highlights the variability in both quantity and nature of contaminants discharged by industry to water bodies. The NPI data does, however, highlight the extent to which multiple sources of key emissions are associated with metropolitan local government areas such as Cockburn, Joondalup, Nedlands, Port Adelaide, Rockingham and Salisbury in both 2001 and 2006. Given that these are locations of significant population increase, particularly in those LGAs located in Western Australia, this will be of particular significance to future marine planning.

With regards to transport infrastructure, it is evident that there will be an increasingly acute need in the short, medium and long term to cope with the growing road and rail

task between Perth and the south-west of the state, which itself reflects a combination of residential development and industrial expansion inland and on the coast. This will have impacts on other congested areas within the Perth metropolitan area, necessitating investment, but there is likely to be more emphasis on upgrading and maintaining major transport infrastructure outside of these areas.

Figure 3.3 summarises these comments through presenting overall trends with respect to the sub-regions of the SWMR coastline identified in Chapter 2. This underlines the focus of urban development and growth along the coastline adjacent to the west and south-west of the Region and the Adelaide area to the far east, with overall stability in the central area and declining rates of growth in rural coastal areas of South Australia. These projections can be categorised as 'likely' on account of their being driven largely by the wealth of data relating to current and projected trends in population growth outlined in Chapter 2.

Figure 3.3 Overall trends in urban development adjacent to the SWMR



4 OIL AND GAS

4.1 INTRODUCTION

Petroleum constitutes the largest resource sector in Western Australia by value, generating sales of $15.2 billion in 2005-06, an increase of $2.8 billion on the previous year (DoIR, 2006) and totalling $1.0 billion in South Australia, representing a steady increase from $689 million in 2003-04 (PIRSA, 2007).

Expenditure on petroleum exploration in 2005-06 totalled $132.3 million and $593.6 million in South Australia and Western Australia respectively. South Australia's share of national expenditure has increased from 5.6% to 10% over the period 2003-04 to 2005-06, whilst Western Australia's share has declined from 71% to 47% (ABS, 2006). It should be pointed out, however, that the majority of expenditure in Western Australia is associated with fields outside the South-west Marine Region. Oil and gas exploration and recovery within the SWMR is focused on three offshore basins. The Perth Basin covers 172,300km^2 and includes offshore and onshore oil and gas fields. Oil production in the offshore Perth Basin is centred on the Cliff Head field in the W98-31 block 20km south of Dongara in 16 metres of water. Indications and shows of oil and gas have been found in the Vlaming sub-basin 22km west of Perth at the Tuart, Gage Roads and Araucaria wells. Other potential reserves are thought to be located in the eastern section of the Naturaliste Plateau off Cape Leeuwin and the Bight Basin in South Australia. This chapter will outline the present status of the pressure indicators detailed below before discussing their influences and possible future trends.

The driving forces behind the oil and gas sector activity in the SWMR include the existing levels of activity, the economic value of the sector and future trends in exploration and exploitation. This section will examine the development of the oil and gas sector using indicators of these driving forces as outlined below.

Table 4.1 Driving forces and pressure indicators for the oil and gas sector

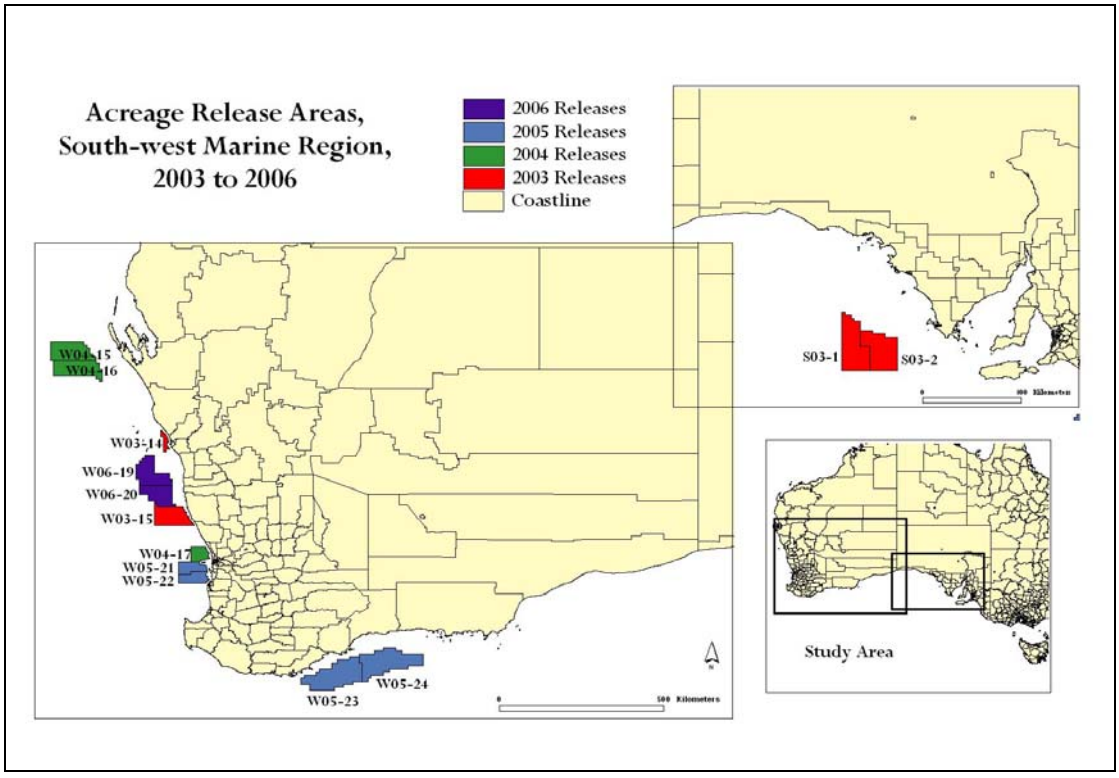
Driving forces	*Pressure indicators*
Existing oil and gas sector activity	Acreage release Drilling activity
Economic value of sector	Annual oil and gas production by basin
Future activity	Estimated reserves and prospectivity Projected price trends

4.2 CURRENT STATUS OF PRESSURE INDICATORS

4.2.1 Acreage release

Figure 4.1 shows the location and timing of acreage releases in the SWMR from 2003-2006. This illustrates the recent focus of activity in the Vlaming sub-basin off the west coast of Australia and the Bremer sub-basin in the western area of the Great Australian Bight.

Figure 4.1 Location of acreage releases in and adjacent to the SWMR, 2003-06



(Source: OGRA Annual Reports 2003-06)

Table 4.2 Leases for exploration in the SWMR, 2000-07

Permit area and size	*Basin / sub-basin*	*Permit and duration*	*Operator*	*Estimated expenditure 6 year program*	*6 year work program*
EPP28 15896 km^2	Bight	EPP28 07/00 – 07/06	Woodside	$5.63 million	Seismic and other geological studies
EPP 29 18763 km^2	Bight	EPP29 07/00 – 07/06	Woodside	$34.65 million	Seismic and other geological studies, one well proposed
EPP30 22225 km^2	Bight	EPP30 07/00 – 07/06	Woodside	$7.18 million	Seismic and other geological studies
EPP31 5592 km^2	Duntroon	EPP31 06/02 – 06/08	Woodside	$13.3 million	Seismic and other geological studies
EPP 32 5300 km^2	Duntroon	EPP32 07/02 – 07/08	Santos	$12 million	Seismic and other geological studies, one well proposed
W01-22 6459 km^2	Perth	WA-327-P 07/02 – 07/08	Apache	$12.7 million	Seismic and other geological studies, two wells proposed
W01-23 5217 km^2	Perth	WA-328-P 07/02 – 07/08	Eni	$35.57 million	Seismic and other geological studies, one well proposed
W01-24 5220 km^2	Perth	WA-325-P 07/02 – 07/08	Roc	$30.5 million	Seismic and other geological studies, four wells proposed
W01-25 5220 km^2	Perth	WA-326-P 07/02 – 07/08	Eni	$25.9 million	Seismic and other geological studies, one well proposed
W01-20 6326 km^2	Perth	WA-336-P 12/02 – 12/08	Petroz	$16.25 million	Seismic and other geological studies, one well proposed
W01-21 5616 km^2	Perth	WA-339-P 01/03 – 01/09	Santos	$5.2 million	Seismic and other geological studies
W01-26 3548 km^2	Perth	WA-337-P 01/03 – 01/09	Kerr-McGee	$4.5 million	Seismic and other geological studies
W03-14 733 km^2	Perth	WA-349-P 01/04 – 01/10	Voyager	$7.1 million	Seismic and other geological studies, one well proposed
W04-17 1875 km^2	Vlaming	WA-368-P 08/05 – 08/11	Nexus	$14.45 million	Seismic and other geological studies, two wells proposed
W05-21 2120 km^2	Vlaming	WA-381-P 09/06 – 09/12	Westralian	$24.7 million	Seismic and other geological studies, two wells proposed
W05-22 2420 km^2	Vlaming	WA-382-P 09/06 – 09/12	Westralian	$24.7 million	Seismic and other geological studies, two wells proposed
W05-23 9145 km^2	Bremer	WA-380-P 08/06 – 08/12	Plectrum	$40.15 million	Seismic and other geological studies, one well proposed
W05-24 9315 km^2	Bremer	WA-379-P 08/06 – 08/12	Plectrum	$40.15 million	Seismic and other geological studies, one well proposed

(Sources: DOIR, 2007; Geoscience Australia, 2006).

Table 4.2 provides further detail of the acreage release and exploration permits granted since 2000. Permits are granted to private companies on a bidding system covering a period of six years, under which companies are required to commit to a guaranteed exploration programme for three years and a secondary programme for the remaining three years. A maximum of two renewals, each of five years' duration, is permitted.

4.2.2 Drilling activity

Drilling activity in the SWMR is currently focused on the southern Perth Basin. Three exploratory wells have been drilled in 2007 in blocks W98-31 and W01-24 by Roc Oil and partners.

4.2.3 Annual production of oil and gas by basin

The Cliff Head field, which commenced output in May 2006, has been producing 8,000 to 9,000 barrels per day (Roc Oil Company Limited, 2007), giving an estimated total of 2.9-3.3 million barrels to date (May 2007). The investment in this field to the end of 2005 totalled $265 million (Roc Oil Company Limited, 2005). This is currently the only oil producing location within the SWMR. There is active gas production from the onshore section of the Perth Basin but no offshore gas production in this basin or elsewhere in the SWMR.

4.2.4 Estimated reserves and prospectivity

Whilst there are technical as well as commercial difficulties in obtaining detailed data on oil reserves, some broad conclusions can be drawn from published sources. With regard to the Perth Basin, drilling has thus far only yielded one commercially recoverable oil field at Cliff Head offshore from sub-region 1 in Figure 1.2. Eight other exploratory wells drilled have been dry. In March 2007, the main shareholders in this venture, Roc Oil, described their exploratory drilling of three wells as 'the last roll of the dice', stating that failure would mean a refocusing of exploratory drilling elsewhere (PESA News, 2007a). However, the company announced in October 2007 that the Dunsborough-1 exploration well 50km north west of the Cliff Head field was classified as a new oil and gas discovery which, although small, would justify further exploratory drilling in the northern Perth Basin, given the characteristics of the oil present and the current high oil prices (ABC News, 2007; PESA News, 2007b).

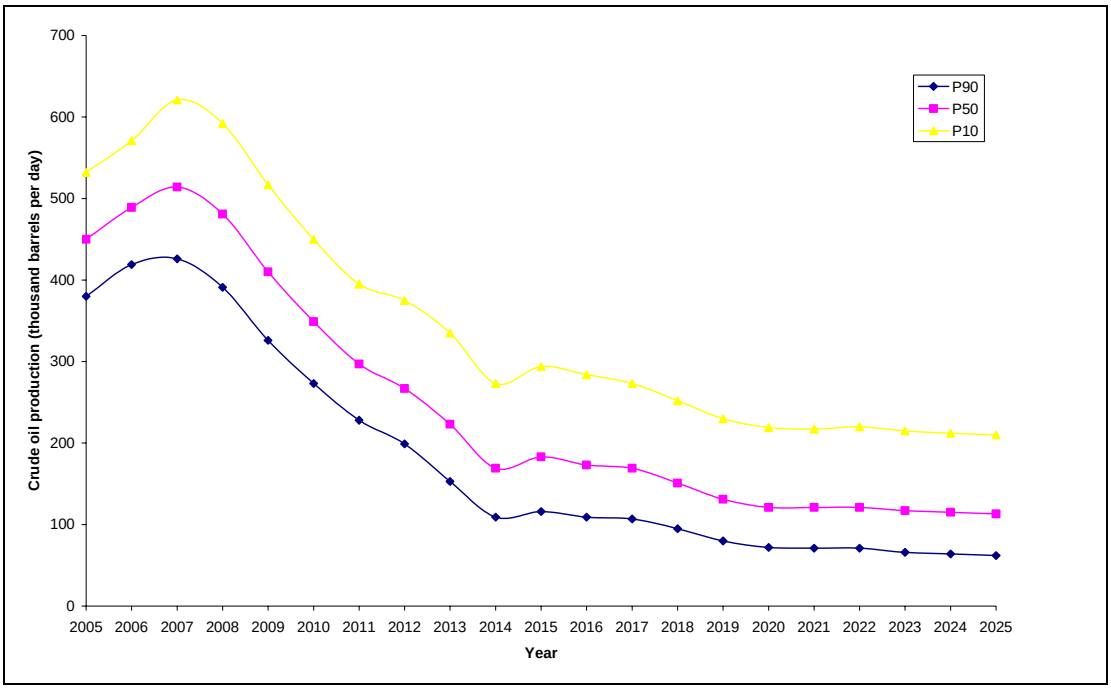
The Bight Basin has the status of a frontier basin, with few wells drilled and no discoveries of oil and gas to date, the exploratory well at Gnarlyknots in the eastern Bight Basin in 2003 representing the first drilling activity for over a decade. There are currently five active permits in the Bight Basin, four operated by Woodside Petroleum and the other operated by Santos (PESA News, 2006). Technical prospectivity as reflected by oil seeps and geological surveys is highest in the Bremer sub-basin to the west and the eastern part of the Bight Basin. Initial estimates are sparse and remain highly speculative, but the central areas of the Bremer sub-basin are considered to have the potential to trap 250 million barrels of oil with an additional potential for 500 million barrels of oil in the eastern and western parts of the sub-basin, along with positive prospects for the associated Denmark, Eyre and Recherche sub-basins (Geoscience Australia, 2007b). The Naturaliste Plateau off south-west Western Australia covers around 90,000km^2 and is considered to have potentially good prospectivity, particularly in the eastern section (the Mentelle Basin), where sediments are similar to those in the southern Perth Basin. However, no estimates of reserves are yet available.

4.3 MACRO-ECONOMIC DRIVERS AT THE INTERNATIONAL AND NATIONAL LEVEL

The key drivers of domestic oil production are world oil prices and the resulting impact these have on exploration activity, in addition to reserve availability. As outlined in Chapter 2, oil prices are predicted to decline to around $50 per barrel in the medium term and then gradually increase towards $55-60 by 2029-30. This will serve to restrict increases in oil exploration and recovery that have in the recent past been boosted by record prices on the international market.

With regard to reserve availability, Figure 4.2 below summarises recent forecasted trends in crude oil production at the national level (Geoscience Australia, 2006).

Figure 4.2 Trends in national crude oil production, 2005-2025



(Source: Geoscience Australia, 2006)

This prediction utilises three scenarios, hence an estimate at the 50% probability level (P50) indicates that there is a 50% probability of production being at least as high as the value shown. The medium P50 scenario envisages an average decline in production of 4.3% per annum following the 2007 peak in production. This is based upon an estimated total of identified, inferred and undiscovered reserves in the Bonaparte, Browse, Carnavon and Gippsland basins amounting to 587 gigalitres (3.7 billion barrels) of oil. By contrast, the ABARE, utilising world oil assessments carried out by the United States Geological Survey, estimates Australian reserves to be in the order of 782 gigalitres (4.9 billion barrels) of oil (Cuevas-Cubria & Riwoe, 2006). This variation reflects differing underlying assumptions regarding technical and economic limits to oil recovery, with the USGS-based method being described as overly optimistic (Powell, 2001). Furthermore, both predictions exclude potential reserves which may exist in unexplored offshore frontier areas such as the Bight Basin.

The forecast decline in production reflects the history of oil production and the characteristics of the major oil producing fields in Australia. Most oil production has taken place in large mature fields such as the Barrow Island and Gippsland fields,

which have received sufficient investment in infrastructure to allow sustained production from the main reserves and associated smaller fields over a long period of time. More recent additions to oil capacity are in remote and relatively small oil fields such as those in the North West Shelf and Timor Sea, whose location and lifespan hinders significant investment in physical facilities such as those which have helped to sustain production in the Gippsland and Barrow fields, giving rise to the forecast decline in overall production from around 2008-09 onwards.

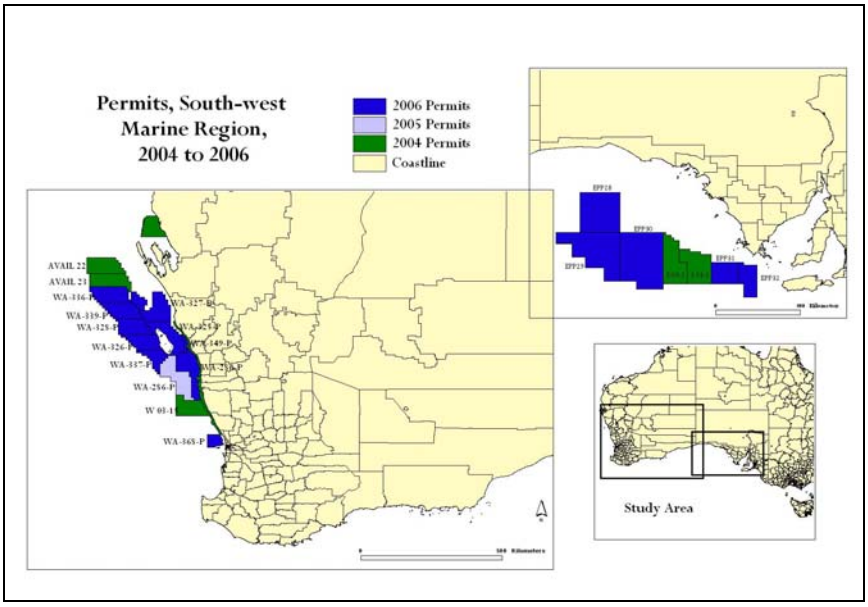
4.4 FUTURE TRENDS WITHIN THE SOUTH-WEST MARINE REGION

As the pressure indicators relating to oil and gas activity in the SWMR are highly inter-dependent, this section will firstly identify recent trends in these indicators in the SWMR. Subsequently, factors contributing to the future evolution of all indicators within the SWMR will be identified and discussed.

4.4.1 Acreage release

Figure 4.3 shows the location of the permits awarded for exploration in the SWMR from 2004-06. This demonstrates the recent attention being given towards oil prospecting in the Perth and Bremer sub-basins located offshore from sub-regions 1 and 2 in Figure 1.2.

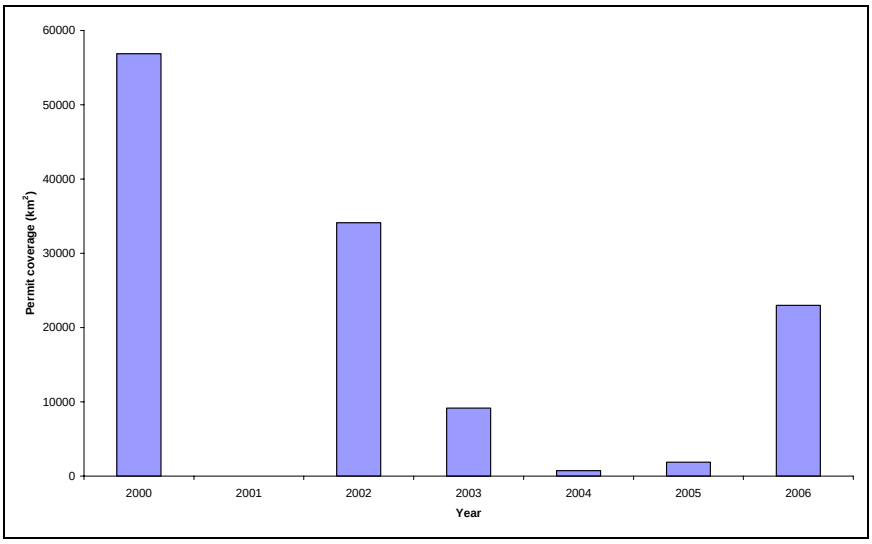
Figure 4.3 Location of permits awarded for oil and gas exploration in and adjacent to the SWMR, 2004-06



(Source: OGRA Annual Reports 2004-06)

Since the year 2000, the area covered by permits awarded for offshore exploration in the SWMR under the annual acreage release and re-release programme has declined overall (Figure 4.4).

Figure 4.4 Area covered by offshore exploration permits annually in and adjacent to the SWMR, 2000-06



(Sources: DOIR, 2007; Geoscience Australia, 2006).

4.4.2 Drilling activity

Table 4.3 below summarises offshore exploration and development drilling activity at the national level and within the SWMR from 2003-05. This shows a fairly constant rate of exploration drilling activity within the SWMR but one which represents a very small proportion of the national drilling programme. Equally importantly, no development wells have been drilled since 2003 in the SWMR.

Table 4.3 Offshore drilling activity in and adjacent to the SWMR 2003-05

	Exploration drilling		*Development drilling*	
Year	*SWMR*	*National*	*SWMR*	*National*
2003	2	34	0	12
2004	1	50	0	42
2005	4	64	0	22
2006	No data available			
2007	3	No data available	No data available	No data available

(Sources: Geoscience Australia 2007a; ROC Oil 2007)

4.4.3 Annual production of oil and gas by basin

The Cliff Head field represents the only active field producing oil or gas within the SWMR. The recoverable reserves were quoted at 15.4 million barrels in June 2006 (ROC Oil Company Limited, 2006) leading to an estimated lifespan of 4-5 years assuming sustained current production rates.

4.4.4 Estimated reserves and prospectivity

Estimates of oil reserves within the SWMR are detailed above and have not been subject to revision in light of new well data or other information.

4.4.5 Discussion

The significance of oil and gas exploration and recovery within the SWMR can be summarised as relatively minor in the national context and one which is subject to unique pressures affecting its future development. The minor status of oil and gas exploration in the SWMR reflects the focus of exploration in areas where technical prospectivity is perceived to be much greater such as the Gippsland, Carnavon and Bonaparte Basins. Furthermore, the Timor Sea Treaty between Australia and Timor-Leste which came into force in April 2003 provided a framework for petroleum exploration in the Timor Sea, which has led to considerable investment in the Bayu-

Undan and Greater Sunrise Fields. By comparison, prospects within the SWMR are characterised by a high level of technical uncertainty and severe gaps in data availability. These factors partly reflect the sheer size of the offshore basins and the lack of comprehensive seismic information, particularly in the case of the Bight Basin. In addition, the offshore structural setting and nature of small, isolated oil fields requires that enhanced technology such as combined seismic and electro-magnetic surveys using submarine towed arrays be used (CSIRO, 2006), thereby increasing the cost of exploration in offshore frontier basins such as the Naturaliste Plateau and Bight Basin. In the context of predicted declines in oil prices on the world market, oil companies are increasingly unwilling to bear the financial risk of drilling in new areas, preferring instead to focus their attention elsewhere on the global scale, thereby reinforcing the perceived low prospectivity of frontier basins such as those in the SWMR. This is illustrated by the fact that over 60,000 wells have been drilled in the Gulf of Mexico in an area smaller than the Carnarvon Basin, whilst total exploratory drilling in all of Australia's offshore and onshore fields amounted to 8,640 wells at the end of 2003 (CSIRO, 2006).

The perceived poor technical and financial prospectivity of Australia's frontier basins is the focus of Australian Government action designed to induce more exploratory activity. The 'Big New Oil' programme announced in 2003 is designed to facilitate take-up of releases in frontier offshore basins through the funding of new geophysical and geological data acquisition to be supplied to companies prior to competitive bidding for offshore releases. The initial phase of this programme involved $61 million being spent between 2003 and 2007, which resulted in the completion of seismic and other surveys of the Bremer Sub-Basin in 2006. The second phase announced in 2006 for 2007-11 allocated $76.4 million for data acquisition in offshore areas covering up to two million square kilometres. Priority areas for the 2007-11 programme in the SWMR include the Eastern Bight Basin and the Vlaming, Mentelle and Bremer Sub-Basins (Geoscience Australia, 2006b).

In addition, the 2004-05 Budget introduced the Offshore Petroleum Exploration Incentive which provides an uplift from 100% to 150% on petroleum resource rent tax deductions for exploration expenditure in Designated Frontier Areas on acreage releases in the 2004-08 period. Up to 20% of annual exploration acreage releases may

be assigned Designated Frontier Area status, subject to the Designated Frontier Area being more than 100km from existing commercialised discoveries whilst each Designated Frontier Area cannot be adjacent to an area designated in the previous year's acreage release (DoIR, 2006). Of the 18 Designated Frontier Areas released since May 2004, four have been within the SWMR, with two releases in May 2004 located in the Houtman Sub-Basin west of Shark Bay (releases W04-15 and W04-16) and two releases in April 2005 lying in the Bremer Sub-Basin offshore from Albany (releases W05-23 and W05-24).

Since the inception of this scheme, permits have been awarded for seven Designated Frontier Areas nationally with investment totalling $228.9 million. The national take-up rate of Designated Frontier Area releases is therefore currently just under 40%, which is reasonably comparable with the 50% average take-up rate of offshore releases from 1996-2004 (Geoscience Australia, 2006), bearing in mind the issues described above with regard to frontier basin exploration. Two of these permits have been awarded within the SWMR (WA-379-P and WA-380-P) relating to the April 2005 Bremer Sub-Basin releases, involving private investment totalling $80.3 million. This investment is taken as indicative of the success of the Big New Oil and Designated Frontier Area initiatives (Geoscience Australia, 2006c). It is too early to comment on the schemes' combined impact upon exploration within the SWMR, but it is worthy of note that these permits represent the two largest single financial commitments by an oil company within the SWMR since 2000.

Forecasts of Australian self-sufficiency in oil consumption vary in detail but are consistent in predicting a decline in self-sufficiency as a result of reserve depletion and continued growth in consumption. Geoscience Australia predict a decline in self-sufficiency from 84% to 20% over the period 2005-2025, whilst ABARE predictions indicate a decline from 78% in 2003-04 to 49% in 2029-30 (Rural and Regional Affairs and Transport References Committee, 2006). As described above, these differences reflect assumptions regarding oil extractability rather than trends in domestic consumption, which is forecast to increase at around 2% per annum over the period 2004-05 to 2029-30. With respect to the SWMR, the possibility of future oil discoveries in frontier basins remains an unknown factor which cannot be quantified at present. However, large oil fields tend to be found at early stages of the exploration

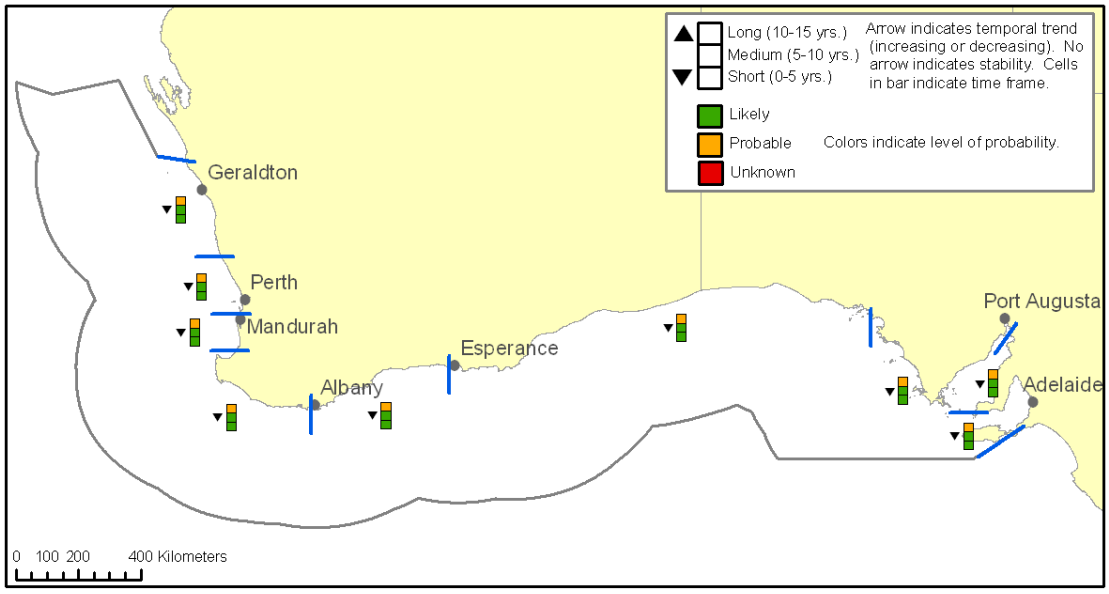
cycle, whilst initial forecasts of new discoveries tend to be under-estimates and revised upwards as the possibilities for recovery are established (Powell, 2001). The crucial step of obtaining detailed systematic geological information under the Big New Oil programme is underway which should increase the confidence of the industry in the technical and financial prospectivity of the SWMR frontier basins. It is therefore highly likely that exploration activity over the next five years will focus on areas where more comprehensive data becomes available such as the Eastern Bight Basin and the Vlaming and Mentelle sub-basins of the SWMR. The award of permits covering large sections of the Bremer Sub-Basin in 2006 following data acquisition under the Big New Oil programme would certainly support this suggestion. However, the possibility of significant discoveries in these basins, which would lead to further development and exploration over the longer term, cannot be quantified at present.

4.5 CONCLUSION

This section has highlighted the extent to which oil and gas exploration has been focused in particular areas within the South-west Marine Region. Despite a total expenditure of over $355 million on past, present and future exploration activities, only one commercially viable oil field has been found in the SWMR and indications point towards this being an isolated reserve with a limited life expectancy. The area covered by current permits for exploration has diversified to include large stretches of the lower western coast of Western Australia and the eastern Great Australian Bight, but has generated negligible results in terms of viable oil fields. It is perhaps too early to comment on the impact of Government initiatives to boost oil exploration in the Region, other than to point out that they have succeeded in raising significant amounts of corporate money in the granting of permits. Given the technical difficulties and the lack of recent successes in exploration, combined with new opportunities opening up in north-west Australia and the Arafura Sea and the projected decline in oil prices, on balance it is difficult to see positive long term prospects for the sector in the SWMR. Even if reserves in the Bight were identified, it is likely they would be relatively costly to develop and would certainly require significant investments in associated infrastructure, rendering them a relatively unattractive proposition in comparison to fields elsewhere in Australian waters.

Figure 4.5 summarises these overall trends in oil and gas exploration activity with reference to the sub-regions of the SWMR coastline identified in Chapter 2. This underlines the common projection of decreasing exploration activity in the short to medium term within the study area. There could be some adjustment to this projection in the Yanchep to Mandurah sub-region around Geraldton owing to the recent discoveries in this area but these are not considered to be highly significant. Furthermore, projections into the longer term are categorised as 'probable' owing to the uncertainty associated with future pressures driving oil exploration along with the largely unexplored frontier status of the basins within and adjacent to the south and south-west of the Region.

Figure 4.5 Overall trends in oil and gas exploration adjacent to the SWMR



5 PORTS AND SHIPPING

5.1 INTRODUCTION

International shipping represents the most significant means of transporting imports and exports from Australia, accounting for 99.9% of international trade and being valued at $248.5 billion in 2003-04 (BTRE, 2006). Shipping is dominated by exports which accounted for 90% of international trade in 2003-04 and which are predominantly transported by bulk vessels as opposed to containerised ships.

The contributory factors behind port activity adjacent to the SWMR involve the interaction of several key driving forces including the growth in the shipping sector as a whole, changes in the structure of the industry and changing patterns of imports and exports. This section will examine the development of the shipping industry using indicators of these driving forces as outlined below.

Table 5.1 Driving forces and pressure indicators for port and shipping activity

Driving forces	*Pressure Indicators*
Growth and change in shipping sector	Total tonnage throughput
Changes in structure of industry	Total port calls
Patterns of imports and exports	Bulk and containerised cargo trends
	International trading links

5.2 CURRENT STATUS OF PRESSURE INDICATORS

The following section summarises the present status of these pressure indicators relating to port activity in areas adjacent to the SWMR. This is followed by a discussion of the economic factors considered to be influential with respect to port activity and an evaluation of their likely development in various scenarios.

5.2.1 Total tonnage

Total tonnage throughput refers to the volume of all cargo passing through the ports adjoining the SWMR. In the year 2004-05, 75.9 million tons of cargo was moved through the region's ports, constituting 12% of the national trade. This represents an

annual increase in the regional volume of trade of 6% from 2000-01 to 2004-05 (AAPMA, 2006). The ports of Fremantle (34%), Bunbury (16%), Adelaide (13%), Esperance (10%) and Geraldton (7%) accounted for over 85% of total tonnage throughput in the region's ports in 2004-05, a ranking which has remained static since the financial year 2000-01. These ports are located in sub-regions 2, 4, 9, 6 and 1 respectively as illustrated in Figure 1.2.

Exports accounted for around 75% of total tonnage throughput in the SWMR ports over the period 2000-01 to 2004-05 (AAPMA, 2006). In 2004-05, exports accounted for 90-95% of total tonnage throughput in the ports of Albany, Bunbury, Esperance and Geraldton, representing a gradual increase from 85-90% in 2000-01. Whilst the proportion of exports from Fremantle has remained fairly constant over this period, accounting for 55% of throughput in 2004-05, exports from Adelaide have declined from 57% of throughput in 2000-01 to 47% in 2004-05.

5.2.2 Total port calls

The number of ship visits to ports adjacent to the SWMR increased by 5.2% to 3722 over the period 2000-01 to 2003-04 (BTRE, 2006). Over this period, the majority of ship visits were to Fremantle (45%), Port Adelaide (20%), Bunbury (8.5%) and Geraldton (5%). However, diverging trends in the number of ship visits to individual ports are apparent over this time period, with visits to Fremantle and Bunbury declining slightly by 2% and 4% respectively, whilst port calls to Adelaide and Geraldton increased by 17% and 37% respectively.

5.2.3 Cargo types

Bulk cargo, representing all types of homogeneous unpacked cargo, constitutes the majority of trade passing through the region's ports, accounting for an average of 91% of trade by tonnage over the period 2000-01 to 2004-05 (AAPMA, 2006). Bulk cargo has increased by an average of 6% per annum over this period, whilst the quantity of containerised trade has increased at a higher rate of 7.4% per annum. Containerised trade is dominated by the ports of Fremantle and Adelaide which accounted for 70% and 29% of the trade in 2005-06 respectively with the remainder taking place at Bunbury and Geraldton.

5.2.4 International trading links

Trade in the SWMR ports is dominated by exports such as iron ore, grain, alumina and petroleum products. Trading partners and commodities for the top 5 ports in the region are listed in Table 5.2. These demonstrate the significance of trade with rapidly developing economies represented by China and the Middle East as well as mature economies such as Japan.

Table 5.2 Trading commodities and trading partners for principal ports adjacent to the SWMR, 2005-06

Port	*Principal trading commodities*	*Principal trading partners*
Adelaide	Grain, limestone, petroleum products, soda ash, motor vehicles, cement	Middle East, North Asia, SE Asia, USA
Bunbury	Alumina export (68%), woodchips export (10%), caustic soda import (9%), mineral sands export (7%), silica sands export (3%)	South Africa (13%), Japan (12%), United Arab Emirates (11%), Canada (11%), Bahrain (10%), Mozambique (9%), China (6%), USA (5%)
Esperance	Iron ore export (70%), grain export (23%), petroleum products import (3%), nickel export (3%)	China (55%), Japan (20%), Saudi (5%), Australia (3%)
Fremantle	Petroleum products export (23%), other imports (22%), grain export (21%), other exports (14%), alumina export (11%), refined petroleum export (10%)	East Asia (27%), Australia (21%), South East Asia (20%), Middle East (14%)
Geraldton	Grain exports (38%), iron ore exports (34%), mineral sands export (12%), petroleum products import (4%), other exports (3%), fertiliser import (3%)	China (35%), Indonesia (11%), South Korea (6%), Iraq (5%), USA (4%), Australia (4%), Japan (4%)

(Sources: Flinders Ports, 2006; DPI, 2006).
NB Data from Port Adelaide covers calendar year 2006; data from other ports refers to financial year 2005-06

5.3 MACRO-ECONOMIC DRIVERS AT THE INTERNATIONAL AND NATIONAL LEVEL

The increase in various indicators of port activity in areas adjoining the SWMR as described above has taken place in an economic context which may have been expected to have an adverse effect on this sector. The appreciation of the Australian dollar from US$0.61 in 1999-2000 to its current value in excess of US$0.80 would be expected to reduce the competitiveness of Australian produce on the international market, whilst increases in world oil prices would serve to increase product prices and thereby reduce demand.

However, other factors have cushioned the impact of these developments. One key element is the strength of demand for Australia's main export products such as mineral resources, which has led to sustained demand and high prices for Australia's mineral exports on the world market (Minerals Council of Australia, 2006a). Forecasted increases in the price of exports for 2006-07 relative to the previous year range from 0.5% (thermal coal), 19% (iron ore), 49% (nickel) to 60% (zinc) (Minerals Council of Australia 2006b).

Furthermore, the demand for Australian exports of coal, iron ore, petroleum products, natural gas and minerals in the East Asian markets contributed towards increased trade with China, Taiwan and Japan in the order of 41%, 32% and 24% respectively in 2005 (Department of Foreign Affairs and Trade, 2006), which is reflected in the growth enjoyed by the region's ports as outlined above. This has been underpinned by continued rapid economic expansion in China, which recorded a growth in GDP of 10.6% in 2006 (Minerals Council of Australia, 2006a). The demand for minerals and other natural resources in China and Japan is expected to continue in the medium to long term, given China's continued growth and the renewed strength and stability of the Japanese yen (Minerals Council of Australia, 2005a).

In addition, the prospects for exports of raw materials and natural resources from the Region's ports are likely to be further enhanced by the gradual establishment of the ASEAN Economic Community over the period 2010-2020. This trading bloc comprises the nations of Brunei Darussalam, Burma, Cambodia, Malaysia, Indonesia, the Lao People's Democratic Republic (or 'Laos'), the Philippines, Singapore, Thailand and Vietnam and as a group represents Australia's single biggest trading partner, accounting for 15% of Australian foreign trade as compared to Japan (14%) or the US and China (11% each). Goods exports to ASEAN countries are dominated in terms of value by resource-based products such as crude petroleum, gold and aluminium, although exports of wheat constituted the most significant increase in 2005 (Department of Foreign Affairs and Trade, 2006b).

5.4 FUTURE TRENDS WITHIN THE SOUTH-WEST MARINE REGION

5.4.1 Total tonnage

In light of these circumstances, continued steady and sustained growth in the volume of trade through the Region's ports is a probable scenario for the foreseeable future. Whilst predictions for all of the ports adjoining the SWMR are not available, forecasts of trade through Fremantle suggest a steady growth in bulk cargo of 2.5% per annum from 1997 to approximately 120 million tonnes in 2027 (Fremantle Port Authority, 2000). These will, however, be constrained by physical, environmental and socio-economic factors as discussed below.

A particularly important factor affecting the future trends in total tonnage throughput will be the physical infrastructure of the ports concerned. Larger ships will be increasingly more economical modes of shipping as the relative cost of transporting goods declines, thus investment in port capacity to accommodate increasingly larger bulk and container vessels is paramount (Flinders Ports, personal communication). Table 5.3 summarises current and future investment activities designed to address these issues and maintain the competitiveness of the Region's ports.

These data underline the significance of ports' investment in facilities designed to accommodate increasingly large bulk cargo as well as container vessels. The requirements of Panamax and Capesize vessels in terms of approach channel and harbour depth, the ability to move cargo or containers through the port efficiently and stacking or storage requirements will all dictate that ports must plan ahead in order to retain their position on international trading routes (Port Operations Task Force, personal communication). Some locations such as Port Adelaide are also receiving investment in recreational or residential development alongside the port as an additional means of generating income and supporting the port infrastructure. However, there are significant constraints associated with port expansion. On the marine side, the impacts of dredging are the focus of conflict with fishing groups and environmental organisations, whilst on the terrestrial side concern is often raised as to the impact of increased port traffic on urban infrastructure.

Table 5.3 Current and future infrastructure investment in ports adjoining the SWMR

Port	*Investment programme and future plans*
Adelaide	Completion in 2006 of $45M dredging project outer harbour channel from 12.2m to 14.2m to facilitate Panamax grain and container vessels Outer Harbour grain wharf to accommodate Capesize vessels, dredging and grain terminal total cost $130M completed.
Albany	$3.5M project over 7 years commenced 2005 to restore and upgrade berths, extending berth operating lifespan to 2035 Planned deepening of port to 18m to facilitate iron ore exports in Capesize vessels
Bunbury	Planned deepening inner harbour and approach channel from 12.2m to 15m or 18m to accommodate partially loaded Capesize vessels or fully loaded Panamax vessels Planned development dedicated coal bunker servicing Panamax vessels Longer term plans relocation Outer Harbour, extension of Inner Harbour to facilitate road and rail links, establishing container trade routes to port
Esperance	2002 upgrade allows berthing and loading of Panamax and Capesize vessels 2007 investment in container crane, storage and handling facilities for sulphur imports
Fremantle	Inner harbour: $126M plan to deepen harbour to accommodate vessels of 13.5m draught by 2008 and a further $38M planned deepening to 14m by 2014-15. Investment in rail links to facilitate expansion of Inner Harbour container trade Outer harbour: $30.3M upgrade of bulk terminal, planned improvement to berth and deepening to accommodate Panamax vessels. Planned construction of new Outer Harbour container port at Kwinana, first of three stages costing $1.3billion aim completion 2015
Geraldton	Construction of berthing facility catering for Panamax iron ore vessels completed 2007 and plans for additional berth 2007-08 Deepening of harbour and approach channel 2005 to accommodate Handymax grain export vessels Planned new deepwater port facility to be operated by Geraldton Port Authority as an outer harbour at Oakajee, 30km north of Geraldton, catering for iron ore exports. In principle approval obtained 2006, expected completion four years from initial construction date.

(Sources: Flinders Ports, 2007; Government of Western Australia, 2006, 2005)
Notes: Handymax vessels: dry bulk carrier of 40,000-60,000 dwt (dry weight tons). Dry bulk Panamax cargo vessels: 60000-80000 dwt. Panamax tankers: 50000-80000 dwt. Panamax container vessels: 3000-5000 TEU. Capesize vessels: dry bulk cargo vessels over 80000 dwt.

The investment programme detailed in Table 5.3 also reflects changes in the nature of produce being shipped through the Region's ports. Ports such as Geraldton have catered primarily for exports of iron ore and other minerals and this trend is expected to increasingly affect other ports in the Region as the minerals sector output increases, including ports in both Western and South Australia (Flinders Ports, personal communication). Locations such as Port Lincoln and Port Pirie in sub-regions 7 and 8 respectively are considered to be prime candidates for increasing trade in association with the minerals sector, whilst more remote ports such as Ceduna in sub-region 6 could experience growth but this will be limited by transport and particularly labour availability.

There is also a certain degree of industrial inertia in relation to port sites that constrains new port development on greenfield or brownfield sites, leading to a focus on upgrading and expansion of existing port facilities. However, there are plans for entirely new port facilities such as those proposed for Oakajee near Geraldton (sub-region 1) and the new Fremantle Port Outer Harbour container facilities at Kwinana (sub-region 2). Exports of grains from Geraldton have increased by 34% to 1.3 million tonnes between 2002-03 and 2006-07, with the major markets being India and South Korea. The projected increase in iron ore exports will lead to capacity being attained in Geraldton by 2009, necessitating planning for a new port at Oakajee to handle iron ore and other mineral exports in Capesize vessels (Geraldton Port Authority, 2007). The proposed new port at Kwinana to cope with the overflow of container traffic from Fremantle gained Cabinet approval in July 2007, with two options being put forward for statutory planning and environmental consideration, which would entail a final capacity of 1.4 million containers at a cost of around $1.3 billion. Related road and rail links will be included in this project in order to alleviate pressure on existing infrastructure and it is anticipated that a final decision would be reached in 2009 and construction commenced in order to meet the projected overflow demand from Fremantle by 2015.

5.4.2 Total port calls

The steady increase in ship visits to ports in the SWMR region masks differing trends for individual ports. This can be partially ascribed to the increasing size of individual ships involved in international trade. This is particularly marked in the containerised trade, with the average size of vessel visiting Fremantle and Adelaide increasing by 12% and 8% respectively between 2000-01 and 2004-05. A similar situation is noted with respect to bulk cargo vessels, although the rate of increase is not as marked (0.8% for Fremantle and 5.2% for Adelaide over the same time period). However, the ability to maintain or increase port calls will again be limited to a large extent by physical constraints associated with the port.

Given this situation and the related factors described elsewhere in this section, it is evident that the established ports of the region will continue to dominate in terms of port calls. However, it may be expected that the investment in new facilities in the hitherto ‘smaller’ ports of Bunbury, Geraldton, Esperance and Albany together with

new sources of raw materials in proximity to these locations will serve to increase the numbers of port calls in the short to medium future. The larger ports of Fremantle and Adelaide, whilst receiving considerable investment, are more likely to encounter opposition or constraints on development owing to the limitations imposed by housing and transport infrastructure in their immediate environs. Should the proposed new ports mentioned previously be approved, it is likely that this will confer a comparative advantage for these locations owing to their ability to develop facilities and transport networks catering for the needs of the modern shipping sector. However, as both proposals are in early stages of development, it is too early to comment on their likely impact until more is known of their likely scale and nature.

5.4.3 Cargo types

The majority of bulk cargo trade is in the form of exports of raw materials such as iron ore, coal, wool and other raw materials to key trading partners such as Japan, China and South East Asia. This constituted around 75% of total cargo trade in 2003-04, the remainder being split fairly evenly between international imports and domestic cargo loaded and discharged. Statistical analysis of data collected over the past twenty years demonstrates that a growth in domestic per capita real income is associated with an increased volume of bulk cargo imports and exports (BTRE, 2006). Given the positive outlook for the Australian economy in a period of reduced but stable GDP and increasingly affluent population, there is no reason to expect that this situation will alter dramatically. Furthermore, given the ongoing increase in production of these raw materials, particularly in the areas of South Australia and Western Australia adjacent to the SWMR, it is evident that the total volume of bulk cargo trade, particularly with respect to the overseas markets, is likely to increase.

Containerised trade is concentrated at the ports of Fremantle and Adelaide, with minor activity at Bunbury and Geraldton. The container trade is split fairly evenly between imports and exports at both Fremantle and Adelaide. Statistical analysis demonstrates that an increase in containerised imports is correlated with an increase in domestic demand as expressed by GNE per capita (defined as the sum total of consumption, investment and government expenditure), whilst growth in containerised exports is positively associated with an increase in per capita real income in destination markets (BTRE, 2006). These factors underlie the recent expansion in the containerised trade

sector and, whilst this currently represents 9% of the total sea freight trade by volume, there are strong indications that the proportion of containerised trade will continue to increase in the short to medium term. The container trade sector is forecast to increase by 5.4% per annum and 5.3% per annum at Fremantle and Port Adelaide respectively from 2004-05 to 2024-25 (BTRE, 2002). This is also reflected in predictions for Fremantle port published in 2000 which indicate that expansion of containerised trade is following the optimal economic scenario which projects an increase from current levels of around 450,000 TEU to 1.6 million TEU by 2027 (Fremantle Port Authority, 2000).

Several aspects of containerisation have resulted in an increased demand for containerised trade where previously this was not cost-effective. These include the ability to control product quality and condition, deliver small volumes directly to point of consumption and low rates charged in terms of pilotage, towing and mooring for containers. In addition, the expansion of the global container fleet and resulting spare capacity results in more low value products being containerised. These trends are particularly significant to the ports adjacent to the SWMR as low value products formerly transported in bulk such as grain and coal are increasingly shipped in containers. This is evidenced in the development of the container industry in new locations such as Bunbury and Geraldton in 2005-06.

There are some factors which may act to the detriment of this positive growth, one of which is the need for efficient road or rail linkages to facilitate onward movement of containers and minimise costs incurred by storage. This has been a problem particularly in South Australia, where the rail network has been developed to service the grain trade; hence additional investment would be needed to facilitate increased minerals exports (Flinders Ports, personal communication). There are social and environmental constraints of increasing road traffic in these two major container ports, leading to the implementation of more efficient rail linkages at both locations. Furthermore, containerised exports generally consist of denser and lower value products than those which are imported, hence smaller twenty foot containers tend to be used in preference to forty foot containers to avoid exceeding crane handling capacity in ports. Conversely, lighter and more valuable imported products tend to be handled in twenty foot containers. There is an overall shift favouring the use of forty

foot containers at the global scale and this could serve to reduce the cost-effectiveness of exporting produce in containers which have a reduced payload, whilst the increased movement of large forty foot containers could generate problems with road haulage restrictions within states (BTRE, 2002). It is therefore likely that the trade in containerised produce will diversify in terms of goods and locations and constitute an increasingly significant source of revenue to the major ports of Fremantle and Adelaide, whilst also being a likely focus of conflict with local residents as the frequency of container movements by road in and out of ports increases. This latter point is recognised in the aim to transport 30% of Fremantle container trade by rail by 2012 (DPI, 2002), as well as increasing efficiency through minimising empty container transport and maximising the loading of trucks entering and leaving the port (DPI, 2005).

5.4.4 International trading links

This discussion has highlighted the pre-eminence of the Asian markets in terms of trading partners for exports and imports through the ports of the SWMR. The generally high forecasted population growth of the ASEAN countries, coupled with progressive industrialisation of the more undeveloped economies within this region and reduction or removal of tariffs following a Free Trade Agreement, is likely to fuel increasing demand for exports of raw materials such as iron ore and minerals from Australia, all of which has significant implications for diversifying and expanding exports and imports to Asian markets through the ports of the SWMR in the short to medium term. Whilst there are some grounds for concern in terms of political stability with certain trading partners, there is little evidence thus far that the mutual dependence and benefits of this trading pattern will alter in the foreseeable future.

However, there are constraints to this forecast which reflect the increasingly acute skills shortage affecting the minerals industry, along with the perceived need to invest heavily in the identification of untapped mineral resources (Minerals Council of Australia, 2005b). It is difficult to evaluate the impact of these factors as there is a lag time before the outcomes of investment in both employment and mineral exploration can be determined. The fact that both are recognised as significant at this stage, however, might be expected to mitigate the potential adverse consequences.

5.5 CONCLUSION

This section has outlined the nature and extent of driving forces influencing port activity adjacent to the South-west Marine Region. The overall trend is one of increasing port activity, with greater tonnage throughput and port calls over the past five years underlining the positive outlook for continued growth. Given the predominance of export trade through the Region's ports, the continued demand for materials such as coal, iron ore and minerals in the East Asian markets has underpinned this expansion in activity. In the near term, there is little to suggest that these markets will diminish, whilst in the medium to long term the prospects for diversifying export markets would be significantly enhanced through the establishment of an ASEAN Economic Community, should that prospect become reality.

This potential new trading bloc could also serve to accentuate the existing trend in faster rates of growth being observed in the 'smaller' ports such as Geraldton and Bunbury. The increase in wheat exports observed with regard to the ASEAN countries would further benefit these ports given their relative proximity to wheat-producing areas in the medium to long term. It is evident that all ports adjacent to the Region are planning or carrying out considerable investment in order to accommodate increasingly large bulk vessels and the anticipated expansion in products moved in container vessels over the next five to ten years. New port development at Oakajee and Kwinana will also enable continued growth in port activity beyond the current capacity limits of Geraldton and Fremantle respectively.

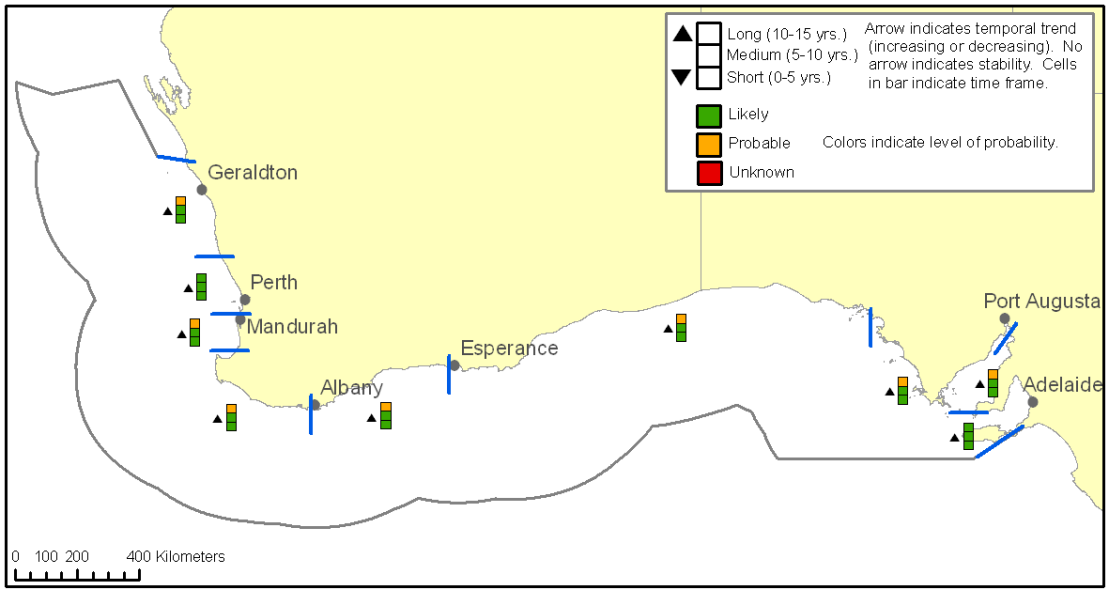
However, this analysis has also underlined the fact that there are likely to be constraints on further expansion of port activity, particularly in relation to Fremantle where concerns over the capacity and impact of land-based transport infrastructure could delimit the planned expansion of the port. This could again act to the benefit of the other ports adjacent to the Region which have greater potential to develop road and rail links to the port.

In summary, therefore, all the ports analysed in this section have experienced sustained growth in recent years, facilitating investment in further infrastructure to

maintain their position. However, it is likely that in the medium to long term there will be a greater balancing of trade across the Region's ports, with Geraldton and Bunbury being particularly well placed to take advantage of potentially new export markets. The relative primacy of Fremantle is predicted to decline as a result of physical constraints, although it will continue to attract the majority of the Region's port trade. There is little evidence to suggest that the macro-economic or political situation will alter to the detriment of either demand or supply of raw materials passing through the Region's ports over the long term.

Figure 5.1 summarises these projections with reference to the sub-regions of the SWMR coastline identified in Chapter 2. It is considered that an overall increase in port and shipping activity is likely in all sub-regions, although the confidence of this projection is tempered in the longer term owing to the limitations associated with land-based infrastructure and other constraints outlined in this chapter.

Figure 5.1 Overall trends in ports and shipping adjacent to the SWMR



6 COMMERCIAL FISHING

6.1 INTRODUCTION

Australia is predominantly an exporter of high value fish products such as crustaceans and molluscs and an importer of high volume lower value fish and crustacean products. The total value of Australia's commercial wild catch and aquaculture fisheries amounted to $1.9 billion in 2005-06, representing a decline of 18% in real terms from the total of $2 billion in 2000-01 (ABARE, 2007a; 2004). In 2005-06, exports of edible fish, crustaceans and molluscs amounted to $1.2 billion, which reflects a decline of 37% in real terms from the total of $1.7 billion in 2000-01.

6.1.1 Commonwealth managed fisheries

Commercial fisheries operating in Commonwealth waters in and adjacent to the waters of the South-west Marine Region include five fisheries under Commonwealth management, as detailed in Table 6.1. The Southern Bluefin Tuna fishery operates in Commonwealth waters but virtually all the catch is reared in pens as a form of aquaculture, hence this fishery is discussed in more detail in Chapter 9 of this Report. The Demersal Gillnet and Longline fishery comprises the Joint Authority Southern Demersal Gillnet and Longline fishery which is managed jointly by the Commonwealth and the Western Australian State Government, and the West Coast Demersal Gillnet and Demersal Longline fishery which is under State management. These two fisheries are grouped together for reporting purposes as detailed in Table 6.1.

Table 6.1 Characteristics of Commonwealth and joint managed commercial fisheries in and adjacent to the South-west Marine Region, 2005-06

Fishery	*Main area of fishery*	*Main species targeted*	*Main fishing methods*	*Participation*	*Catch (tonnes)*	*Value of catch ($ million)*	*Stock status*
Great Australian Bight Trawl	Cape Leeuwin to Cape Jervis (excluding Great Australian Bight Marine Park) in shelf waters 120-160m depth and deepwater slope over 800m depth	Shelf waters: deepwater flathead, Bight redfish. Deepwater slope: orange roughy, oreo dories	Demersal otter trawl, limited midwater trawl	10 vessels	5,406	15.5	All species uncertain
Southern Bluefin Tuna	On and near shelf break south-west of Ceduna	Southern bluefin tuna	Purse seining	112 vessels	5,220	37.5	Overfished and subject to overfishing. Spawning stock at low fraction of original biomass and current catches severely limit likelihood of rebuilding. Listed as critically endangered species by World Conservation Union
Southern and Eastern Scalefish and Shark: Gillnet and Hook Sector	Gillnet: in shelf waters from Kangaroo Island to WA border Hook: in and around shelf waters from Kangaroo Island to WA border	Mixed fish species, predominantly gummy shark, blue eye trevalla, pink ling	Demersal gillnet, dropline	116 vessels	4,502	21.5	Gummy shark not overfished and probably not subject to overfishing, school shark overfished and overfishing status uncertain, sawshark and elephant fish uncertain
Western Tuna and Billfish	From 200m depth to outer limit of EEZ in waters stretching from Albany to Shark Bay. Most activity off SW peninsula of WA and from opposite Perth northwards to Shark Bay	Broadbill swordfish and other billfish Yellowfin, bigeye, skipjack and albacore tuna.	Pelagic longlining	125 permits	926	3.2	Broadbill swordfish, bigeye and yellowfin tuna not overfished. Overfishing status of bigeye tuna uncertain. Overfishing of broadbill swordfish and yellowfin tuna in broader Indian Ocean
Western Deepwater Trawl	On and around 200m depth off west coast of WA from 115°08´E to 114°E	Over 50 species	Otter trawl	11 permits	67.5 (2004-05)	0.8 (2004-05)	All species uncertain
Demersal Gillnet and Longline (Joint Managed Fishery)	Along WA coastline from 114°06´E to SA border	Dusky whaler, whiskery, gummy sharks	Demersal gillnet	83 licenses (2003-04)	1,728 (2003-04)	7 (2003-04)	Dusky whaler, whiskery and school sharks overfished, gummy sharks not overfished

(Sources: ABARE, 2007a; AFMA, 2007; Department of Fisheries, 2006; Larcombe & McLoughlin, 2007)

6.1.2 State managed fisheries

Within the State managed commercial fisheries of Australia, rock lobster was the single most valuable Australian export species in 2005-06, with exports totalling $489 million, equivalent to 39.5% of total edible fish exports. Abalone was the second most valuable export, with trade totalling $246 million or 20% of the total edible fish export sector. The principal destination for both products was Hong Kong, which accounted for 47% and 46% of the value of rock lobster and abalone exports respectively in 2005-06. The United States and Japan were also significant destinations for rock lobster, representing 19% and 14% of rock lobster exports by value in 2005-06. Japan and Singapore were important markets for abalone exports, accounting for 22% and 8% of total abalone exports by value in 2005-06 (ABARE, 2007a).

Tables 6.2 and 6.3 provide details of the State managed commercial fisheries of South Australia and Western Australia respectively which operate adjacent to the waters of the South-west Marine Region. These data are derived from annual reports produced by the respective government departments in each state, the most recently available reports providing data collected during 2004-05. The ABARE also publishes summary data relating to State managed fisheries in the annual Australian Fisheries Statistics reports, the most recent of which provides data collected in 2006. Both of these sources are used where appropriate in the following text in order that the most up to date information is presented.

Table 6.2 Characteristics of South Australian managed commercial fisheries within and adjacent to the South-west Marine Region, 2004-05

Fishery	*Main area of fishery*	*Main species targeted*	*Main fishing methods*	*Participation*	*Catch (tonnes)*	*Value of catch ($ million)*	*Stock status*
Abalone (Central and Western Management Zones)	Along coastline from Kangaroo Island to WA border	Blacklip and greenlip abalone	Manual collection	6 licenses Central Zone, 23 licenses Western Zone	180 Central Zone; 540 Western Zone	7.4 Central Zone; 20.5 Western Zone	Not overfished
Rock Lobster (Northern Management Zone)	Along coastline from Kangaroo Island to Ceduna	Southern rock lobster	Pots	68 licenses	446	11.6	Overfished
Prawn	Spencer Gulf, Gulf of St Vincent and West Coast	Western king prawns	Trawl	52 licensed vessels	2,173	35.8	Fully fished
Sardine	Shelf waters in Spencer Gulf and Gulf of St Vincent, extending into Commonwealth waters off Spencer Gulf and western Eyre Peninsula	Sardines (pilchards)	Purse seining	14 licensed vessels	56,952	28.4	Fully fished
Marine Scalefish	Across shelf waters from Kangaroo Island to WA border	King George whiting, snapper, tommy ruff, pilchards, Australian salmon, garfish, crustaceans, molluscs	Netting	377 licenses	3,673	17.2	King George whiting fully fished, snapper over fished, garfish over fished, southern calamari fully fished

(Source: Knight *et al*., 2006)

Table 6.3 Characteristics of Western Australian managed commercial fisheries within and adjacent to the South-west Marine Region, 2004-05

Fishery	*Main area of fishery*	*Main species targeted*	*Main fishing methods*	*Participation*	*Catch (tonnes)*	*Value of catch ($ million)*	*Stock status*
Roe's abalone	All WA waters from Shark Bay to SA border	Roe's abalone	Diving	26 licensed vessels	96.5	3.1	Not overfished
Greenlip and brownlip abalone	All WA waters from Busselton to SA border	Greenlip and brownlip abalone	Diving	14 licensed vessels	208	9.7	Not overfished
West Coast Rock Lobster	Along WA coast, concentrated from Perth to Shark Bay	Western Rock Lobster	Pots	536 boats, 56,838 pots	12,138	259	Fully exploited
Abrolhos Islands and Mid West Trawl	Waters landward of 200m isobath between 27°51´S and 29°03´S	Southern saucer scallops, western king prawn	Demersal otter trawl	Not available	6,470	22	Fully exploited
South-west Trawl	Waters landward of 200m isobath between 31°43´27´´S and 115°08´E, main effort off Perth	Saucer scallops, western king prawn	Demersal otter trawl	14 licensed vessels	14 (prawns), 1 (scallops)	0.18	Not assessed
West Coast Deep Sea Crab	Outside 150m isobath between Cape Leeuwin and NT border, most activity Geraldton-Bunbury and Albany-Esperance	Giant (king) crabs, crystal (snow) crabs, champagne (spiny) crabs	Pots	5 full time, 2 part time	207	2.7	Not assessed
West Coast Demersal Scalefish	All WA waters south of 27°S and west of 115°30´E	West Australian dhufish, pink snapper, baldchin groper	Demersal handline, drop line	239 licensed vessels	1,220	7.8	Not assessed
South Coast Crustacean	Windy Harbour to SA border	Southern rock lobster, western rock lobster, giant crabs, crystal crabs, champagne crabs	Pots	45 licensed vessels	39	1.4	Fully exploited
South Coast Trawl	Off south coast of WA	Scallops	Otter trawl	4 licensed vessels	30	0.1	Fully exploited

(Source: Department of Fisheries, 2006)

In order to examine the characteristics and development of these commercial fisheries within and adjacent to the SWMR, the key drivers of change and associated indicators are detailed in Table 6.4.

Table 6.4 Driving forces and pressure indicators for commercial fisheries in the SWMR

Driving forces	*Pressure indicators*
Demand for produce	Catch data: tonnage (kg) for individual fisheries
	Effort for individual fisheries
Expansion of sector	Number of licences
	Location of activity
	Employment
Profitability of sector	GVP of catch

6.2 CURRENT STATUS OF PRESSURE INDICATORS

The following section outlines the development of the key Commonwealth and State managed commercial fisheries in waters within and adjacent to the SWMR, providing the basis for discussion of the future development of the commercial fishing sector.

6.2.1 Tonnage

Commonwealth managed fisheries

The most productive fishery in tonnage terms in the Commonwealth managed sector is the Great Australian Bight trawl fishery, which operates in waters adjacent to sub-regions 4 to 9 illustrated in Figure 1.2. In 2006, the catch declined by 9% to 5,406 tonnes, although the longer term trend displays a significant increase from 2002 when the total catch recorded was 2,533 tonnes (ABARE, 2007a; 2004). The Southern Bluefin Tuna fishery catch totalled 5,220 tonnes in 2005-06, details of which are discussed further in Chapter 9. The Gillnet and Hook sector of the Southern and Eastern Scalefish and Shark fishery which also encompasses waters between sub-regions 4 to 9 caught a total of 4,502 tonnes in 2005-06, annual totals ranging between 4,500 and 5,000 tonnes since 2002-03 (ABARE, 2007a; 2004). The total catch in the Demersal Gillnet and Longline fishery totalled 1,728 tonnes in 2003-04, around 84% of which involved shark catch (Department of Fisheries, 2006). The total shark catch in this fishery has not varied significantly since 1999-2000 when the total shark catch

amounted to 1,257 tonnes (Department of Fisheries, 2001). The Western Tuna and Billfish fishery operates in waters adjacent to the entire coastline of the SWMR. The total catch in this fishery amounted to 926 tonnes in 2005-06, which has declined significantly since 2002 when the catch totalled 3,105 tonnes (ABARE, 2007a). Catches in the Western Deepwater Trawl fishery which operates in waters adjacent to sub-regions 1 to 4 are more variable owing to the limited number of participants, the most recently available data indicates that the catch amounted to 67.5 tonnes in 2004-05 (ABARE, 2007a).

State Managed Fisheries

In terms of tonnage, the most significant fishery in both South Australian and Western Australian waters adjacent to the SWMR is the sardine or pilchard fishery of South Australia, which amounted to almost 57,000 tonnes in 2004-05. This fishery is concentrated in waters adjacent to sub-regions 7 to 9 in the Gulf of St Vincent and Spencer Gulf. Annual catch totals have increased dramatically in this fishery from 4,547 tonnes in 2000-01. The rate of this increase reflects the consequences of natural mass mortality events in the fishery thought to originate from a herpes-like disease (PIRSA, 2005). These events occurred in both 1995 and 1998, causing temporary closures of the fishery and reduced quotas to enable stock recovery, which are considered successful in light of current catch levels and stock biomass. Recent efforts to increase catch levels have been partially driven by the growing need for feedstock for the southern bluefin tuna farming sector which is based in Port Lincoln (see Chapter 9).

Abalone and rock lobster are harvested from both South Australian and Western Australian waters. The total abalone harvest from the Western and Central management zones amounted to 720 tonnes in 2004-05, which has remained stable since 2000-01. These management zones are approximately adjacent to sub-regions 7 and 8-9 illustrated in Figure 1.2 respectively. By contrast, total Roe's, greenlip and brownlip abalone catches in Western Australia have declined slightly from 319 tonnes in 2000-01 to 306 tonnes in 2005-06 (ABARE, 2007a; 2004), accounting for 7% of the national abalone harvest in 2005-06. The rock lobster fishery is concentrated in Western Australian waters from Perth to Shark Bay (sub-regions 1 and 2) which accounted for 65% of the national harvest in 2005-06. However, the total harvest of

10,435 tonnes in 2005-06 represents a decline in the order of 8% from the catch in 2000-01 (ABARE, 2007a). Rock lobster from the Northern management zone in South Australian waters which encompasses waters adjacent to sub-regions 4 to 9 in Figure 1.2 totalled 446 tonnes in 2004-05, which has almost halved from the 846 tonnes recorded in 2000-01 (Knight *et al*., 2006).

The other significant State managed fisheries adjacent to the SWMR include the marine scalefish fishery in South Australian waters, which is active in areas adjacent to sub-regions 4 to 9. The 2004-05 catch amounted to 3,673 tonnes, representing a decline of 18% from the 4,500 tonnes recorded in 2001-02 (Knight *et al*., 2006). The annual catch in the prawn fishery operating in waters adjacent to sub-regions 4 to 9 totalled 2,173 tonnes in 2004-05, reflecting a decline of 27% from the all-time peak catch of 2,988 tonnes in 2000-01. The catch from the Abrolhos Islands and Mid West Trawl fishery in Western Australian waters adjacent to sub-region 1 totalled 6,470 tonnes in 2004-05, but catches in this fishery are highly variable as a result of environmental factors and the mobility of the fleet, ranging from 5,840 tonnes in 2002-03 to 144 tonnes in 2003-04.

6.2.2 Effort

Commonwealth managed fisheries

Fishing effort in the Commonwealth fisheries is reported using differing parameters reflecting the nature of each sector's activity and is subject to varying data availability (AFMA, 2007). Effort in the Great Australian Bight trawl fishery reached 30,386 bottom-time hours in 2006, representing a slight decline of 5% on the 2005 effort. However, effort has increased overall by over 130% in the period 2002-2006, most notably between 2002 and 2003 when effort increased by 80% (Larcombe & McLoughlin, 2007). Effort in the Western Tuna and Billfish fishery has declined markedly since 2002 from 6 million hooks to 1.5 million hooks in 2004, which is the last date for which data are available. Around 75% of this reduction in effort is associated with activity in the southern sector of the fishery which stretches from 34°S eastwards to the South Australia/Victoria border (Knight *et al*., 2006). Fishing effort in the Demersal Gillnet and Longline fishery reached 174,000 km gillnet hours in 2005, with little overall trend evident in the period from 2003 when data are available (Larcombe & McLoughlin, 2007). Due to commercial reasons, there are no

effort data available for the Western Deepwater Trawl fishery and there are no recent effort data for the Gillnet and Hook sector of the Southern and Eastern Scalefish and Shark fishery.

State managed fisheries

Fishing effort in the marine scalefish fishery in South Australian waters adjacent to the SWMR amounted to 53,551 person days in 2004-05, representing a decline of 16% from 63,636 person days in 2000-01 (Knight *et al*., 2006). In 2004-05, 42% of the total effort was in the Spencer Gulf/Coffin Bay area (sub-regions 7 and 8 in Figure 1.2), with 36% in the Gulf of St Vincent/Kangaroo Island area (sub-region 9) and 21% in the West Coast (sub-region 6). Fishing effort in the prawn fishery totalled 25,208 hours in 2004-05, which has been relatively stable at around 23,000-27,000 hours annually since 2000-01, despite the overall decline in catches over this time. The most recent data for the sardine fishery indicates that fishing effort totalled 658 boat days in 2003, although this has been subject to fluctuations over the past ten years as a result of mass mortality events in the fishery (SARDI, 2007).

Due to variations in the methods used to calculate effort between Western Australia and South Australia, it is not possible to combine abalone effort data. Fishing effort in the Central and Western Zones of the abalone fishery in South Australia fell by 10% from a total of 9,247 hours in 2000 to 8,277 hours in 2005. This reflects a declining effort in the Western Zone (sub-region 7), as effort in the Central Zone (sub-regions 8 and 9) increased marginally by 188 hours over this time period (Knight *et al*., 2006). In Western Australia, the total effort declined marginally from 1,928 days in 2000 to 1,917 days in 2005 (Department of Fisheries, 2006).

Fishing effort in the rock lobster sector is expressed in terms of annual pot lifts. In the Northern management zone of South Australia, pot lifts declined by 19% from 687,228 in 2000-01 to 553,701 in 2004-05 (Knight *et al*., 2006). Fishing effort in the south coast Western Australia rock lobster fishery increased by 11% from 132,500 pot lifts in 1999-2000 to 146,000 in 2004-05 (Department of Fisheries 2006). The fishing effort in the west coast Western Australia rock lobster fishery is orders of magnitude

greater than in the south coast fishery, but experienced a decline of around 9% from 10.7 million pot lifts in 1999-2000 to 9.7 million pot lifts in 2004-05 (Department of Fisheries, 2006).

6.2.3 Number of licences

Commonwealth managed fisheries

The conditions for licensing and renewal arrangements differ for each of the Commonwealth managed fisheries (AFMA, 2007). A total of 10 vessels hold statutory fishing rights to the Great Australian Bight Trawl fishery, which were issued in 1993. Many of the other Commonwealth managed fisheries are characterised by a high degree of latent effort. In the Demersal Gillnet and Longline fishery, the number of active licenses was 53 in 2003-04, although the total number of licenses in 2003-04 amounted to 83. The number of vessels actively involved in the Western Tuna and Billfish fishery has declined from 27 in 2003 to less than five in 2005, although there are over 100 permits to operate in the fishery (Larcombe & McLoughlin, 2007). With regard to the Western Deepwater Trawl fishery, only three vessels were operating in 2005-06, although a total of 11 permits have been issued.

State managed fisheries

A total of 29 commercial licenses exist for abalone collection in South Australian waters adjacent to the SWMR, 23 in the Western Zone and 6 in the Central Zone, which has remained the same since 2000 (Knight *et al*., 2006). 68 licenses for rock lobster harvesting in the Northern Management Zone were issued in 2005, which again has remained the same since 2000. A total of 52 licences were issued in the prawn fishery in 2005, which has remained stable since 1994. Licences in the marine scalefish fishery of South Australia have declined slightly from 412 in 2000 to 377 in 2004. Whilst a total of 14 licences exist in the sardine fishery, these are amalgamated and used by only 7 or 8 vessels (Rogers *et al*., 2004).

In Western Australian state waters, a total of 40 licenses for abalone collection were issued in the period 2004-05, 26 of which applied to the Roe's abalone fishery and 14 to the greenlip and brownlip abalone fishery. This has remained constant since 2000-01 (Department of Fisheries, 2006; 2001). A fishing boat license is required along with a minimum ownership of 63 lobster 'units' in order to obtain a license in the

West Coast rock lobster fishery (Western Rock Lobster Council, 2007). The number of pots that can be fished per unit is obtained through a multiplier expressing the unit value, which varies temporally and across management zones within the fishery. The most recently available data relating to vessel licenses and unit allocation in this fishery is detailed in Table 6.5.

Table 6.5 License and unit allocation in the West Coast rock lobster fishery, 2002-2007

Management Zone	*December 2002*		*January 2007*	
	Vessel licenses	Unit allocation	Vessel licenses	Unit allocation
A (Abrolhos Islands)	152	17,463	128	18,498
B (South of 30°S)	148	16,083	111	14,906
C (North of 30°S)	301	35,736	252	35,634
TOTAL	**601**	**69,282**	**491**	**69,038**

(Source: Department of Fisheries, 2007)

This indicates the extent to which unit ownership has become increasingly concentrated, with the number of licensed vessels declining by 18% between December 2002 and January 2007, whilst the number of units owned remained static. This decline in the size of the fleet has been experienced in all three management zones but is most acute in Zone B, where the number of licensed vessels declined by 25% between December 2002 and January 2007, as compared to declines in the order of 15% in the other two management zones. There were 239 licensed vessels in the West Coast Demersal Scalefish fishery in 2004-05, which has remained constant since 1999-2000, although only 68 of these vessels held licenses for this fishery alone in 2004-05 (Department of Fisheries, 2006; 2001). License numbers in the other fisheries detailed in Table 6.3 have remained constant since 2000-01.

6.2.4 Location of activity

Commonwealth managed fisheries

The Commonwealth managed fisheries lying within the waters of the South-west Marine Region cover large areas but fishing activity is specific to certain key locations within each (AFMA, 2007). In the Great Australian Bight Trawl fishery, most fishing takes place over the continental shelf in depths of 120-160m, although some fishing in the continental slope occurs to depths of 1000m. The continental shelf

fishery is most active between 125ºE and 134ºE in the central area of the fishery, targeting deepwater flathead and Bight redfish. The Gillnet and Hook sectors of the Southern and Eastern Scalefish and Shark fishery are active in the area stretching from Kangaroo Island towards Ceduna, with a greater relative intensity of fishing in the gillnet sector which catches mainly shark (Larcombe & McLoughlin, 2007). Fishing activity in the Western Tuna and Billfish fishery within the South-west Marine Region is focused around the 200m isobath off the coast of Western Australia between 35ºS and 25ºS, with particular emphasis on the waters off the South-west Peninsula (sub-region 4 in Figure 1.2) and offshore from Perth to Kalbarri (sub-regions 1 and 2). The Demersal Gillnet and Longline fishery is most active in the area stretching from 116°30´E to the South Australian border, where approximately 44% of the total shark species catch was taken in 2003-04 (Department of Fisheries, 2006). The West Coast area of this fishery from 33°S northwards to 104°06´E accounted for a further 35% of the shark catch, whilst the remainder was taken along the south coast in the area between 33°S and 116°30´E. The size of the Western Deepwater Trawl fishery and the limited number of operators has limited the extent of research into the location of activity in this fishery.

State managed fisheries

The abalone fishery of the Central and Western Management Zones in South Australia has become increasingly focused on a number of key collection areas. Over 80% of the blacklip abalone catch is harvested from the south and west coast of Kangaroo Island (sub-region 9 in Figure 1.2), whilst other sites further west include Streaky Bay, Flinders Island, Venus Bay and the west of Coffin Bay, all of which are located in sub-region 7 illustrated in Figure 1.2. Greenlip abalone are collected around the towns of Moonta, Wallaroo and Colwell on the western coast of the Yorke Peninsula (sub-region 8), as well as the areas surrounding Port Lincoln and Elliston in sub-region 7 (Mayfield, Carlson & Ward, 2005; Mayfield *et al*., 2005a; 2005b). The commercial rock lobster fishery in South Australia shares some key areas with the abalone fishery, with activity being concentrated to the north-west and south-east of Kangaroo Island, the Coffin Bay peninsula and along the coast to the south of Streaky Bay (Linnane *et al*., 2005). The sardine fishery is concentrated in the Spencer Gulf off the eastern coast of the Eyre Peninsula from opposite Arno Bay in the north to Port Lincoln in the south (sub-region 7). Activity in the prawn fishery is also

concentrated in the Spencer Gulf area, where 39 out of the total of 52 licences were issued in 2005. In 2004-05, 89% of the total harvest came from this region, followed by 10% in the Gulf of St Vincent and just 1% in the West Coast. Activity in the Marine Scalefish fishery is complex, owing to the large number of species targeted and the size of the fishery. The most recent catch data for selected species targeted in this fishery is summarised in Table 6.6 which indicates the distribution of activity in this fishery.

Table 6.6 Total catch (tonnes) by region for selected species in the Marine Scalefish commercial fishery, South Australia, 2004-05

	Australian salmon	*Southern calamari*	*King George whiting*	*Snapper*	*Yellowfin whiting*	*Garfish*	*Tommy ruff*	**TOTAL**
West Coast	12.3	9.1	136.0	35.4	0.3	16.7	3.8	**213.6**
Spencer Gulf / Coffin Bay	61.1	199.1	126.7	403.7	125.2	151.3	150.0	**1217.1**
Gulf of St Vincent / Kangaroo Is.	59.1	295.3	84.1	60.2	12.7	195.5	29.5	**736.4**
Other	0.1	0.1	0.4	5.2	0	0.5	0	**6.3**
TOTAL	**132.6**	**503.6**	**347.2**	**504.5**	**138.2**	**364.0**	**183.3**	

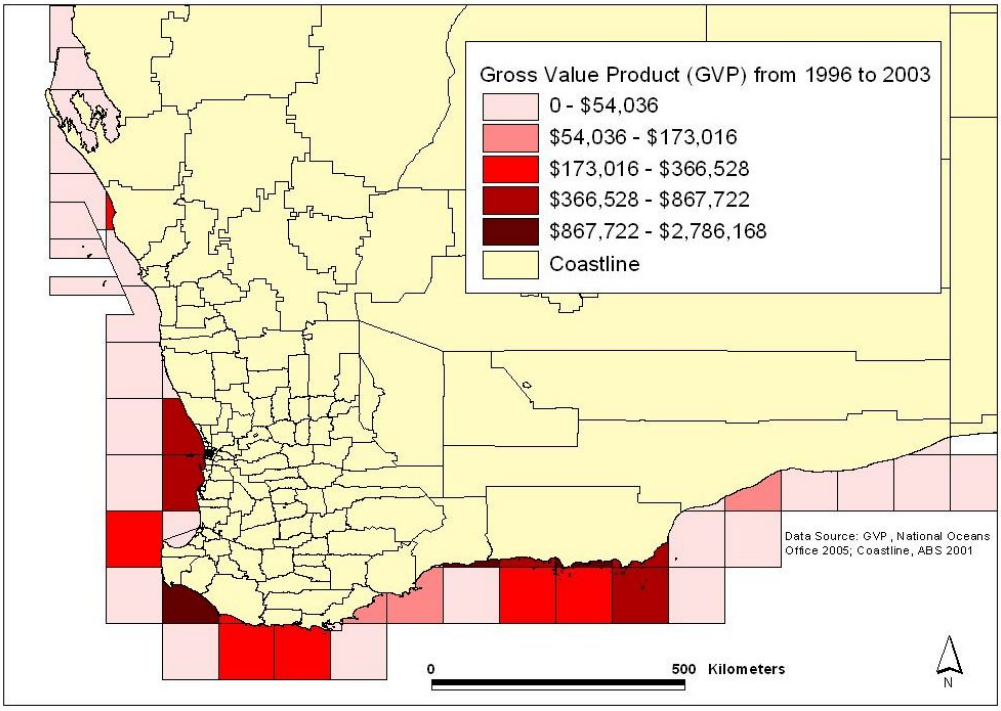
(Source: Knight *et al*., 2006)

Table 6.6 highlights the overall concentration of activity in the Spencer Gulf / Coffin Bay area (sub-regions 7 and 8), which accounted for 56% of the total catch in this fishery in 2004-05. This in turn reflected the catch from the snapper fishery, which represented around 33% of the total scalefish catch from this single region. The Gulf of St Vincent / Kangaroo Island area (sub-region 9) is marked by a concentration of activity in the southern calamari and, to a lesser extent, the garfish fishery, which together accounted for 67% of the total scalefish catch from this region. The West Coast area (sub-region 6) is notable for a concentration of the King George whiting fishery, which represented 64% of the total scalefish catch from this region in 2004-05 (Knight *et al*., 2006).

With regard to the Western Australian abalone fishery, detailed information is available expressing the distribution of the catch value of this fishery, which is reflective of prime collection areas. This is illustrated in Figure 6.1, demonstrating the significance of the abalone harvest in proximity to the shire of Nannup in the south-west peninsula (sub-region 4) and the shires of Ravensthorpe and in the vicinity of

Esperance along the south coast in sub-region 5. As would be expected, activity is also shown to be concentrated around the Perth metropolitan area in sub-region 2.

Figure 6.1 Value of abalone harvest by location in the Western Australian section of the SWMR, 1996-2003



(Source: National Oceans Office, personal communication)

The most intensive activity in the Western Australian West Coast rock lobster fishery takes place in the waters off Lancelin and Ledge Point in sub-region 1, with significant harvesting around Dongara, Port Denison and Two Rocks (Department of Fisheries, 2005). Activity in the West Coast Demersal Scalefish can be summarised through reference to the main catch areas for selected target species. The fishery is divided into four management zones comprising Kalbarri (26°30´S to 28°S), Mid West (28°S to 31°S), Metropolitan (31°S to 33°S) and South West (33°S to 115°30´E). In 2003-04, around half of the dhufish catch approximating 100 tonnes came from the Kalbarri zone (sub-region 1 of Figure 1.2), with between 25-35 tonnes from each of the other management zones. Pink snapper were predominantly caught in the Kalbarri (175 tonnes) and Mid West (90 tonnes) management zones, with the

other two zones contributing around 25 tonnes each (Department of Fisheries, 2006). The South Coast Crustacean fishery covers an extensive area and involves a limited number of vessels, hence information on the specific concentration of activity is difficult to determine, although most fishing takes place in shallow water inshore areas along the coastline.

6.2.5 Employment

Commonwealth managed fisheries

Data relating to employment in the Commonwealth managed fisheries is generally only available to the level of numbers of vessels operating in each fishery as detailed in Table 6.1. More detailed data are available for the jointly managed Demersal Gillnet and Longline fishery, which employed a total of 60 skippers and crew in 2004-05 (Department of Fisheries, 2006).

State managed fisheries

Details on employment by fishery are derived from the national census and published by the ABARE. As the results of the 2006 census are not yet available to this level of detail, this discussion will use the 2001 census information. Whilst somewhat dated, this shows that rock lobster collection involved over a quarter of all Western Australian commercial fishery employees and almost half of all rock lobster fishermen were active in Western Australia (table 6.7). It is unclear as to how abalone collection was categorised in this survey, but it is most likely to be included in the undefined commercial fishing sector along with other gleaning activities.

Table 6.7 Estimates of employment in the commercial fishing industry, 2001

Industry	*South Australia*	*Western Australia*	*National*	
Marine fishing	237	245	1,611	
Rock lobster fishing	221	722	1,459	
Prawn fishing	109	150	1,040	
Finfish trawling	40	27	288	
Squid jigging	3	0	12	
Line fishing	26	10	91	
Commercial fishing, undefined		459	493	3,152
Fish wholesaling	583	742	5,540	
Seafood processing	457	239	2,213	
TOTAL	**1,935**	**2,628**	**10,146**	

(Source: ABARE, 2007a)

6.2.6 Gross Value Product

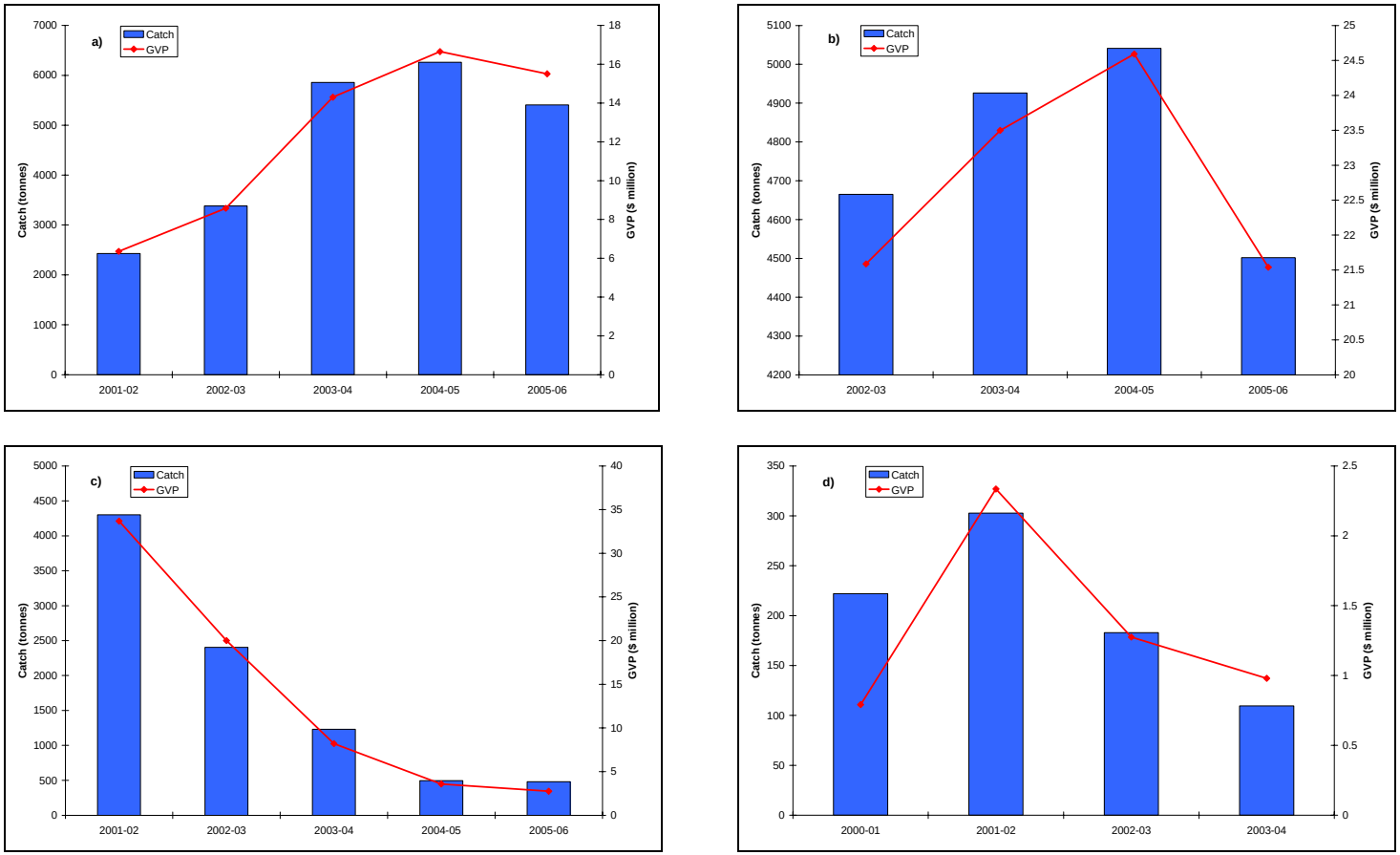
Commonwealth managed fisheries

Figure 6.2 summarises the trends in gross value product (GVP) and catch for the highest value Commonwealth fisheries within and adjacent to the SWMR where recent data are available covering the period 2001-02 to 2005-06 (ABARE, 2007a; 2005). The Southern Bluefin Tuna fishery is described in Chapter 9, as trends in production primarily reflect aquaculture operations in this fishery. The GVP of the Demersal Gillnet and Longline Joint Managed fishery has varied between $4.8 million and $7 million from 1998-99 to 2004-05, with catches ranging from 1,350 tonnes to 1,728 tonnes over this period.

Figure 6.2 underlines the contrasting trends in catch outlined above and their economic implications. The overall GVP of the three major fisheries (Great Australian Bight trawl, Southern and Eastern Scalefish and Shark and Western Tuna and Billfish) has decreased from $50.2 million in 2002-03 to $39.8 million in 2005-06, representing a decline of 31% in real terms. This is almost wholly attributable to the decline in the Western Tuna and Billfish fishery from $33.7 million in 2001-02 to $2.8 million in 2005-06. This in turn reflects the increase in domestic effort after 1997, when Japanese pelagic longliners were excluded from the Australian Fishing Zone and the subsequent impacts of lower prices and increased fuel costs experienced since 2002. The increased catches in the Great Australian Bight trawl fishery since 2002-03 reflects the introduction of freezer boats into the fishery which can stay at sea for extended periods of time. The stocks of deepwater flathead are not overfished but could be if present effort is maintained, whilst Bight redfish are considered to be not subject to overfishing. However, total allowable catches were introduced in 2006 in order to maintain stocks under present effort levels. Effort in the Western Deepwater trawl fishery has been negatively affected since 2001-02 by increased fuel costs, with stocks of the varied target species uncertain.

Figure 6.2 Catch and GVP data for selected Commonwealth managed fisheries within and adjacent to the SWMR:

a) Great Australian Bight Trawl; b) Southern and Eastern Scalefish and Shark: Gillnet and Hook sector; c) Western Tuna and Billfish; d) Western Deepwater Trawl



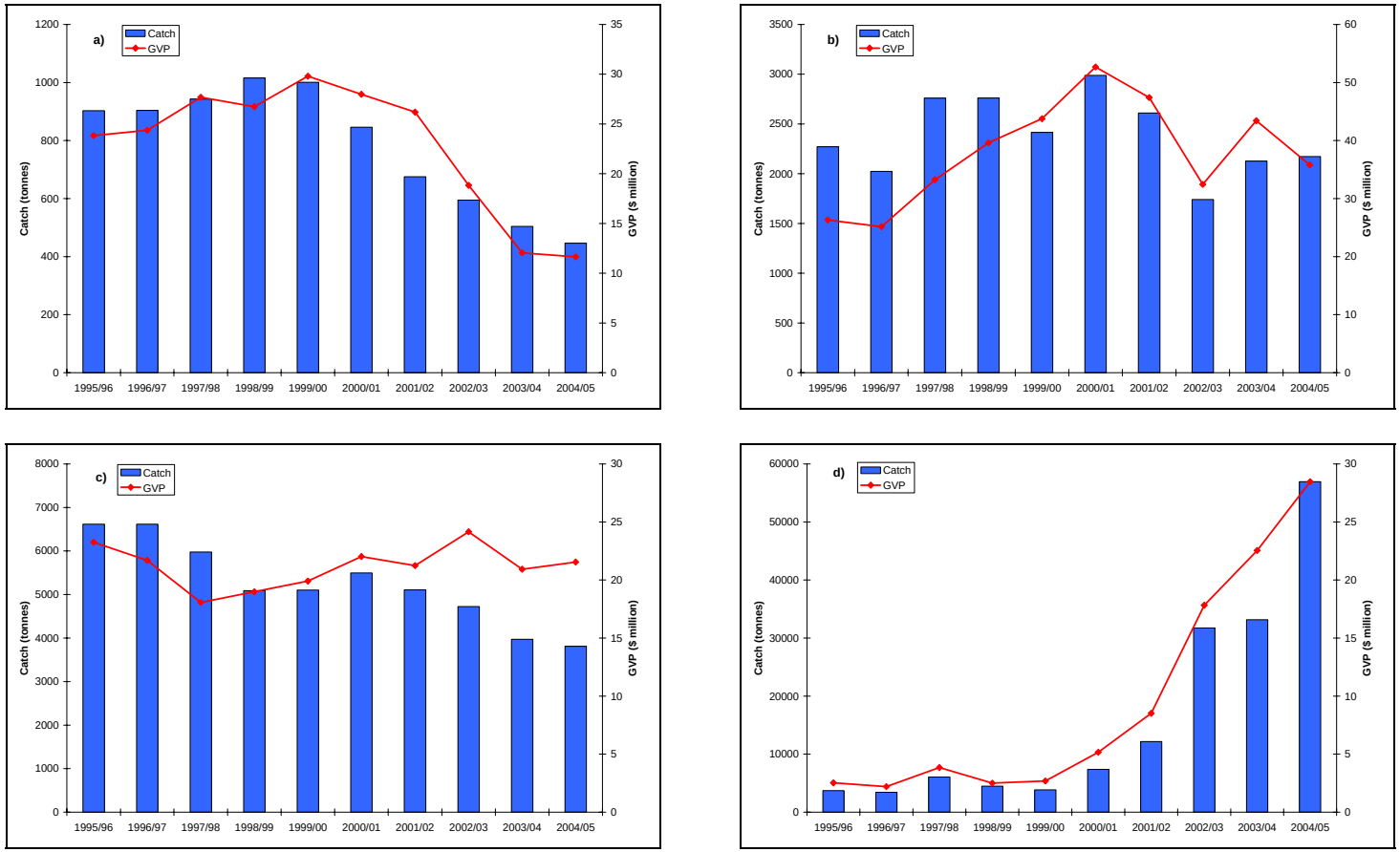
(Sources: ABARE, 2007a; 2005; AFMA, 2007; DEW, personal communication)

State managed fisheries

Figure 6.3 outlines the available data relating to recent trends in GVP and catch for South Australian State managed fisheries operating in waters adjacent to the SWMR where data extend back to 1995-96.

Figure 6.3 indicates the varying trends in GVP and catch for the South Australian managed fisheries, with steady declines in GVP and catch since 1999-2000 in the rock lobster fishery, fluctuating overall growth within the prawn fishery, gradually declining catches but stable GVP in the marine scalefish fishery and a recent dramatic increase in both GVP and catch in the sardine fishery. The total GVP for these fisheries rose by 28% in real terms from $76 million in 1995-96 to $108 million in 2000-01, declining slightly to $97 million in 2004-05. This largely reflects the increased GVP of the prawn fishery over this time period, which almost doubled from $26 million in 1995-96 to $53 million in 2000-01. The subsequent decline in GVP in this fishery has been partially offset by the increased contributions from the growing sardine fishery. The total catch was stable between 12,000 and 16,000 tonnes from 1995-96 to 2000-01, but increased subsequently to 63,381 tonnes in 2004-05, all of which is due to the increased catches in the sardine fishery. The abalone fishery of the Central and Western management zones has remained stable between 2001-02 and 2004-05, with catches varying between 709 and 745 tonnes and GVP ranging between $27 million and $31 million

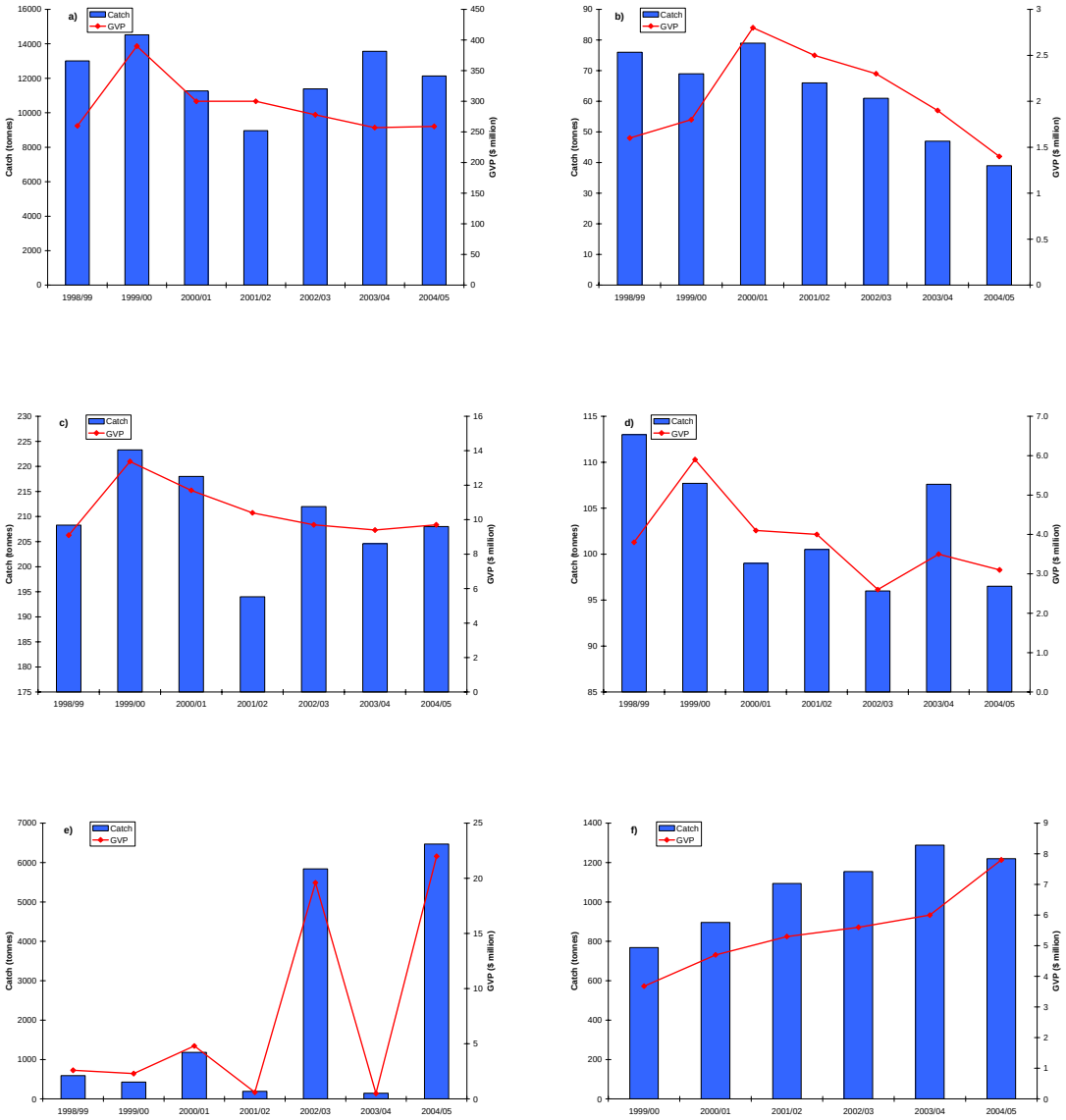
Figure 6.3 Catch and GVP data for South Australian managed fisheries within and adjacent to the SWMR: a) Northern Zone Rock Lobster; b) Prawn; c) Marine Scalefish (excluding sardine); d) Sardine



(Sources: Knight *et al.*, 2006; DEW, personal communication)

Data relating to GVP and catches in Western Australian state managed fisheries are derived from the annual State of the Fisheries Reports and are summarised in Figure 6.4.

Figure 6.4 **Catch and GVP data for Western Australian managed fisheries within and adjacent to the SWMR: a) West Coast Rock Lobster; b) South Coast Crustacean; c) Greenlip and brownlip abalone; d) Roe's abalone; e) Abrolhos Islands and Mid West Trawl; f) West Coast Demersal Scalefish**



(Sources: Department of Fisheries, various reports)

These data reflect the varying trends in fisheries managed by the Western Australian government adjacent to the SWMR. The principal fishery in GVP terms is clearly the West Coast rock lobster fishery, which generated $259 million in 2004-05, although this has declined from a peak value of $390 million in 1999-2000. However, catches have not declined similarly, varying from 9,000 tonnes to 14,500 tonnes over this time period. Rock lobster account for a proportion of the South Coast Crustacean fishery catch but the GVP of this fishery is orders of magnitude lower, varying between $1.4 million and $2.8 million over this time period. Greenlip and brownlip abalone catches accounted for $9.7 million in 2004-05, exceeding the GVP of Roe's abalone which was $3.1 million in that year. Whilst catches in both abalone sectors have fluctuated to some extent over time, there is a consistent declining GVP and catch evident from 1999-2000 through to 2004-05 in both abalone fisheries. The Abrolhos Islands and Mid West trawl fishery fluctuates dramatically over time in terms of GVP and catch, reflecting the effort in this fishery which is linked to effort in adjacent scallop fisheries in Shark Bay (Department of Fisheries, 2006). Finally, the West Coast Demersal Scalefish fishery indicates a consistent increase in GVP from $3.7 million in 1999-2000 to $7.8 million in 2004-05, reflecting the overall rise in annual catches over this period. The increase in GVP from 2003-04 to 2004-05 in the context of slightly declining annual catches over this period was a result of the increased value of target species, primarily dhufish.

6.3 MACRO-ECONOMIC DRIVERS AT THE INTERNATIONAL AND NATIONAL LEVEL

Trends in commercial fishing activity reflect a variety of macroeconomic and demographic factors. Domestic demand for fish produce is driven largely by population, which is projected to continue to grow, albeit at a reduced rate, to a total of 25 million by 2050. As a result of increasing ageing of the population, retention of past consumption habits and preference to living near the coastline, domestic demand for seafood is projected to increase in the context of declining production from Australian waters (table 6.8).

Table 6.8 Projections for seafood demand and supply, 2000-2050 (tonnes live weight of fish)

Component	*2000*	*2020*	*2050*
Domestic requirement	442,000	776,000	1,150,000
Production of wild caught fisheries	198,000	170,000	165,000
Domestic aquaculture production	34,000	66,000	130,000
Projected fish exports	70,000	70,000	70,000
Projected fish imports	280,000	610,000	925,000

(Source: FRDC, 2005)

These projections underline the future significance of the aquaculture sector which is discussed further in Chapter 9 as well as the increasing reliance on imports to meet domestic demand. The gradual decline in wild caught species reflects recent trends supporting evidence that many domestic State and Commonwealth commercial fisheries are already operating at or near to the maximum sustainable limit (FRDC, 2005). It is therefore envisaged that the extra demand may well be met only through expansion of the aquaculture sector.

The markets for the Commonwealth managed fisheries within the South-west Marine Region are primarily domestic with regard to the Great Australian Bight trawl fishery, with some exports to Europe, whilst produce from the Western Tuna and Billfish sector is exported fresh chilled to Japan and the United States. With respect to State managed commercial fisheries in the SWMR, it is evident that the key rock lobster and abalone fisheries are directed towards export rather than domestic consumption,

exports accounting for 74% of rock lobster and 67% of abalone production by tonnage in 2005-06.

Demand for exports of Australian produce is mediated by the value of the dollar, with appreciation in the currency leading to higher prices of Australian exports, thereby theoretically lowering the demand for price elastic products. However, population levels and GDP in overseas markets for Australian fish exports in East Asia are both projected to increase, leading to the likelihood that, whilst the price of Australian exports may rise, demand will continue to be sustained through increased overall population and greater disposable incomes in overseas markets (FRDC, 2005).

Nevertheless, the export of commercially fished products takes place in a highly competitive market, where lower input costs such as labour or fuel enable participants to increase their share of the market. It remains to be seen whether rapidly developing countries such as China will develop their own commercial fishing operations to an extent where they can challenge the position of countries such as Australia. This would require considerable investment and expertise to develop the complex supply chain linkages needed to supply high value fresh produce which currently benefit Australian producers, illustrated by the fact that in 2005-06 60% of Australian rock lobster exports were live, fresh or chilled and 58% of abalone exports were fresh, chilled or frozen (ABARE, 2007a). The extent to which individual countries are willing or able to regulate the activities of their own commercial fisheries will also evidently be another significant, if largely unpredictable, factor in this respect.

6.4 FUTURE TRENDS WITHIN THE SOUTH-WEST MARINE REGION

6.4.1 Tonnage

Commonwealth managed fisheries

The Commonwealth managed fisheries have experienced considerable changes in tonnage over the past five years, particularly with regard to the Western Tuna and Billfish fishery. Of particular significance in this context have been the effects of the appreciation of the Australian dollar on the value of exports, which are cited as the main reason behind the similar drop in value and tonnage experienced in the Eastern Tuna and Billfish fishery (ABARE, 2007b). The Western Tuna and Billfish fishery is one component of the larger tuna and billfish fisheries within the Indonesian Exclusive Economic Zone and elsewhere in the Indian Ocean, where the international fleet includes boats from Spain, Japan, Indonesia, South Korea and Taiwan. Individual shares of the Asian market for tuna and billfish will therefore be particularly susceptible to competition between different fishing fleets and international currency fluctuations, which are seen to have negatively impacted the Australian fishing fleet in particular. Given recent trends in the value of the dollar, there is little evidence to suggest an upturn in the fortunes of the domestic tuna and billfish fishery on the international market, whilst foreign imports could become correspondingly more economically competitive. Future trends in catch data in the other Commonwealth managed fisheries are subject primarily to effort regulations as discussed below.

State managed fisheries

The preceding discussion has underlined the extent of recent decreases in catch in some key State managed commercial fisheries adjacent to the SWMR, particularly the rock lobster fishery of South Australia and the abalone fisheries of Western Australia. However, it is apparent that a declining harvest does not equate to a commensurate decline in GVP, reflecting the fact that abalone and rock lobster fisheries service a niche market where prices are relatively inelastic. Therefore, the product price can be increased by producers to offset reduced harvests which are tolerated by consumers due to high or increasing living standards and disposable income in overseas markets. It remains a possibility, however, that the State managed commercial fisheries adjacent to the SWMR may be increasingly unable to cope with demand, particularly

in the East Asian market, opening the way for regional competitors to expand their share of the market. This is also a potential consequence of the highly seasonal nature of the fisheries, with closed seasons resulting in alternative sourcing of produce which presents opportunities for competitors over the longer term (WAFIC, personal communication). The forecast for the fisheries themselves therefore would seem to indicate a stable or declining tonnage catch but overall stable and possibly increasing levels of profitability.

6.4.2 Effort

Commonwealth managed fisheries

Fishing effort in Commonwealth managed fisheries is subject to regulations designed to ensure stock stability in the long term. In all fisheries, there is considerable uncertainty surrounding stock abundance and status with respect to fishing effort, hence these regulations are reviewed and updated annually. Whilst the details are necessarily specific to each fishery, the Great Australian Bight trawl fishery and the Southern Demersal Gillnet and Longline fishery share the long term objective of reducing fishing effort by introducing total allowable catches in the former and a combination of closures, size limits and gear-time units in the latter. The overall effect in all Commonwealth managed fisheries has been to increase the degree of regulation over time, partly reflecting more precise data regarding stocks and also in recognition of the need for a precautionary approach when managing fish stocks. Other influences on fishing effort include technological developments, with the advent of on board freezing capability contributing in large part to recent increased effort in the Great Australian Bight trawl fishery, whilst fuel prices and, to a lesser extent, labour costs have exacerbated the difficulties associated with lower product values on the international market.

It is therefore apparent that fishing effort in the Commonwealth managed fisheries has declined as a result of increased input costs and lower market value in the case of the Western Deepwater Trawl and the Western Tuna and Billfish fisheries, whilst effort has been more subject to management regulations in the Great Australian Bight and Southern Demersal Gillnet and Longline fisheries. There is little evidence to suggest that this situation will alter in the foreseeable future, with the latter two fisheries

representing the majority of fishing effort in Commonwealth waters in the South-west Marine Region.

State managed fisheries

The State managed fisheries of both South Australia and Western Australia are all characterised by static or declining fishing effort over the past five years. Effort in these fisheries is largely determined by management controls which are implemented in light of data regarding stock abundance. In the case of the abalone fisheries in South Australian waters, the comparatively rapid decline in effort as compared to total harvest levels, particularly in the Western management zone, would seem to indicate that stocks are not endangered and therefore effort may well be able to increase in the future (Mayfield *et al*., 2005b). The Western Australian abalone fishery is similarly tightly regulated, with effort levels controlled and maintained at static levels through the introduction of individual transferable quotas which have remained stable since the 1990s.

With regard to the Western Australian West Coast rock lobster fishery, management changes designed to reduce effort such as reducing the unit holding of each pot from the 1990s onwards has resulted in a decline in the size of the fleet. Furthermore management activities in the rock lobster fishery operate in a system of some uncertainty, with settling rates of broodstock being monitored closely to determine likely changes in stock levels and the necessary adjustments to fishing effort. It is therefore very difficult to make projections regarding future effort levels with regard to this fishery other than observing that the decline in fishing effort since 2000-01 has shown little evidence of alteration thus far.

In the case of multi-species fisheries such as the Marine Scalefish fishery of South Australia, predicting future effort intensity is complicated by the wide variation in fishing effort directed towards individual species in the fishery. However, most effort in this fishery has been consistently directed towards King George whiting, which accounted for around 32% of the total fishing effort in this fishery in 2004-05. In common with other species in this fishery, this effort has declined over the past five years as part of a longer term trend. The sardine fishery of South Australia has undergone recent increases in effort from 482 boat days in 2000 to 658 boat days in

2003, although this partially reflects the recovery of the fishery from the mass mortality event in late 1998 which killed around 70% of the spawning stock (SARDI, 2007). Given that the total allowable catch in this fishery has been reduced from 51,100 tonnes in 2005 to 25,463 tonnes in 2006 in response to various biological indicators (Knight *et al*., 2006), this would indicate that effort in the fishery will decline from its recent peak. However, effort in this fishery will be to some extent dependent upon the performance of the southern bluefin tuna rearing sector, for which sardine is the predominant feedstock, although there are export market opportunities which could supplement this (SARDI, 2007).

6.4.3 Number of licences

Commonwealth managed fisheries

The Commonwealth managed fisheries operate under conditions of limited entry for the Great Australian Bight and Western Deepwater Trawl fisheries, where entry is restricted to a total of 10 and 11 vessels respectively. The other fisheries have considerable latent effort, with around half of licenses within the Southern Demersal Gillnet and Longline fishery being active in 2005, whilst less than five out of a total of 110 licensed vessels were active in the Western Tuna and Billfish fishery in 2005. Additional management methods relating to individual transferable quotas, gear and area restrictions operate within these four fisheries. There is little evidence to suggest that conditions will change in the near future with regards to licenses and participation in these fisheries. The introduction of total allowable catches in the Great Australian Bight trawl fishery reflect concerns about the ability of the target species to withstand fishing effort and their susceptibility to overfishing, hence any increase in the number of licensed vessels is very unlikely. Economic factors are seen to preclude wider participation in the Western Tuna and Billfish and Western Deepwater Trawl fisheries, whilst closures and other restrictions in the Southern Demersal Gillnet and Longline fishery introduced in 2006 designed to augment stocks of the principal shark target species would again suggest that increased activation of licenses appears unlikely.

State managed fisheries

The number of licences in abalone fisheries has remained constant in South Australia and varied only slightly in Western Australia. Given the economic importance of

abalone in South Australia and the perceived increase in greenlip abalone stocks it is presumed that licence numbers will remain stable in the region over the short to medium term.

The future licensing arrangements for the rock lobster industry in Western Australia are the subject of current debate following proposals that the industry could move towards an output control system based on quotas, replacing the current input control method based on individual transferable effort. This current system has resulted in efforts to maximise individual shares of the catch through investing in technology, boats and bait, which in combination with fluctuating product prices has generated problems of efficiency and equity within the fishery. This is further evidenced in the increased leasing of pots and declining number of vessel licences as operators seek to take advantage of economies of scale, although these are being reduced by the cost-price squeeze outlined above. It is felt that any shift to output controls would cause further rationalisation within the industry (WAFIC, personal communication), although this has not yet transpired. Whilst it is apparent that management of the rock lobster sector in Western Australia is in a state of transition, the underlying economic drivers causing rationalisation of the industry relate primarily to input costs which reflect the broader national and international economic situation, hence are unlikely to alter significantly in the short term.

6.4.4 Location of activity

Identifying factors driving spatial and temporal variations in fishing activity is difficult because fishers may move among areas to maintain or increase their expected levels of catch in response to changes in stock abundance or technology (Mayfield *et al*., 2005b). Changes in technology such as increased boat size could restrict the number of access points and thus indicate movement to more accessible areas. Furthermore, increases in technology could enable boats to travel faster and withstand rougher environmental conditions, thereby increasing length of time at sea, and house equipment that enables more efficient targeting of known ‘hot spots’.

Commonwealth managed fisheries

Given the increased significance of fuel costs, it is logical that effort is becoming increasingly concentrated in those areas in proximity to ports of landing or in more

productive fisheries. There is little data to provide further detail on this aspect, however, which reflects the sheer size of each fishery and the low numbers of vessels operating in each. However, all fisheries should have implemented computerised vessel monitoring systems by the end of 2007 which would clarify this issue in the future.

State managed fisheries

In the South Australian abalone fishery, fishers targeting greenlip abalone have increasingly concentrated effort over the last 20 years, with 70% of the catch caught in four out of the 20 fishing areas in the western management zone and 85% of the greenlip abalone harvest in the central management zone being collected in just one fishing area (Mayfield *et al*., 2005a). Mayfield *et al*. (2005b) suggested that this either reflects changes in fisher behaviour or stock abundance, with no quantifiable data being available to support either hypothesis. Predictions regarding future fishing activity are therefore fraught with uncertainty. Time series data relating to location of catch is not available for Western Australia's abalone fishery.

With respect to the rock lobster sector, there has been relatively little variation in the location of prime collection sites. The Western Australian rock lobster fishery is managed through a series of input controls which can be spatially variable, resulting in increasing effort as the mobility of the fleet increases. However, output controls in the form of quotas are being considered as management options in place of input controls, which could alter the location of fishing effort in the future.

6.4.5 Employment

There are suggestions that national labour shortages are having a negative impact on the Commonwealth and State fishing industry (ABARE, 2007a), although this cannot be confirmed due to the lack of systematic data collection on employment in this sector. However, the combined impact of competition for labour from the mineral resources sector and associated high rate of wage inflation, the potential for alternative employment in tourism, the declining overall population of rural areas and the seasonality of labour requirements in the fishing sector will inevitably have a detrimental impact on labour availability.

This has been particularly marked in the abalone and rock lobster fisheries, with a poor perception of the industry amongst younger people and better earnings in the oil sector contributing towards a lack of participation (WAFIC, personal communication). Furthermore, crew in the rock lobster sector are commonly paid on the basis of a percentage of catches, which introduced greater uncertainty to owners as competition is increasing within the fishery as described above. A recent survey showed that labour costs in the eastern tuna and billfish fishery amounted to 24% of total cash costs, representing the single highest expense for each boat in the fishery in both 2004 and 2005 (ABARE, 2007b). Labour costs in the rock lobster fishery have been estimated as amounting to 50% of total operating costs (Western Rock Lobster Council, 2007). It is therefore considered that the availability of labour will continue to present a problem to the State managed fisheries, with low skill levels, training requirements and high turnover all contributing towards the variable cost of labour continuing to rise.

6.4.6 Gross Value Product

Commonwealth managed fisheries

Fisheries operating in Commonwealth waters have recently experienced challenging circumstances in terms of profitability, as reflected in tonnage, effort and GVP data. As these have been particularly acute in those fisheries primarily geared towards the export market, the current trend of expanding activity in the Great Australian Bight trawl fishery and declining value of production in the Western Tuna and Billfish fishery do point towards an increasing focus on domestic markets for Commonwealth managed fisheries. However, there is considerable uncertainty in predicting future trends in any fishery, particularly one where there is an unknown degree of commonality between stocks such as tuna in Australian and international Indian Ocean waters. The future direction of the fishery will largely depend upon the outcome of future research into stocks in the broader Indian Ocean and the ability of the Indian Ocean Tuna Commission to effectively manage the fishery.

State managed fisheries

The overall reduction in GVP of the main State managed commercial fisheries in South Australia and Western Australia in the period 2000-01 to 2005-06 illustrated in Figures 6.3 and 6.4 will also reflect to some degree the appreciation in the value of the

Australian dollar, although this will be cushioned by the niche market status of some of these products. There are also, however, significant fluctuations in GVP such as the decline in the GVP of West Coast rock lobster from $300 million in 2001-02 to $259 million in 2004-05. This short term volatility reflects the impact of competition with Mexican lobsters in the high value Taiwanese live lobster market, Mexican produce being sold at around US$3 less per kg than Australian exports (ABARE, 2007a). Coupled with the effects of the SARS virus on trade with large parts of East Asia, this demonstrates that unpredictable events can have significant impacts on the GVP of commercial fishery exports. Concurrent with this increasing degree of competition, negotiations with the European Union succeeded in agreeing a tariff reduction on 1,500 tonnes of frozen lobster exports in 2003 from 18% to 12.5% which could be extended to cover live and cooked produce in the future. However, the EU market is small at present, generating just over $2 million in 2005-06 principally involving exports to the UK (ABARE, 2007a), whilst the reduced tariff still presents a significant economic barrier to exporters (WAFIC, personal communication). It is therefore possible that capitalising upon the high quality brand of Australian rock lobster could augment the future GVP of rock lobster exports, but economic circumstances dictate against this under present conditions.

Whilst the GVP of abalone exports from South Australia and Western Australia has been shown to have declined by 30% in real terms in the 2000-01 to 2005-06 period, most of this took place between 2000-01 and 2001-02, with total GVP remaining relatively constant at around $46 million since 2001-02. Analysis of export data indicates a lesser degree of reliance on single markets, with Hong Kong's share of exports declining from 56% of all abalone exports in 2003-04 to 44% in 2005-06 (ABARE, 2007a). Meanwhile, China's share of the higher value fresh, chilled and frozen abalone export sector has increased dramatically from 3.5% in 2000-01 to 29% in 2005-06, representing an increase in GVP in real terms of around 370% to $34.5 million. Duties of between 25%-45% are placed on Australian fish exports to China and there are other issues relating to illegal monopolies on trade and illegal duplication of Australian brands which need to be overcome (Abalone Association of Australasia, 2006), but it is apparent that a strong demand exists for high value products such as fresh abalone which are reflected in these data.

6.5 CONCLUSION

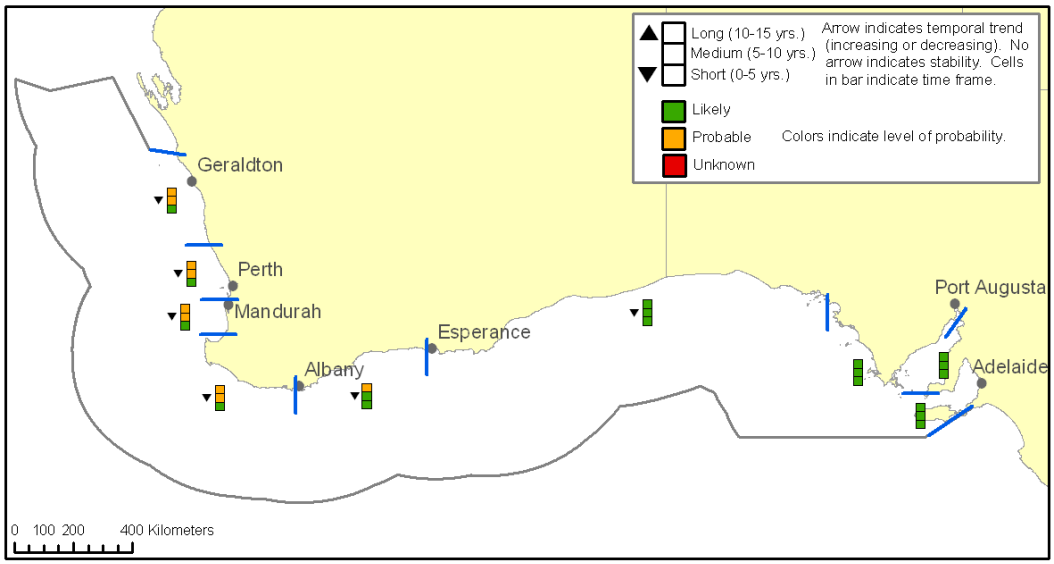
The Commonwealth managed fisheries within the South-west Marine Region have been shown to be undergoing a period of overall contraction in tonnage, value and effort which relate primarily to broader economic circumstances and competition in the case of the Western Tuna and Billfish fishery. Under these conditions, costs of labour and fuel become more significant, with the outcome that overall production emphasis has shifted towards catches for domestic markets centred on the Great Australian Bight trawl fishery. There is evidence to suggest that this fishery is also approaching its capacity in terms of catches relative to biomass, although research will be conducted to determine if the newly applied total allowable catches for the three main target species are appropriate. There is little evidence to suggest that the driving forces behind these trends at the international and national level will alter in the foreseeable future. Together with the emphasis on precautionary fishery management and improved data accuracy regarding fish stocks, it is considered that the Commonwealth fisheries in the Region will continue to experience stable or reduced activity levels.

These patterns are broadly reflected in the State managed fisheries operating adjacent to the SWMR, with an overall pattern of declining catch and effort, if not GVP, in recent years. These relate primarily to the imposition of catch limits in each fishery, rather than any change in demand, hence it is reasonable to conclude that the high value export species such as abalone and rock lobster are faced with fairly secure markets based upon a strong brand image. Furthermore, the potential impact of any fluctuations in demand would be partly offset by the fact that many, if not all, fishers will have other sources of income, given the strong seasonality imposed by catch regulations. However, the effects of labour shortages will continue to be felt in the short to medium term at least while the current expansion of the minerals sector in particular proceeds. Despite the negative impacts of this on the labour pool for the fishing sector, it is inevitable that the minerals sector will experience a contraction in growth at some point, which could then result in participation in fishing becoming a more attractive proposition.

It also remains to be pointed out that the State managed fisheries operating in coastal and nearshore areas are more likely to experience conflict with other resource users. This has already been noted within the South-east Marine Region with regard to the potential for surfers to become entangled in rock lobster fishing pots, which resulted in a ban on all potting activity and access for rock lobster boats over 8.5m in length in 31 popular surfing locations in the Capes region of south-west Western Australia (Government of Western Australia, 2005). The potential for conflict with this user group as well as recreational fishers in terms of resource access is increasingly present, particularly as tourism development proceeds and potential declines in nearshore water quality are experienced by commercial fishers (WAFIC, personal communication). The combination of these activities is most likely to be evidenced in the short term in growing tourist destinations such as the central west coast and south-west peninsula of Western Australia and locations such as Kangaroo Island and the Fleurieu, Yorke and Eyre Peninsulas in South Australia.

To conclude, figure 6.5 summarises projected trends in commercial fishing activity in sub-regions of the SWMR coastline identified in Chapter 2. This highlights the overall projected decline in commercial fishing activity towards the west of the Region, reflecting the trends in pressure indicators in both Commonwealth and, to a lesser extent, State managed fisheries operating within and adjacent to the waters of the SWMR. The stability of commercial fishing activity towards the eastern sections of the SWMR indicated in figure 6.5 primarily reflects the State managed fisheries such as the sardine fishery in particular. There is a lesser degree of uncertainty surrounding the projected trends for these fisheries than those operating towards the south west and west coast, reflecting recent trends within the Commonwealth managed sectors as well as the uncertain environmental influences on State managed west coast fisheries such as the rock lobster fishery.

Figure 6.5 Overall trends in commercial fishing activity adjacent to the SWMR



7 RECREATIONAL FISHING

7.1 INTRODUCTION

Recreational fishing constitutes a significant activity in socio-economic terms for the Australian population as a whole, and the coastal population adjacent to the SWMR in particular. The first national survey of recreational fishing was undertaken in 2000-01, indicating that around 3.36 million Australians aged 5 years and older participated in this activity, representing 19.5% of the population. Each participant spent an average of $552 per annum, amounting to a total expenditure of $1.86 billion in 2000-01 (Henry & Lyle, 2003).

At the State level, management and research activities relating to recreational fishing activity in South Australia is undertaken principally by the Department of Primary Industries and Resources (PIRSA) and the Aquatic Sciences branch of the South Australian Research and Development Institute (SARDI). The Department of Fisheries undertakes the bulk of these responsibilities in Western Australia. Detailed information relating to recreational fishing activity in South Australia is largely based upon the 2001 National Recreational and Indigenous Fishing Survey (NRIFS), with a specific analysis of these data relating to South Australia being published by Jones and Doonan (2005). Annual summaries of recreational fishing activity in Western Australia are published by the Department of Fisheries.

Both States operate systems of regulation through controlling fishing gear, size limits, bag limits and areal closures in order to manage specific recreational fisheries. In addition, licenses must be held by individuals participating in the recreational rock lobster and abalone fisheries in both States. These management arrangements are the responsibility of each State, irrespective of whether the recreational fishing activity takes place in State or Commonwealth waters, hence recreational fishing within the SWMR is subject to individual State government regulations. It is therefore not always possible to differentiate recreational fishing data representing activity within Commonwealth waters from that taking place in State waters.

Figure 7.1 Location of recreational fishing zones, South Australia

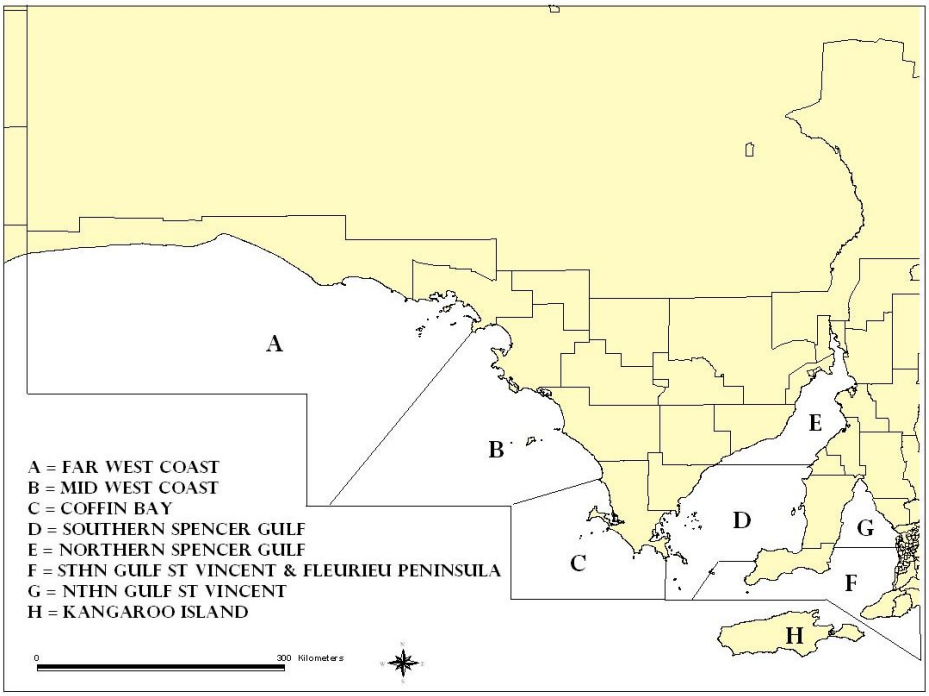
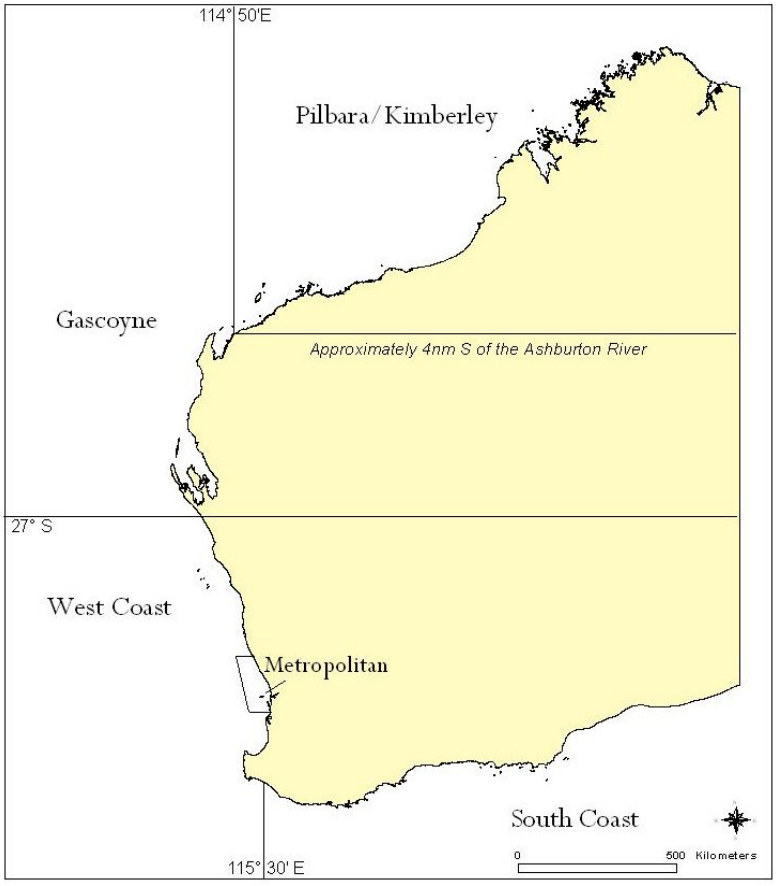


Figure 7.2 Location of recreational fishing zones, Western Australia



Each State has adopted a practice of delineating fishing regions to aid analysis of recreational fishing effort. In South Australia, this has followed the regions used in the NRIFS, the locations of which are illustrated in Figure 7.1. Western Australia has adopted a more simplified system reflecting the boundaries of the major marine bioregions of the State. These include the West Coast and the South Coast bioregions and the Perth metropolitan area (Figure 7.2), the latter being taken to reflect the coastal waters between Yanchep and Mandurah (Baharthah, 2006).

With rising resident and tourist populations, increased access to a variety of coastal areas and the diversity of marine species, the coastal regions adjacent to the SWMR hold many attractions for recreational fishing activities. The key driving force behind the growth of this sector relates to population growth overall and the participation in this activity. Aspects of population growth are considered in detail in Chapter 3, hence the focus here is on pressure indicators relating to participation as outlined below.

Table 7.1 Pressure indicators for recreational fishing activity adjacent to the SWMR

Driving forces	*Pressure indicators*
Population growth and participation	Number of recreational fishers Distribution of fishing effort Number and distribution of privately owned boats Number and distribution of chartered boat operators Total catch and species catch

7.2 CURRENT STATUS OF PRESSURE INDICATORS

7.2.1 Number of recreational fishers

Table 7.2 presents summary information relating to numbers and participation in recreational fishing at the State level as recorded between 1999 and 2000. The total numbers of recreational fishers were estimated at 328,227 in South Australia and 479,425 in Western Australia. The convention in this and subsequent surveys is to exclude the cohort of the population aged under 5 from calculations as they are not deemed to be potential participants in recreational fishing, hence these figures represent participation rates of 24.1% in South Australia and 28.5% in Western Australia. These data underline the significance of male and female participation in

both States with respect to the national average and highlights the popularity of this activity in Western Australia, where almost 30% of the total population undertook recreational fishing at least once during 1999-2000.

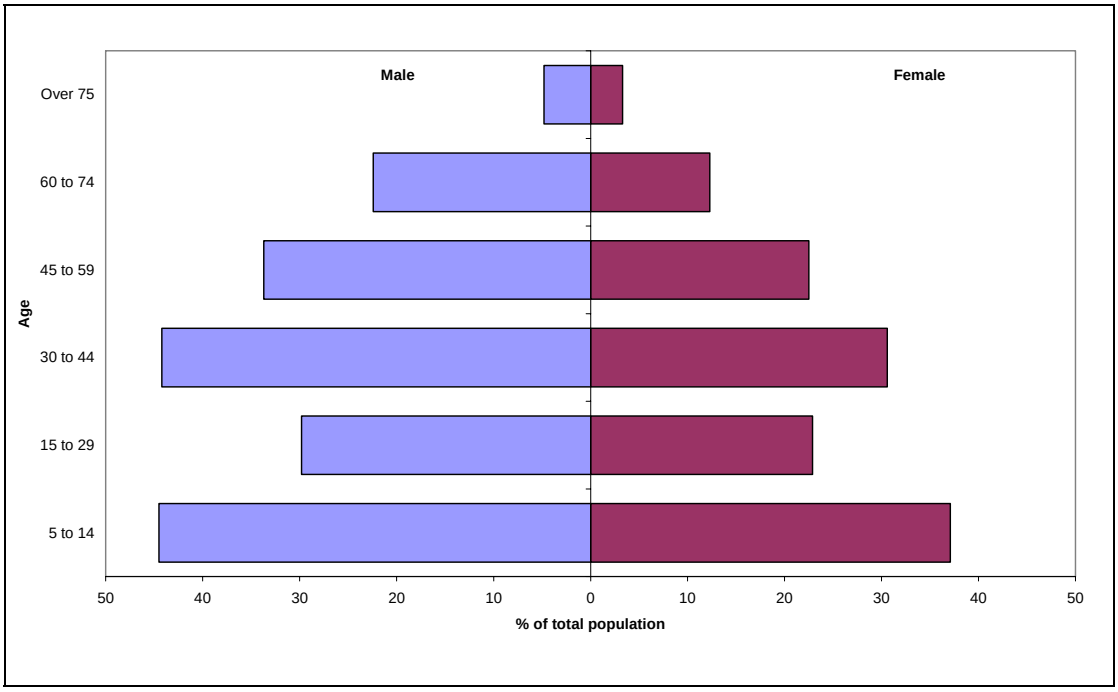
Table 7.2 Male and female percentage participation in recreational fishing at the State level, 1999-2000

	South Australia	*Western Australia*	*National*
Males	34.1	37.3	26.7
Females	14.5	19.7	12.4
Total	24.1	28.5	19.5

(Sources: Henry & Lyle, 2003; Jones & Doonan, 2005)

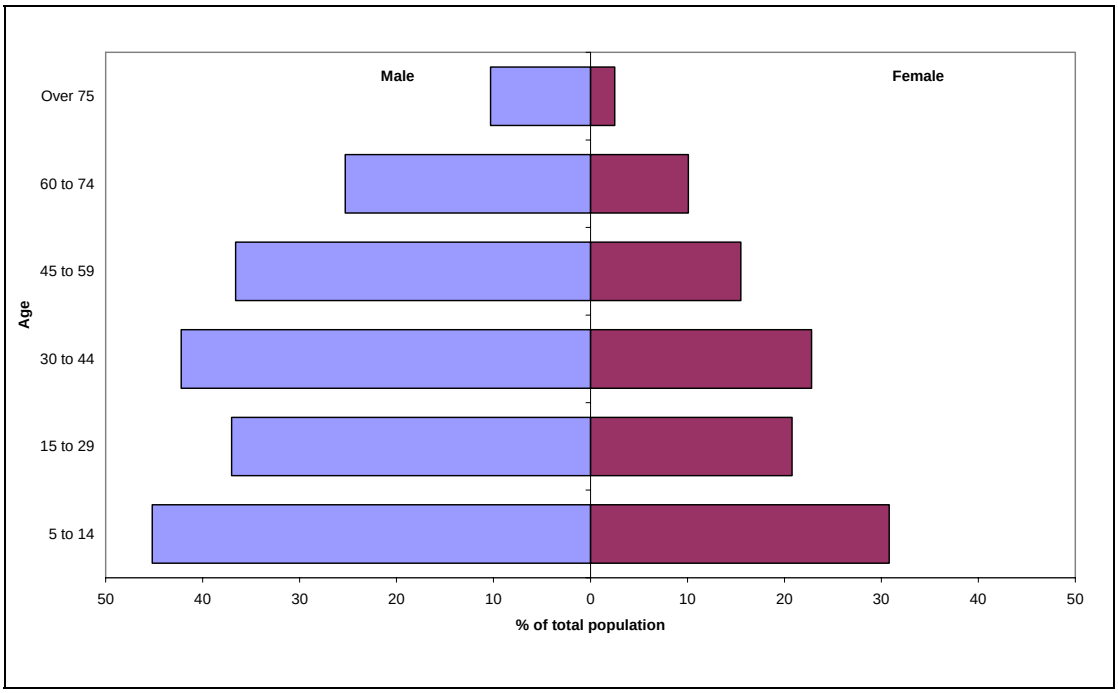
Figures 7.3 and 7.4 detail the percentage of age groups recorded as participating in recreational fishing as a proportion of the State population aged 5 years and over in South Australia and Western Australia respectively between 1999 and 2000.

Figure 7.3 Participation in recreational fishing South Australia, 1999-2000



(Source: Jones & Doonan, 2005)

Figure 7.4 Participation in recreational fishing Western Australia, 1999-2000



(Source: Henry & Lyle, 2003)

These demonstrate the greater popularity of recreational fishing amongst males than females, in accordance with the national trend. Furthermore, the greater participation of males in specific age groups is highlighted, particularly with regard to those aged from 5-14 and 30-44, whose participation in recreational fishing approached 45% in both States. With respect to females, the relative popularity of recreational fishing was most marked with regard to the youngest cohort aged from 5-14.

More recent data collected in May 2005 is available with respect to Western Australia (Baharthah, 2006), detailing the recreational fishing activities undertaken by 700 members of the public over the preceding 12 months. This indicated a slight increase in the overall recreational fishing participation rate to 31.1%, equivalent to 537,587 recreational fishers. Recreational fishing was found to be more popular in the regions of Western Australia than the Perth metropolitan area, particularly with regard to male participation which increased from 0.30 to 0.55, whilst female participation in recreational fishing increased from 0.21 to 0.37.

7.2.2 Distribution of fishing effort

Table 7.3 summarises the recreational fishing effort by State between 1999-2000 expressed as fishing hours, days spent fishing and fishing events as reported by Henry and Lyle (2003).

Table 7.3 Recreational fishing effort by State, 1999-2000

Parameter	*South Australia*		*Western Australia*	
	Number	*% of national total*	*Number*	*% of national total*
Fishing hours	9,768,000	9.5	19,694,000	19.1
Fisher days	1,944,000	9.4	3,367,000	16.3
Fishing events	2,216,000	9.6	3,442,000	14.8

(Source: Henry & Lyle, 2003)

These data demonstrate the overall greater recreational fishing effort within Western Australian state waters as calculated by different techniques. Analysis of fishing effort at a more detailed level is complicated by the different parameters used to express fishing effort. Jones and Doonan (2005) undertook further analysis of the NRIFS data to calculate fishing effort expressed in terms of fishing hours for regions within South Australian waters. However, a similar exercise using the NRIFS data from Western Australia has yet to be conducted. The most recent effort data is published by Baharthah (2006) which details recreational fishing effort in regions within Western Australia in terms of days spent fishing.

In order to provide comparable data across regions adjoining the SWMR and to facilitate analysis later in this section, it is necessary to adopt a common frame of reference for fishing effort, which for these purposes is best represented by days spent fishing. Analysis of recreational fishing effort data for all States presented by Henry & Lyle (2003) indicates a conversion factor of 5.2 fishing hrs = 1 fisher day. The data from South Australia has therefore been converted from fishing hours to fisher days. The resulting indicative distribution of recreational fishing effort within the recreational fishing zones of South Australian and Western Australia is summarized in Table 7.4.

Table 7.4 Distribution of recreational fishing effort in recreational fishing zones of South Australia and Western Australia

Region	*Fishing effort (total annual fishing days)*	*Percentage of total*
South Australia		
Far West	42,093	3.6
Mid West	59,369	5.1
Coffin Bay	72,784	6.3
Southern Spencer Gulf	265,801	23.0
Northern Spencer Gulf	188,780	16.3
Southern Gulf St Vincent / Fleurieu Peninsula	213,821	18.5
Northern Gulf St Vincent	289,526	25.0
Kangaroo Island	25,683	2.2
TOTAL	**1,157,856**	**100**
Western Australia		
West Coast excluding Perth Metropolitan	2,481,000	48.4
Perth Metropolitan	1,884,000	36.8
South Coast	760,500	14.8
TOTAL	**5,125,500**	**100**

(Sources: Baharthah, 2006; Jones and Doonan, 2005)

It should be borne in mind that there are potential errors introduced by converting fisher hours to fisher days, whilst there is a considerable time difference separating the periods when the data from the two states were collected, rendering direct comparison difficult. In South Australia, it is evident that the Spencer Gulf and Gulf of St Vincent experience the most intensive fishing effort, together accounting for over 80% of the total recreational effort within South Australian waters adjoining the SWMR. The concentration of effort is more acute in Western Australia, with the small Perth Metropolitan region accounting for over a third of the total effort and the wider West Coast bioregion accounting for almost half of the total effort. If some comparison between the two datasets can be assumed, it is evident that overall fishing effort is far greater in Western Australian waters adjoining the SWMR.

7.2.3 Number and distribution of privately owned boats

This pressure indicator reflects the fact that the regulation of recreational fishing through species-specific licenses differs according to individual State regulations, hence this is not a reliable indicator of recreational fishing activity within and adjacent to the SWMR. However, licensing of motorized recreational vessels is mandatory in both South Australia and Western Australia and can therefore be used as an indicator of recreational fishing activity. Licensing of private boats is the responsibility of the

Department of Transport, Energy and Infrastructure in South Australia and the Department of Planning and Infrastructure in Western Australia. Licenses are issued for various categories of boat and are subject to annual renewal in Western Australia, but single category licenses are issued for life in South Australia. The latter data must be viewed with this caveat in mind, particularly as they will not reflect cases where the licensee may no longer possess or use the boat or may have deceased.

Data provided by the DPI relating to the postcodes of all private boat licensees in Western Australia is categorized into nine postcode regions, the locations of which are illustrated in Figure 7.5. These were analysed to derive annual totals relating to renewals and new registrations. The most recently available data for 2005-06 indicates that a total of 78,375 new and renewed licenses were issued to residents of Western Australia in areas adjacent to the SWMR (Table 7.5). This definition is taken to exclude licensees' postcodes within the Central West and North West regions, which together accounted for another 6,744 licenses. Licensees in South Australia within the SWMR were identified on the basis of the home postcode being within 10km of the coastline adjacent to the SWMR. These were then grouped into the fishing regions illustrated previously in Figure 7.1. The total number of licensees thus identified amounted to 147,000, with the distribution by fishing region being detailed in Table 7.5. Given the differing circumstances relating to the issuing of licenses in the two states, it is not considered appropriate to combine these two datasets.

Figure 7.5 Location of postcode regions for private boat ownership in Western Australia

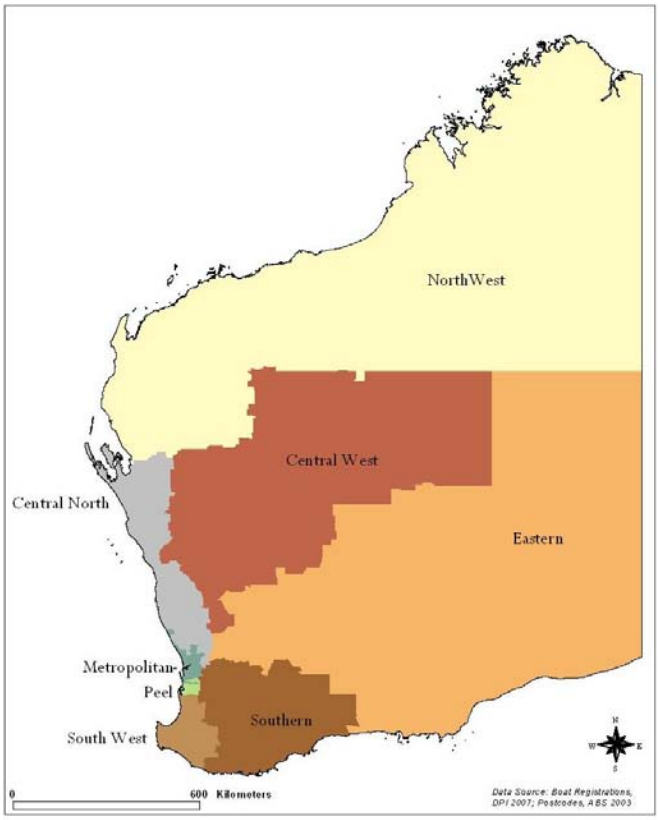


Table 7.5 Distribution of recreational boat ownership in South Australia and Western Australia by licensee postcode

Postcode region	*Number of licensees*	*Percentage of total*
South Australia		
Far West	1,072	0.7
Mid West	3,493	2.4
Coffin Bay	6,644	4.5
Southern Spencer Gulf	11,145	7.6
Northern Spencer Gulf	15,304	10.4
Southern Gulf St Vincent / Fleurieu Peninsula	72,398	49.2
Northern Gulf St Vincent	35,533	24.2
Kangaroo Island	1,421	1.0
TOTAL	**147,010**	**100**
Western Australia		
Metropolitan	47,928	61.2
Southwest	11,186	14.3
Peel	8,142	10.4
Southern	4,900	6.3
Central North	4,344	5.5
Eastern	1,875	2.4
TOTAL	**78,375**	**100**

(Sources: DTEI; DPI, personal communications 2007)

Table 7.5 demonstrates that, as expected, there is a clear concentration of recreational boat ownership in the two urban centres of Adelaide and Perth. However, boat ownership is more widespread in South Australia, with significant proportions of owners in the northern Gulf of St Vincent and the northern Spencer Gulf areas. In Western Australia, boat ownership is concentrated in the Perth, South West and Peel regions, together accounting for 85% of all boats registered in 2005-06.

These data for Western Australia reflect all 19 categories of privately owned boats defined by the DPI and therefore are not directly relevant to the recreational fishing sector. Further analysis was carried out focusing on the licensing of the 'Runabout' category, which is most likely to be used for recreational fishing and therefore arguably constitutes a more appropriate indicator of this activity. The distribution of licenses in this category for 2006 is detailed in Table 7.6.

Table 7.6 Distribution of licensees by postcode region for Runabout private boat category, 2006

Postcode region	*Number of Runabout licenses*	*Percentage of total*
Metropolitan	12,877	57.8
Southwest	3,694	16.6
Peel	2,433	10.9
Southern	1,514	6.8
Central North	1,276	5.7
Eastern	492	2.2
TOTAL	**22,286**	**100**

(Source: DPI, personal communication 2007)

This confirms that the Perth metropolitan region accounted for the majority of recreational fishing boat registrations in 2006, which together with the adjoining Peel and Southwest postcode regions, represented over 85% of all boat licenses in this category.

7.2.4 Number and location of chartered boat operators

This indicator is designed to reflect the growth of the aquatic tour industry which involves fishing or other use of marine resources. In Western Australian coastal waters, all such activities outside of marine protected areas have been managed under a transferable license system under by the Department of Fisheries since 2001 and are

divided into three categories. The first category comprises fishing tour operator licenses, which are required where fish may be taken home by the participants at the end of the tour. In order to manage the growth of this sector, there is currently a moratorium on the issuing of new licenses, which may only be granted under extraordinary circumstances. The second category of restricted fishing tour operator licenses regulate those activities where fishing takes place but the catch is not taken home. This category also covers non-fishing activities such as scuba diving and snorkeling. Both of these license categories are also governed by other relevant regulations applying to recreational fishing. The final category of aquatic eco-tour operator licenses covers other tour activities which do not involve fishing. A total of 162 fishing tour operator licenses were granted in 2005-06 in waters within and adjacent to the SWMR, 138 of which applied to the West Coast bioregion and 24 to the South Coast bioregion. A total of 28 restricted fishing and ecotour operator licenses were issued in 2005-06, 23 in the West Coast bioregion and 5 in the South Coast bioregion (Department of Fisheries, 2006a).

In South Australia, the recreational charter boat industry has been managed since 2005 under a system of annually renewable licenses with no sub-division of categories. A total of 106 chartered boat operator licenses were issued with the introduction of the licensing system in South Australia in 2005, followed by three in 2006 and one in 2007 (PIRSA, personal communication).

7.2.5 Total catch and species catch

Total catch and species catch at State level

The NRIFS survey provides comparable data relating to recreational fishing catch at the State level using data collected from 2000-01. Given the standard error associated with these calculations, these should be regarded as broad estimates of the total catch.

Table 7.7 Total recreational fishing harvest by State, 2000-01

	South Australia		*Western Australia*		*National*
	Harvest (nos)	*% of national*	*Harvest (nos)*	*% of national*	*harvest (nos)*
Finfish	10,818,744	15.0	10,474,383	14.6	71,907,568
Crustaceans/ cephalopods/ molluscs	6,582,415	10.3	5,872,571	9.2	63,999,058
TOTAL	**17,401,159**	**12.8**	**16,346,954**	**12.0**	**135,906,626**

(Source: Henry & Lyle, 2003)

Table 7.7 indicates that the recreational harvest in South Australian waters was slightly greater than that in Western Australia in 2000-01, together amounting to almost a quarter of the total national recreational catch. The recreational catch of finfish was around twice that of crustaceans, cephalopods and molluscs combined in both States.

These data reflect recreational fishing activity in the year 2000-01, which can be projected forward using current population data to provide a broad estimate of the contemporary recreational catch. The most recently published population data indicates that the estimated resident population of South Australia and Western Australia was 1,575,700 and 2,081,000 in December 2006 respectively, with a national total of 20,852,000 (ABS, 2007a). Currently the percentage of the population aged under 5 is around 6%, which has been deducted from the population data to generate estimates of the current recreational harvest as detailed in Table 7.8.

Table 7.8 Estimated total numbers of recreational fishing harvest, 2006

	South Australia	*Western Australia*	*National*
Population over 5 years of age June 2001	1,371,377	1,722,088	17,643,094
Recreational harvest 2000-01	17,401,159	16,346,954	135,906,626
Estimated catch per person 2000-01	12.7	9.5	7.7
Population over 5 years of age December 2006	1,481,158	1,956,140	19,600,880
Population increase 2001-06	109,781	234,052	1,957,786
Estimated total catch 2006	18,794,147	18,568,702	150,987,659
Estimated catch increase 2001-06	1,392,988	2,221,748	15,081,033
% of estimated national catch 2006	12.4	12.3	-

It must be remembered that these estimates assume constant participation rates, catch returns and stock levels, as well as a lack of change in management practices, and are henceforth highly speculative, but they do indicate the effect of overall population trends on recreational fishing harvest at the State level. The annual recreational harvest for South Australia and Western Australia using 2006 population data is estimated to be in the order of 18.8 million and 18.6 million individuals respectively. The relatively stable population of South Australia in comparison to Australia as a whole and Western Australia in particular results in the latter increasing its proportion of the estimated national recreational harvest in 2006.

Further analysis of data in the NRIFS survey from 2000-01 allows the identification of the most frequently caught species in South Australian and Western Australian waters by number. These totals can also be expressed in biomass terms using average weight per species data presented by Jones and Doonan (2005).

Table 7.9 Estimated recreational catch harvest by number and weight for selected species, 2000-01

Species	*Harvest (nos.)*	*Harvested biomass (kg live weight)*	*% of national total*
		South Australia	
Garfish	1,511,250	132,990	62.0
King George whiting	2,238,071	606,517	61.8
Squid / cuttlefish	1,047,904	423,353	60.8
Australian herring	2,973,402	297,340	43.4
		Western Australia	
Lobsters	403,833	339,220	58.8
Blue swimmer crab	2,211,466	756,321	56.6
Australian herring	3,873,411	387,341	56.5
Abalone	214,351	103,532	55.5

(Sources: Henry & Lyle, 2003; Jones & Doonan, 2005)

This indicates that the coastal waters of South Australia and Western Australia together accounted for the majority of the national recreational harvest of herring (99%), blue swimmer crabs (86%), lobster (76%), King George whiting, garfish and squid / cuttlefish (74% each) and abalone (61%) in 2000-01. It is also worthy of note that the larger recreational target species such as sharks and rays ranked first (614,440 kilograms) and third (488,640 kilograms) in terms of total catch by weight in South Australia and Western Australia respectively, although this represented a minor fraction of the national catch (13% and 11% respectively). Similarly, tuna and bonito ranked second (519,426 kilograms) in terms of catch by weight in Western Australian waters in 2000-01, although this only accounted for 12% of the national recreational catch.

Total recreational catch and species catch in waters in and adjacent to the SWMR

Detailed data on individual species catch is available for those marine fisheries which operate under a licensing system in Western Australia, which include the rock lobster fishery and the abalone fishery. Data are also available from returns provided by

holders of chartered boat licenses. Annual catch data and participation rates are published annually by the Department of Fisheries for these activities. There is a lack of similar detailed data from the South Australian government. The most detailed available information extant for the coastal waters off South Australia remains the analysis of the NRIFS survey published by Jones and Doonan (2005).

The recreational rock lobster fishery of Western Australia largely targets western rock lobster (*Panulirus cygnus*) using pot traps and SCUBA diving equipment and is concentrated in the Perth metropolitan area and Geraldton (sub-regions 1 and 2 of Figure 1.2). The total estimated catch in 2004-05 was 379 tonnes, of which 75% (285 tonnes) was taken by potting and 25% (94 tonnes) by diving. The recreational catch accounted for 3% of the combined estimated commercial and recreational catch. A total of 45,188 licenses were issued in 2004-05, comprising both rock lobster licenses and umbrella licenses which cover all forms of recreational fishing. Of this total, it was estimated that 25,900 individuals or 57% of the total number of licensees were active in 2004-05. Catch rates were 1.8 and 2.9 lobsters per person per fishing day for potters and divers respectively.

The recreational abalone fishery of Western Australia targets three species in distinct geographical regions adjacent to the SWMR. Roe's abalone (*Haliotis roei*) is exploited by wading and snorkeling in shallow waters between Geraldton and Augusta in the West Coast bioregion (sub-region 1), whilst greenlip abalone (*H. laevigata*) and brownlip abalone (*H. conicopora*) are taken in by diving and snorkeling in deeper water south of Cape Naturaliste and along the south coast of Western Australia (sub-regions 4 and 5). A total of 20,000 licenses were issued in 2004-05. The latest available full dataset for the abalone fishery dates from 2004-05, which is summarized in Table 7.10. Catch rate is expressed as abalone per fisher day and catch is expressed in tonnes wet weight. The recreational catch accounted for 23-31% of the combined commercial and recreational catch for Roe's abalone and 2-7% for greenlip and brownlip abalone.

Table 7.10 Catch data for the recreational abalone fishery in Western Australian waters adjoining the SWMR, 2004-05

Bioregion / area	*Effort ('000 fisher days)*	*Roe's abalone*		*Greenlip abalone*		*Brownlip abalone*	
		Catch rate	*Catch (t)*	*Catch rate*	*Catch (t)*	*Catch rate*	*Catch (t)*
Perth Metro	14 – 20.5	17.8	25-31	-	-	-	-
West Coast excl Perth Metro	6.5 – 13.6	11.0	7-14	0.6	2-6	0.4	1-5
South Coast	1.7 – 3.7	6.2	1-3	2.4	1-5	<0.1	0-1

(Source: Department of Fisheries, 2006a)

With respect to the chartered boat sector, the most recently available data summarized in Table 7.11 relates to the financial year 2004-05 (Department of Fisheries, 2006a), as the majority of chartered boat activity takes place between September to March.

Table 7.11 Summary of chartered boat recreational fishing catch in Western Australian waters adjoining the SWMR, 2004-05

	West Coast Bioregion	*South Coast Bioregion*	***Total***
License holders	160	27	**187**
Usage rate	55%	40%	**-**
Number of tours	4885	359	**5244**
Number of fishing-only tours	2347	323	**2670**
Total estimated catch (t)	110	21.5	**131.5**
Estimated average catch per fishing only tour (t)	0.05	0.07	**0.05**

(Source: Department of Fisheries, 2006a)

This underlines the predominance of chartered boat fishing activity in the West Coast bioregion, with 93% of all chartered boat tours, 88% of fishing only tours and 84% of the total catch being recorded in this area. Table 7.12 details the most commonly caught species as recorded by chartered boat operator returns.

Table 7.12 Species catch by chartered boat operator licensees in Western Australian waters adjoining the SWMR, 2004-05

Species	*West Coast catch (t)*	*South Coast catch (t)*
Pink snapper	26	1
Dhufish	24.5	0.5
Samson fish	12	2
Bight redfish	3	5.5
Baldchin groper	7.5	0
Sweetlip emperor	5.5	0
Queen snapper	5	1.5
Breaksea cod	4	1.5
Skipjack trevally	1.5	1
Swallowtail	0	2
Sea sweep	0	0.5
Other finfish	21	6
TOTAL	**110**	**21.5**

(Source: Department of Fisheries, 2006a)

This indicates the reliance of chartered boat operators on the pink snapper, dhufish and samson fish stocks in Western Australian waters, which together accounted for just over half of the total catch in 2004-05. These species are almost entirely caught in the West Coast bioregion, the most commonly caught species in the South Coast bioregion being bight redfish, representing around a quarter of the total catch in this bioregion.

As stated previously, similarly detailed data are not available for the recreational fisheries of South Australia. However, the analysis of the NRIFS survey conducted by Jones and Doonan (2005) allows some overall comment on fishing activity in South Australian waters adjacent to the SWMR. This analysis provided total catch numbers for 17 key species for each of the eight fishing regions illustrated in Figure 7.1. These data indicate that the recreational catch in fishing regions within and adjacent to the SWMR amounted to approximately 15.6 million individuals in 2000-01, representing 90% of the total recreational catch within South Australian coastal waters. This catch equated to around 4,600 tonnes, which accounted for 89% of the total State catch by wet weight. Table 7.13 indicates the spatial distribution of this catch by number and wet weight equivalent for the eight South Australian recreational fishing regions which lie within and adjacent to the boundaries of the SWMR.

Table 7.13 Distribution of recreational catch within South Australian fishing regions adjacent to the SWMR, 2000-01

Region	*Total harvest*		*Total harvest biomass*	
	Numbers	*% of SWMR total*	*Weight (tonnes)*	*% of SWMR total*
Far West	503,405	3.2	186.5	4.1
Mid West	660,590	4.2	158.4	3.5
Coffin Bay	1,132,293	7.3	282.4	6.2
Southern Spencer Gulf	2,313,821	14.8	722.5	15.7
Northern Spencer Gulf	3,060,039	19.6	1660.1	36.2
Southern Gulf St Vincent / Fleurieu Peninsula	3,883,633	24.9	566.7	12.4
Northern Gulf St Vincent	3,727,570	23.9	905.0	19.7
Kangaroo Island	331,646	2.1	106.8	2.3
TOTAL	**15,612,997**	**100**	**4,588.5**	**100**

(Source: Jones & Doonan, 2005)

It should be borne in mind that these data are estimated catch totals of selected key species based upon interviews, diaries and telephone diaries of a representative sample of the South Australian public, hence will differ in accuracy from the information submitted by recreational fisher licensees in Western Australia. The summary statistics presented in Table 7.13 indicate the spatial distribution of catch numbers and biomass, with the three westernmost regions contributing a total of around 15% of the total catch by number and biomass. Catch numbers from the Spencer Gulf (sub-regions 7 and 8 of Figure 1.2) amounted to around 35% of the total caught within these eight fishing regions, represented over 50% of the total catch by weight, whilst the reverse pattern was evident in the Gulf of St Vincent (sub-region 9), which contributed almost half of the total catch by number and around 32% by weight. This is mainly due to the concentration of the recreational snapper fishery in the northern Spencer Gulf, which accounted for over two thirds of the snapper harvest from these eight regions. Large recreational target species such as the whaler shark were predominantly caught in the Gulf of St Vincent, representing 75% of the total catch of these eight regions, but the total biomass of this regional fishery was small in comparison to the Spencer Gulf snapper fishery (22.7 tonnes and 1,147 tonnes respectively).

Further analysis of the recreational catch by species in these fishing regions within and adjacent to the SWMR is provided in Table 7.14, which summarises the estimated recreational fishing catch in tonnes wet weight for the most commonly caught South Australian species identified in Table 7.9.

In the absence of more recent data, this analysis provides the most detailed information available regarding the most frequently caught species in these eight regions within and adjacent to the SWMR. King George whiting dominated in terms of overall catch by weight, with activity being concentrated in the Spencer Gulf, which accounted for almost half of the total catch. Approximately equal total catch weights of squid / cuttlefish and Australian herring were recorded with a broadly similar spatial distribution of catches, although the Far West region contributed a substantial amount of squid / cuttlefish, representing the most significant recreational fishing activity by catch weight in this region. Garfish landings were the lowest by overall catch weight but were highly concentrated in the northern area of the Gulf of St Vincent.

Table 7.14 Estimated recreational catch data for commonly caught species within South Australian fishing regions adjacent to the SWMR, 2000-01

Region	*Garfish*		*King George whiting*		*Squid / cuttlefish*		*Australian herring*	
	Catch (t)	*%*	*Catch (t)*	*%*	*Catch (t)*	*%*	*Catch (t)*	*%*
Far West	1.2	0.9	44.8	5.5	57.1	13.8	5.9	1.7
Mid West	0.5	0.3	48.5	6.0	16.5	4.0	25.2	7.2
Coffin Bay	13.7	10.1	155.6	19.1	6.7	1.6	18.9	5.4
Southern Spencer Gulf	32.0	23.5	168.0	20.6	99.8	24.1	69.2	19.7
Northern Spencer Gulf	13.4	9.8	192.3	23.6	46.8	11.3	47.8	13.6
Southern Gulf St Vincent / Fleurieu Peninsula	15.4	11.3	57.4	7.0	54.2	13.1	60.9	17.3
Northern Gulf St Vincent	56.9	41.8	118.0	14.5	130.5	31.5	114.6	32.6
Kangaroo Island	3.0	2.2	30.1	3.7	2.1	0.5	9.5	2.7
TOTAL	**136.0**	**100**	**814.7**	**100**	**413.8**	**100**	**351.9**	**100**

(Source: Jones and Doonan, 2005)

7.3 MACRO-ECONOMIC DRIVERS AT THE INTERNATIONAL AND NATIONAL LEVEL

The popularity of recreational fishing at the national level is not a new phenomenon, with one in four households containing at least one participant and an estimated total effort of over 20 million fisher days in 2000-01. The main reasons for participating related to the opportunity to relax, to undertake a sporting pastime and to spend time with family in an outdoor setting. This underlines the social and recreational significance of recreational fishing.

Given the widespread popularity of recreational fishing, it is logical to assume that regions experiencing a growth in population described in Chapter 2 will witness a rise in the numbers of recreational fishers. The driving forces behind an increased population reflect wider economic influences, with the growth of the regional economy in Western Australia being a case in point. The strength of the Western Australian economy largely reflects effects of the expansion of the mineral resources sector, which in turn is a function of the growing international trade with key partners such as China. In the period 2000-06, the average annual rate of population increase was 0.5%, 1.6% and 1.3% for South Australia, Western Australia and the country as a whole respectively (ABS, 2006a). Over this time period, the annual increase in gross state product averaged 3.7% and 6.1% for South Australia and Western Australia respectively, whilst the figure for gross domestic product at the national level was 4.0% (ABS, 2006b), indicating the overall relationship between economic growth and population trends. It is possible that the increasing popularity of Western Australia and the Perth metropolitan area in particular as a retirement destination is associated with greater individual time and effort for the average fisher in this region, although this correlation is actually not borne out by the demographic profiling of recreational fishers reported above.

One outcome of this economic growth in Western Australia with respect to recreational fishing in particular is the increased disposable income of households, which has significant consequences with regard to recreational fishing effort. Over the period 2000-06, individual average weekly earnings increased at an annual rate of 6.7% in Western Australia, as compared to 4.2% in South Australia and 5.1% for the

country as a whole. This resulted in average individual weekly earnings in November 2006 being $876, $772 and $844 for Western Australia, South Australia and the nation as a whole respectively (ABS, 2007b).

As a consequence, it would be expected that a greater proportion of people, particularly in Western Australia, are able to invest increasing amounts of capital in recreational boats. This is supported by data from the DPI showing that the number of new and renewed licenses issued for all recreational vessels over 8.5m in length in Western Australia increased from 3,128 in 2000 to 4,270 in 2006, an annual rate of increase of around 7.3% (DPI, personal communication). If it is assumed that some of these larger vessels are used for recreational fishing, it could be the case that this is actually aiding the dispersal of fishing effort, given the greater range of larger boats. Unfortunately, more detailed information relating areas used by fishers to boat type and size is unfortunately not available to explore this possibility in more depth.

It is more certain that an increasing proportion of all recreational fishing boats, particularly those at the more expensive end of the range, are likely to be equipped with GPS and other fish-finding technology, thereby increasing the overall potential catch out of proportion to the actual numbers of boats involved. Whilst this is again difficult to quantify, data from 1996-97 estimates that 12% of privately owned recreational fishing boats in the West Coast bioregion had GPS equipment (Department of Fisheries, 1999). Similar surveys conducted from 1998 to 2000 indicate that GPS was present on 49% and 40% of recreational fishing boats in the Gascoyne and Pilbara bioregions respectively (Department of Fisheries 2006, 2002). Given the relative cost of this technology currently, it is highly probable that these devices are common in most recreational fishing boats at the present time.

The increasing prevalence of recreational boat ownership associated with an expanding economy and optimistic forecasts for continued growth has concurrent effects on the balance between shore and boat-based fishing, as the latter clearly has a greater potential impact upon fish stocks. Data from 2000-01 indicates that boat-based fishing accounted for 38% and 43% of annual fishing events in South Australia and Western Australia respectively (Henry & Lyle, 2003). It is likely that this balance is changing, with recent anecdotal evidence suggesting a decrease in the number of

shore-based anglers (ABC News, 2007), although more recent data on this aspect of recreational fishing is lacking.

It can therefore be concluded that, as a popular recreational pastime with potentially considerable financial investment in gear and vessels, the economic climate in Western Australia has been particularly conducive to the rise in numbers involved in this activity. By comparison, rates of economic growth and population increase in South Australia have been more modest, indicating that participation and effort in recreational fishing, whilst stable, is increasingly likely to be exceeded by that in Western Australia.

7.4 FUTURE TRENDS WITHIN THE SOUTH-WEST MARINE REGION

7.4.1 Number of recreational fishers

The number of recreational fishers in and adjacent to the SWMR can be projected through combining population predictions with participation data. The latter are calculated at the statistical division level for all States in the NRIFS report (Henry & Lyle, 2003). Population predictions are available at the statistical local area level from the ABS for the period 2007-2022 as discussed in Section 2. In accordance with previous research, the population cohort under 5 years old has been excluded from these population predictions, yielding the population forecasts detailed in Table 7.15.

Table 7.15 Projected population aged 5 and over in statistical divisions adjacent to the SWMR, 2007-2022

Statistical division	*Predicted population aged 5 and over*			
	2007	*2012*	*2017*	*2022*
	South Australia			
Adelaide	1,076,924	1,098,071	1,114,198	1,127,195
Outer Adelaide	116,829	123,340	129,141	134,366
Yorke & Lower North	42,250	42,116	41,756	41,201
Eyre	32,701	33,371	33,839	34,155
Northern	72,174	69,516	66,169	62,346
	Western Australia			
Perth	1,431,730	1,535,756	1,635,385	1,732,391
South West	204,498	221,134	236,760	251,530
Lower Great Southern	52,623	54,600	56,275	57,703
Midlands	51,703	53,132	54,203	54,976
South Eastern	50,792	50,837	50,323	49,402
Central	57,667	58,626	59,095	59,192

(Source: ABS, 2007a)

Applying the appropriate participation ratio for each statistical division as detailed by Henry & Lyle (2003) yields projected total participants in recreational fishing in statistical divisions adjacent to the SWMR as detailed in Tables 7.16-7.17 and Figure 7.6.

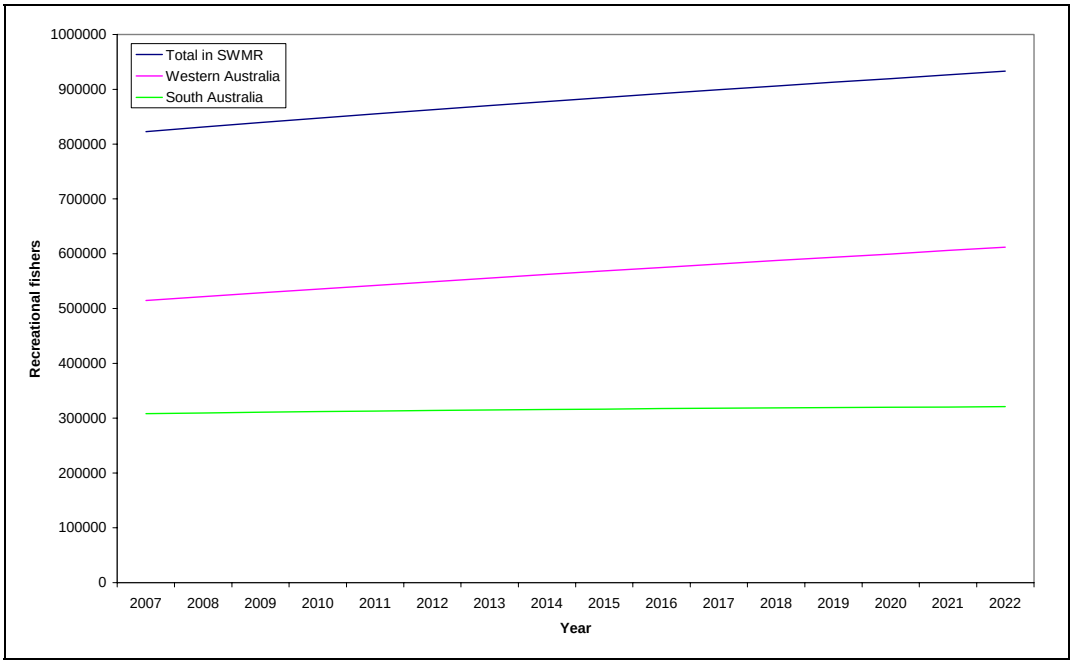
Table 7.16 Projected total recreational fishers in statistical divisions adjacent to the SWMR, 2007-2022

Statistical division	*Participation rate*	*Projected participants in recreational fishing*				*% change 2007-2022*
		2007	*2012*	*2017*	*2022*	
		South Australia				
Adelaide	20.3	218,616	222,908	226,182	228,821	4.7
Outer Adelaide	30.0	35,049	37,002	38,742	40,310	15.0
Yorke & Lower North	36.5	15,421	15,372	15,241	15,038	-2.5
Eyre	48.1	15,729	16,051	16,277	16,429	4.4
Northern	32.6	23,529	22,662	21,571	20,325	-13.6
		Western Australia				
Perth	24.1	345,047	370,117	394,128	417,506	21.0
South West	46.8	95,705	103,491	110,804	117,716	23.0
Lower Great Southern	35.7	18,786	19,492	20,090	20,600	9.7
Midlands	29.5	15,252	15,674	15,990	16,218	6.3
South Eastern	34.1	17,320	17,335	17,160	16,846	-2.7
Central	39.0	22,490	22,864	23,047	23,085	2.6
TOTAL		**822,944**	**862,970**	**899,232**	**932,893**	**13.4**

Table 7.17 Distribution of projected total recreational fishers by statistical division adjacent to the SWMR, 2007-2022

Statistical division	*Percentage of participants in recreational fishing*			
	2007	*2012*	*2017*	*2022*
		South Australia		
Adelaide	26.6	25.8	25.2	24.5
Outer Adelaide	4.3	4.3	4.3	4.3
Yorke & Lower North	1.9	1.8	1.7	1.6
Eyre	1.9	1.9	1.8	1.8
Northern	2.9	2.6	2.4	2.2
		Western Australia		
Perth	41.9	42.9	43.8	44.8
South West	11.6	12.0	12.3	12.6
Lower Great Southern	2.3	2.3	2.2	2.2
Midlands	1.9	1.8	1.8	1.7
South Eastern	2.1	2.0	1.9	1.8
Central	2.7	2.6	2.6	2.5
TOTAL	**100.0**	**100.0**	**100.0**	**100.0**

Figure 7.6 Projected total numbers of recreational fishers adjacent to the SWMR, 2007-2022



These calculations indicate that the numbers of recreational fishers adjacent to the SWMR are likely to increase at an average rate of 0.9% per annum from 823,000 in 2007 to 933,000 in 2022. The majority of this increase reflects growing numbers of

fishers in the Western Australian divisions adjacent to the SWMR, which are projected to increase by 19% from 514,600 in 2007 to 612,000 in 2022, in comparison to the projected increase of 4% from 308,300 in 2007 to 321,000 in 2022 in the South Australian divisions. As a result, the proportion of recreational fishers in the South Australian divisions adjacent to the SWMR is projected to decline from 37.5% in 2007 to 34.4% in 2022.

As the boundaries of these statistical land divisions and the recreational fishing zone regions illustrated in Figures 7.1 and 7.2 are based upon differing terrestrial and marine-based demarcation systems, it is not possible to express the above projections in terms of numbers of recreational fishers in each recreational fishing zone. However, these projections do illustrate several issues relating to the distribution of fishers adjacent to the SWMR. In the case of South Australia, almost all of the projected increase in total recreational fishers takes place in the Gulf of St Vincent in association with the wider Adelaide metropolitan area (sub-region 9 in Figure 1.2), whilst a significant decline in recreational fishers is seen in the Northern region which encompasses the far western coastal districts of the State (sub-region 6). In Western Australia, the continued population increase in and around Perth (sub-regions 2 and 3) is seen to result in this region carrying around 66% of the overall total projected increase in recreational fishers between 2007 and 2022, despite the lower participation rate of the metropolitan area. The relatively small size of this statistical division further underlines the likely consequences in respect of intensified recreational fishing pressure. There is also a notable increase in recreational fishers in the south-west of the state, reflecting a combination of population growth and high participation rates in this sector. Outside of these two regions, the Western Australian divisions are characterized by similar projected rates of increase in recreational fishers to those found in rural divisions of South Australia.

It is also worth noting that the participation rates used in the above calculations are relatively conservative. Estimates of participation rates vary in the literature according to the method of calculation used, with cited ratios ranging from 27% to 51% (Baharthah, 2006). Recent research by Baharthah (2006) cites overall Western Australian participation rates of 31.1% which would, for example, add 120,000 recreational fishers to the total cited in Table 7.16 for the Perth metropolitan region by

2022. It is therefore likely that, whilst the forecasts detailed in Tables 7.16-7.17 are of use in that they represent the only means of providing a consistent method of prediction at the inter-State level, there is potential for underestimation, particularly with respect to the relatively low participation rates used for the Perth metropolitan area.

7.4.2 Distribution of fishing effort

Data relating to fishing effort in terms of fisher days, fishing events and hours spent fishing are calculated at the State level for 2000-01 in the NRIFS report (Henry & Lyle, 2003). The extent to which fishing effort can be forecast using population data is hampered by the fact that, as mentioned previously, population forecasts are made using land-based statistical divisions, whilst fishing effort data in the NRIFS and subsequent reports are calculated using marine regions. It is possible, however, to utilize the NRIFS data to calculate average fishing effort at the State level and forecast this effort using the predicted participants in recreational fishing described above. The NRIFS survey indicates that the average number of days spent fishing annually by each recreational fisher was 6.1 and 6.94 in South Australia and Western Australia respectively. Table 7.18 indicates the resulting forecasts for fishing effort at the State level from 2007 to 2022.

Table 7.18 Projected fishing effort by total annual fishing days in South Australia and Western Australia, 2007-2022

	Predicted fishing effort (total annual fishing days)			
	2007	*2012*	*2017*	*2022*
Western Australia	3,571,331	3,809,877	4,033,658	4,247,080
South Australia	1,880,895	1,915,378	1,939,880	1,957,625
TOTAL	**5,452,226**	**5,725,255**	**5,973,538**	**6,204,704**

The combination of greater rates of population growth and higher average days spent fishing by individuals in Western Australia results in the differing rates of increase in total fishing effort illustrated in Table 7.18. The total annual number of fishing days is predicted to increase by 13.8% over the fifteen year time period, with annual rates of growth in Western Australia in the order of 1.3% far exceeding those in South Australia, which are predicted to increase at around 0.3% per annum.

Predicting fishing effort at a finer spatial scale can be undertaken if it is assumed that the average number of days spent fishing for individual recreational fishers in South Australia and Western Australia cited above can be applied to population predictions for each statistical division adjoining the SWMR. Table 7.19 details the resulting estimated number of fishing days associated with recreational fishers by statistical division. Whilst this is not truly representative of fishing effort in terms of the exact location of the activity, it does provide some indication of the likely trends in the distribution of fishing effort within and adjacent to the SWMR.

Table 7.19 Projected fishing effort by total annual fishing days in statistical divisions adjacent to the SWMR, 2007-2022

Statistical division	*Predicted fishing effort (total annual fishing days)*				*% change 2007-2022*
	2007	*2012*	*2017*	*2022*	
			South Australia		
Adelaide	1,333,555	1,359,741	1,379,711	1,395,806	4.7
Outer Adelaide	213,797	225,712	236,328	245,890	15.0
Yorke & Lower North	94,070	93,771	92,970	91,734	-2.5
Eyre	95,948	97,914	99,287	100,214	4.4
Northern	143,525	138,240	131,584	123,981	-13.6
			Western Australia		
Perth	2,394,626	2,568,613	2,735,247	2,897,493	21.0
South West	664,193	718,226	768,978	816,949	23.0
Lower Great Southern	130,378	135,276	139,426	142,964	9.7
Midlands	105,852	108,777	110,970	112,552	6.3
South Eastern	120,201	120,308	119,091	116,912	-2.7
Central	156,082	158,677	159,947	160,209	2.6
TOTAL	**5,452,226**	**5,725,255**	**5,973,538**	**6,204,704**	**13.8**

As these predictions are based upon the same population forecasts used in Section 7.4.1, there are inevitable similarities in terms of changes over the fifteen year time period. However, this does confirm that, under these population scenarios, fishing effort is likely to continue to intensify in and around the Perth metropolitan region, accounting for almost half of the total effort in areas adjoining the SWMR by 2022. Furthermore, the fastest rate of increase in fishing effort of all statistical divisions adjoining the SWMR is found in the South West of Western Australia (sub-region 4), which is forecast to account for around 13% of all fishing activity by 2022. In South Australia, the Adelaide metropolitan area is seen to continue to dominate fishing effort, although, reflecting the population trends, the overall proportion of fishing

effort associated with the South Australian statistical divisions is predicted to diminish from 35% to 31%.

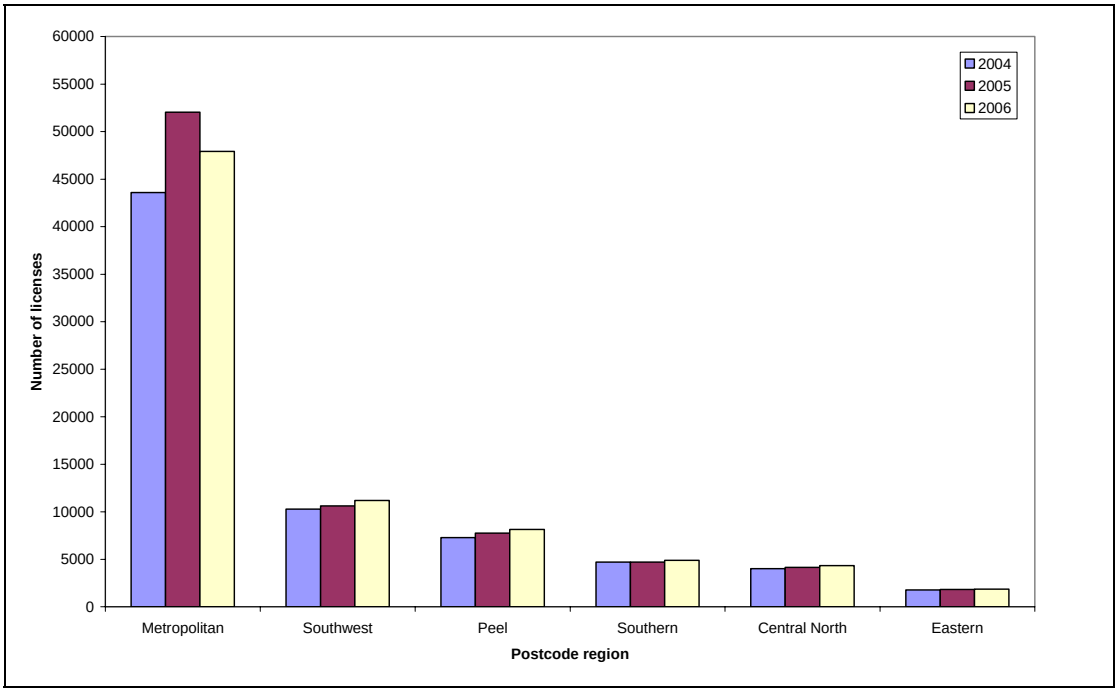
However, these projections do not reflect the known skewed distribution of fishing effort amongst participants. At the national scale, it is estimated that around 15% of fishers contribute around half of the total fishing effort, whilst the top 3% of fishers spend more than 25 days per year fishing, representing around 20% of the total fishing effort (Henry & Lyle, 2003). Baharthah (2006) indicates that regional fishers are more likely to contribute greater individual effort, given the time spent fishing in comparison to their metropolitan counterparts. More detailed data relating fishing effort to individual socio-economic characteristics is not available, but it is evident from these findings that minor changes involving the upper end of the participation scale could have significant effects on overall fishing effort.

7.4.3 Number and distribution of privately owned boats

As stated earlier, recreational boat licenses are issued for life in South Australia and the data available from PIRSA relates to 2005-06 only. It is therefore not possible to comment on temporal trends in boat ownership for that State. Annual license data from 2004-06 for Western Australia covering new and renewed registrations for the six postcode regions within the SWMR are illustrated in Figure 7.7.

The total number of new and renewed licenses issued increased from 71,609 in 2004 to 81,705 in 2005, but then decreased to 77,375 in 2006. Most of this variation reflected the issuing of licenses in the Perth metropolitan postcode, which accounted for 61-64% of the total licenses in the Western Australian section of the SWMR. The other postcode regions were characterized by slight increases in the number of licenses issued over this time period.

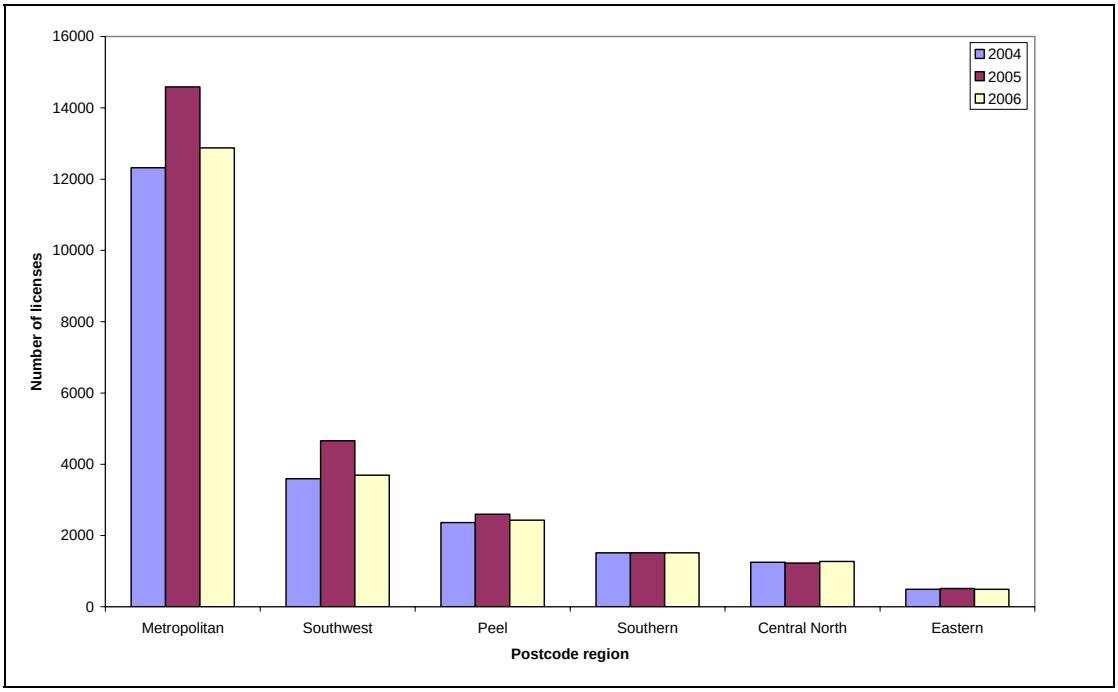
Figure 7.7 Distribution of recreational boat licenses in Western Australian postcode regions adjacent to the SWMR, 2004-06



(Source: DPI, personal communication 2007)

A recent survey of boat ownership in the Perth metropolitan region projected that, under a medium population growth scenario, the total number of recreational boats would increase by 75% from 45,915 in 2006 to 80,368 in 2025, underlining the scale and rate of increased activity in this sector (DPI, 2007). However, this does not provide detailed information regarding the relationship between recreational boat ownership and recreational fishing. In order to explore this in more depth, further analysis of the numbers of new and renewed boat licenses in the Runabout category from 2004 to 2006 was conducted as illustrated in Figure 7.8. This indicates that the total number of licenses in this category for the postcode regions within the SWMR increased by 16% from 21,528 in 2004 to 25,100 in 2005, followed by a decrease by 11% to 22,286 in 2006. The Metropolitan region accounted for around 57% of these licenses over the 2004-06 time period, again followed by the Southwest (sub-region 4 in Figure 1.2) and Peel (sub-region 3) regions, which represented around 17% and 10% of licence holders respectively.

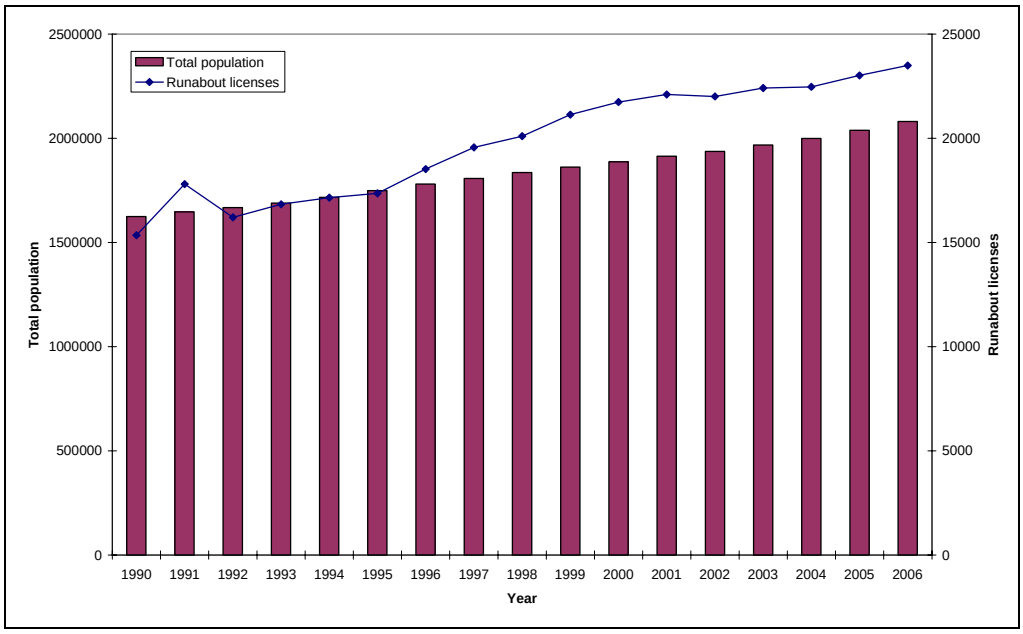
Figure 7.8 Distribution of Runabout category boat licenses in Western Australian postcode regions adjacent to the SWMR, 2004-06



(Source: DPI, personal communication 2007)

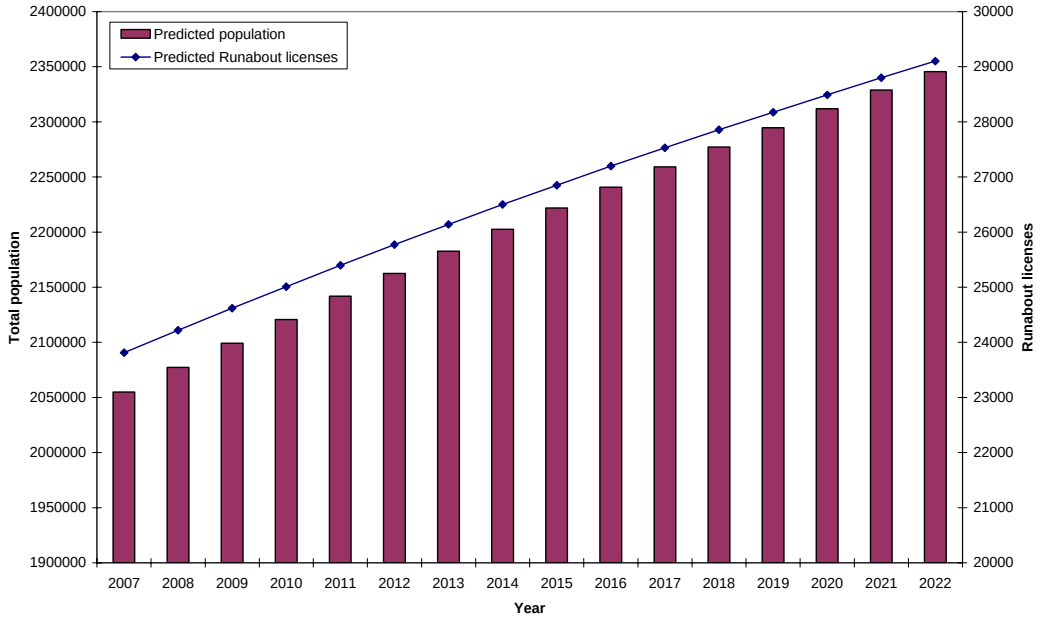
In order to derive forecasts of boat ownership with reference to recreational fishing, data relating to new and renewed licenses in the Runabout boat category for Western Australia as a whole has been obtained covering the period 1990-2006. These are compared to State population data for this time period as illustrated in Figure 7.9. This analysis demonstrates the close correlation (r^2=0.94) between Runabout category licenses and population numbers in Western Australia. This relationship is used to predict future numbers of Runabout licenses using population forecasts from 2007 to 2022 as illustrated in Figure 7.10.

Figure 7.9 Population and number of Runabout category licenses in Western Australia, 1990-2006



(Sources: ABS, 2007a; DPI, personal communication 2007)

Figure 7.10 Projected population and number of Runabout category licenses in Western Australia, 2007-2022



This indicates that the total number of recreational licenses in the Runabout category is likely to increase at around 1.5% per annum from 23,800 in 2007 to 29,100 in 2022. If it is assumed that the future distribution of Runabout license holders remains similar to that described in Table 7.6 for 2006, then estimates can be made of the likely proportions of these licenses by postcode over the period 2007-2022. These projections are detailed in Table 7.20.

Table 7.20 Projected number of Runabout category license holders in Western Australian postcode regions adjacent to the SWMR, 2007-2022

Postcode region	*Projected number of Runabout category licenses*			
	2007	*2012*	*2017*	*2022*
Metropolitan	13,764	14,896	15,913	16,821
Southwest	3,953	4,278	4,570	4,831
Peel	2,596	2,809	3,001	3,172
Southern	1,619	1,753	1,872	1,979
Central North	1,357	1,469	1,569	1,659
Eastern	524	567	606	640
TOTAL	**23,814**	**25,772**	**27,531**	**29,103**

This provides an indication of the likely future trends in licenses for the Runabout category, with overall increases in the order of 22% over the period 2007-2022 resulting in almost 17,000 licenses being held in the Perth metropolitan area by 2022. Whilst it is difficult to make inferences regarding the direct impact on recreational fishing pressure, these predictions do support the notion that continued population growth, particularly in the Perth postcode area, will serve to increase the effort exerted by boat-based recreational fishing. It must also be borne in mind that other boat categories can be used for recreational fishing activities, which will affect the total numbers involved but is unlikely to alter the spatial distribution of effort implied by Table 7.20.

7.4.4 Number and location of chartered boat operators

Detailed information relating to chartered boat activity is restricted to the period from 2005 in South Australia and from 2003 in Western Australia, reflecting the point at which licensing of this sector was introduced in each State and the coverage in annual fisheries reports began. As there is also a moratorium on the issuing of new licenses in

Western Australia and data only exists for 2005-06 in South Australia, it is difficult to comment on temporal and spatial trends in this activity. It can be pointed out that, in Western Australia, the total number of licenses as cited in annual State of the Fisheries reports has increased from 169 to 190 in the 2003-05 period, with 85% of these being in the West Coast bioregion (Department of Fisheries, 2006a). Furthermore, the majority (85-88%) of all licenses issued were fishing tour licenses, with restricted fishing and ecotour licenses representing a small minority of the total. However, data from 2004-05 indicates that only around 55% of these fishing tour licenses were actively used by those involved in the West Coast chartered boat fishery. Moreover, it is apparent that there is a reduction in the proportion of fishing-only tours in the West Coast bioregion, which declined from 58% of all tours in 2002-03 to 48% in 2004-05. Similarly, the number of fisher days represented by fishing only tours in the West Coast bioregion has fallen by 15% from 30,266 in 2002-03 to 25,609 in 2004-05. A similar trend is apparent in the South Coast bioregion, where only 40% of licenses were actively used in 2004-05 and where fishing-only tours have declined from 340 in 2002-03 to 323 in 2004-05, although fishing effort has only marginally reduced from 3,037 fisher days in 2002-03 to 2,905 in 2004-05.

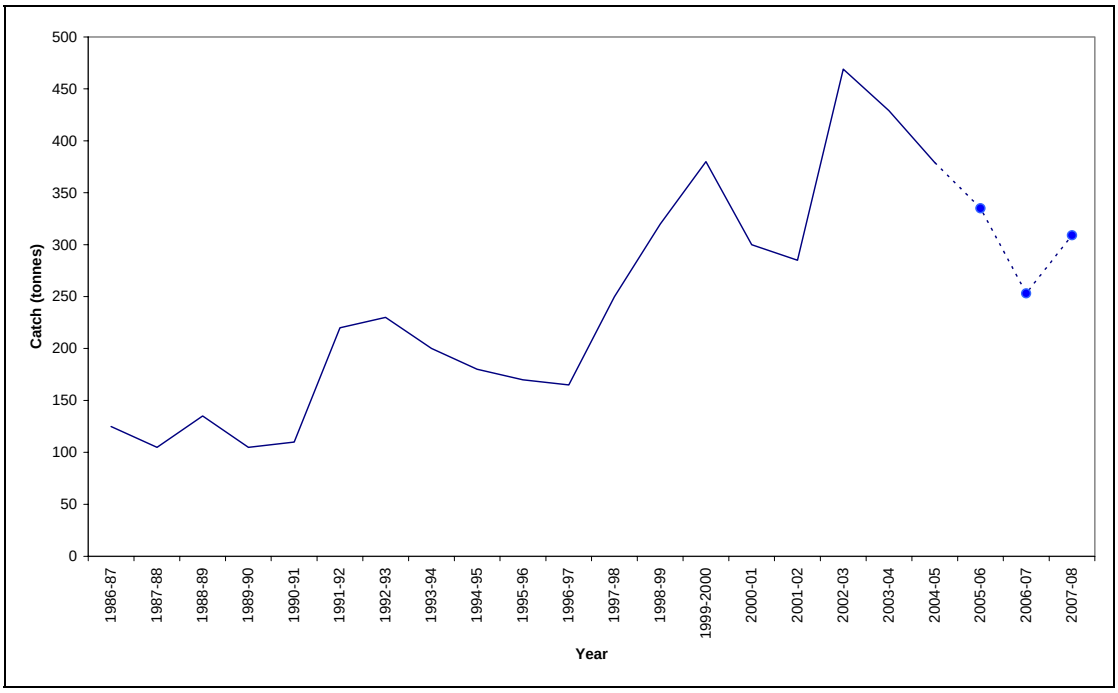
Taking the chartered boat fishery sector in Western Australia as a whole, it is therefore evident that there has been a declining rate of activity as measured by fisher days and fishing-only tours. This could be related to the increased rates of ownership of private boats discussed in Section 7.4.3 having a negative impact on the chartered boat sector, a notion which is supported by the low rates of active license usage. Further comparison of these effort data with annual catch totals indicates that the calculated average catch per fisher day has increased from 4.1kg in 2002-03 to 4.6kg in 2004-05 and the average catch per tour has risen from 41.5kg in 2002-03 to 49.3kg in 2004-05. Whilst forecasts of temporal trends based upon three annual totals are difficult to justify, it can be suggested that the recent declining rates of activity are not necessarily being matched by declining catch per unit effort. Possible contributory factors to these trends include improved on-board technology such as echo-sounding equipment and GPS facilitating greater catch returns, but it is not feasible to infer future trends in this sector based upon the information available.

7.4.5 Total catch and species catch

Rock Lobster

Modelling of the rock lobster harvest has been based since the 1980s on the correlation observed between records of larval settlement at Alkimos north of Perth and commercial rock lobster harvests in the fishing region south of 30°S around three to four years later (Department of Fisheries, 2006a). The recreational fishery forecasts combine this relationship with the rate of recreational license usage to predict future harvests, as illustrated in Figure 7.11. The decline in forecasted harvests from 2005-06 onwards reflect lower levels of larval settlement between 2001 and 2004.

Figure 7.11 Modelled estimates of recreational rock lobster harvest in the West Coast bioregion, 1986-87 to 2007-08

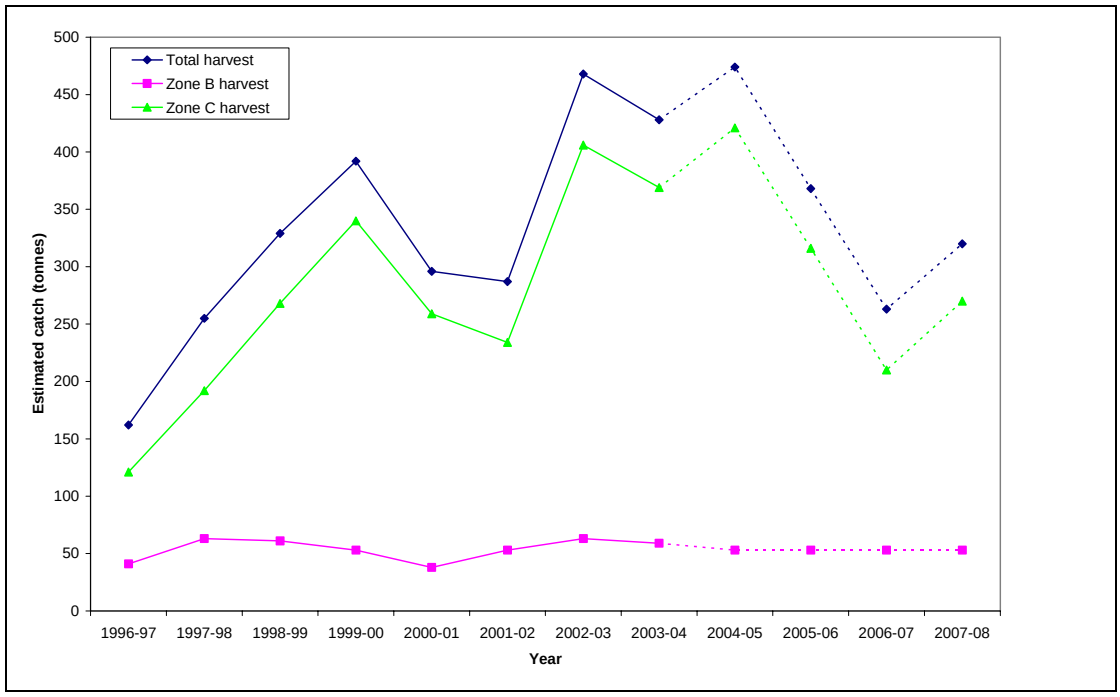


(Source: Department of Fisheries, 2006a. NB Data from 2005-06 onwards are projections)

Figure 7.11 indicates the overall increase in rock lobster harvest estimates since 1986-97, which equate to an average increase of 14 tonnes per annum to 2004-05, although there are evident fluctuations superimposed on this long-term trend. The distribution of this harvest is of importance in terms of predicting future trends, as Figure 7.12 indicates that from 1996-97 onwards over 75% of the harvest originates from the fishing area between 30°S and 34°S termed Zone C (Department of Fisheries, 2007).

Zones A and B are the Abrolhos Islands and the West Coast bioregion between 22°S and 30°S respectively. Zone A contributes a negligible amount to the fishery and is included within Zone B.

Figure 7.12 Distribution of recreational rock lobster harvest in Western Australia, 1996-97 to 2007-08

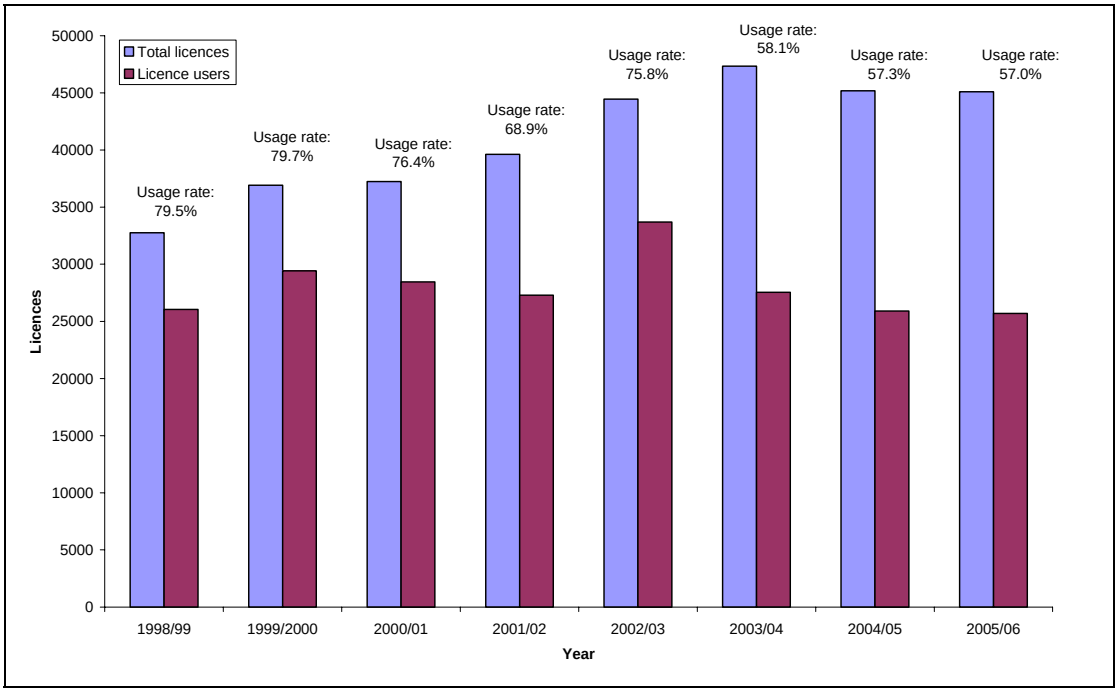


(Source: Department of Fisheries, 2007. NB Data from 2004-05 onwards are projections)

The most recently available catch estimates indicate that 86% of the total recreational catch was taken from Zone C in 2003-04 (Department of Fisheries, 2007), the majority of this effort being in the area bounded by Mandurah and Two Rocks (sub-regions 2 and 3). It is predicted that this proportion of the total catch will increase over time, reflecting the rapid growth of population in the Perth Metropolitan Area, whilst the majority of fishermen active in Zone B originate from Geraldton (Department of Fisheries, 2007). However, the other parameter used in forecasting future harvests is the participation rate, defined here as the proportion of license holders active in the fishery. Figure 7.13 indicates that between 1998-99 and 2003-04, license sales increased by an average of around 2,900 per year from 32,768 to 47,345, followed by a slight decline to 45,100 in 2005-06. The price of a rock lobster license was increased in 2002-03 from $25 to $30 which did not negatively impact on

subsequent total license sales, possibly because it reduced the relative costs of umbrella licenses. Despite this increase in license sales, usage rates have declined from over 70% in the period 1998-99 to 2002-03 to a plateau of around 57% from 2003-04 to 2005-06. This reflects the decline in predicted harvests observed in Figure 7.12 and indicates that a falling number of participants have been actively involved in the fishery in the past three years, implying that population increase in the State as a whole is not reflected in an increase in the number of active licensees.

Figure 7.13 Total license sales, license users and usage rates in the rock lobster fishery of Western Australia, 1998-99 to 2005-06



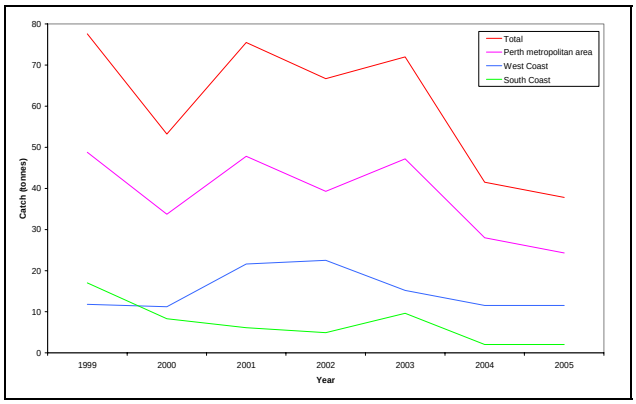
(Source: Department of Fisheries, Annual Reports. NB Data for 2005-06 are projections)

These trends indicate that, whilst sales of licenses are stable, usage rates overall have declined but there is evidence of sustained concentration of fishing effort in the area between Mandurah and Two Rocks. It is therefore difficult to derive a relationship between population growth and participation in the fishery based on the above trends, rendering forecasts of future trends in the fishery problematic.

Abalone

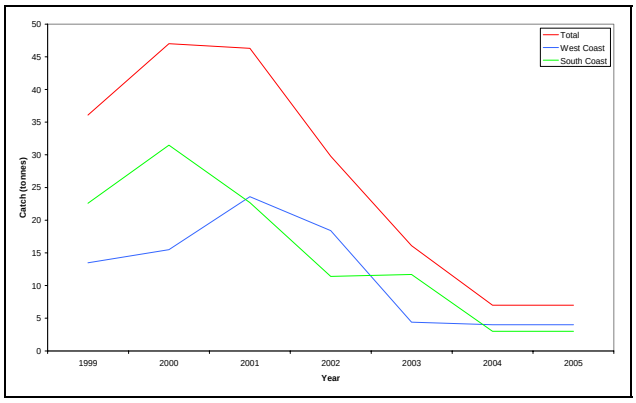
Figures 7.14-7.16 illustrate the annual harvest of Roe's, greenlip and brownlip abalone in the Perth Metropolitan Area and the West Coast and South Coast bioregions from 1999 to 2005.

Figure 7.14 Annual recreational harvest of Roe's abalone in Western Australian fishing regions, 1999-2005



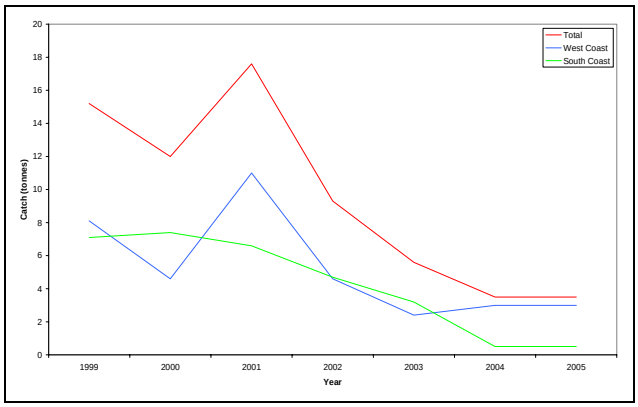
(Source: Department of Fisheries, Annual Reports)

Figure 7.15 Annual recreational harvest of greenlip abalone in Western Australian fishing regions, 1999-2005



(Source: Department of Fisheries, Annual Reports)

Figure 7.16 Annual recreational harvest of brownlip abalone in Western Australian fishing regions, 1999-2005



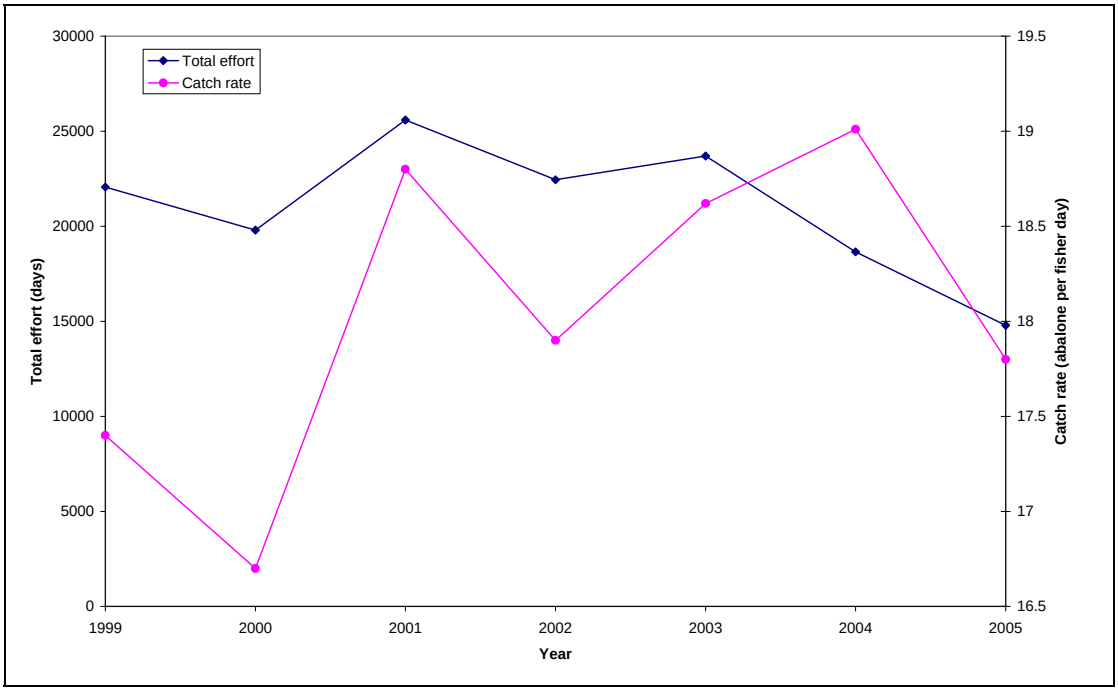
(Source: Department of Fisheries, Annual Reports)

Figure 7.14 indicates that the overall recreational harvest of Roe's abalone in these fishing regions has halved in the 2003-05 period from just over 70 tonnes to 38 tonnes. The proportion taken within the Perth Metropolitan Area remained constant at around 65%, whilst the proportion of the total harvest from the South Coast has declined over the 1999-2005 period from around 20% to 5%. The West Coast proportion of the harvest has doubled from around 15% to 30%. Both greenlip and brownlip abalone display similar marked declines in total recreational harvest over an extended time period from peaks of 46 tonnes and 18 tonnes respectively in 2001 to 7 and 4 tonnes respectively in 2005. In both cases, the West Coast bioregion has accounted for the majority of this reduced harvest since 2004.

The abalone fishery in Western Australia is regulated to the effect that, since 1997, annual fishing activity has been restricted to 1.5 hours per day for six days; hence adverse weather conditions can result in significantly reduced total harvests. This has been noted to be contributory to the low harvests recorded in 2005 (Department of Fisheries, 2006a). The limits on the fishing season could well act as a deterrent to potential participants, restricting involvement to those living in close proximity to the shoreline. It could therefore be the case that annual variations simply reflect short-term local environmental conditions rather than stock abundance, with favourable climatic conditions resulting in increased harvests. This is supported by Figure 7.17, which demonstrates that, in the Perth Metropolitan Area Roe's abalone fishery, catch rates have remained constant at around 18-19 abalone per fisher day irrespective of

the decline in total effort since 2003, implying that stock abundance is not the causative factor behind diminished harvests.

Figure 7.17 Total effort and catch rate in the Perth Metropolitan Area Roe's abalone fishery, 1999-2005



(Source: Department of Fisheries, 2006a)

In terms of overall participation, abalone licenses issued in Western Australia have declined from around 8,000 in 2001 to just over 6,000 in 2005, although the number of umbrella licenses has increased from around 12,000 to 14,000 over this time period. This could imply that, whilst the overall number of licenses permitting abalone fishing has remained at or around 20,000 since 2001, there has been a reduced focus within the recreational fishing community on abalone, as reflected by the decline in total fishing effort illustrated in Figure 7.17.

Given the increased densities of Roe's abalone being recorded in the Perth Metropolitan Area, proposals to alter the management of fishery are currently being considered with the effect of introducing a total allowable catch system and increasing the sustainable harvest limits (Department of Fisheries, 2007). This could result in increased participation in the Metropolitan Roe's abalone fishery, particularly as there

are a considerable proportion of non-active license holders. However, there are no similar proposals under consideration for the other fishing regions and, in the absence of other identifiable factors, it can be posited that the greenlip and brownlip abalone fisheries are likely to follow a pattern of gradual decline in total harvests and a reduced or stable total fishing effort. In light of the above evidence, it is considered unlikely that population growth is a significant driving force influencing participation in the abalone fishery.

Chartered boat operators

Catch data returned by chartered boat operators in Western Australia can be analysed with a view to identifying temporal trends and their significance within the SWMR.

Table 7.21 Species catch (tonnes) by chartered boat operator licensees in the West Coast and South Coast bioregions of Western Australia, 2002-03 to 2004-05

Species	*2002-03*		*2003-04*		*2004-05*	
	West Coast	*South Coast*	*West Coast*	*South Coast*	*West Coast*	*South Coast*
Pink snapper	17.5	2	20	2	26	1
Dhufish	23	0.5	18	1	24.5	0.5
Samson fish	13	3	13	3	12	2
Bight redfish	2	8	4.5	8.5	3	5.5
Queen snapper	5	3	5	2.5	5	1.5
Baldchin groper	8	0	5.5	0	7.5	0
Breaksea cod	5	1.5	4	1.5	4	1.5
Sweetlip emperor	4	0	5	0	5.5	0
Skipjack trevally	3.5	1.5	2	2	1.5	1
Swallowtail	0	1	0	2	0	2
Sea sweep	0	0.5	0	0.5	0	0.5
Other finfish	30	5	21.5	5.5	21	6
TOTAL	**111**	**26**	**98.5**	**28.5**	**110**	**21.5**

(Source: Department of Fisheries, 2006a)

Table 7.21 shows that the total catch by chartered recreational boat fishing in West Coast and South Coast bioregions declined by 8% from 137 tonnes in 2002-03 to 126 tonnes in 2004-05, with the West Coast bioregion accounting for between 76-82% of this total. Pink snapper and dhufish represent the most commonly caught species, each comprising 13-20% of the annual catch over this time period, the vast majority of both species being caught in the West Coast bioregion. There is little evidence of temporal

trends in catch over the time period for which data are available, other than an increasing catch of pink snapper in the West Coast bioregion.

7.5 CONCLUSION

This chapter has employed a range of indicators to explore the nature and distribution of recreational fishing activity within and adjacent to the South-west Marine Region. It should be noted that this exercise has been constrained by limited data availability and differing methods of calculating parameters relating to recreational fishing across both states, an inability to consistently identify data appropriate to the boundaries of the SWMR and a lack of congruence between land-based and maritime divisions, rendering a comprehensive analysis difficult. Nevertheless, there are certain consistent trends that have emerged from this analysis.

In light of overall population projections and the differing rates of economic growth being experienced in each state, it is inevitable that there will be a greater volume of catch and degree of fishing effort in Western Australia than South Australia, which is reflected in the data summarized above. Whilst there is a certain degree of uncertainty relating to participation rates, the overall trend of increasing effort in the Perth metropolitan region (sub-regions 2 and 3), the south-west peninsula of Western Australia (sub-region 4) and, to a lesser extent but still important at the Regional level, the Spencer Gulf, Gulf of St Vincent and Fleurieu Peninsula region (sub-regions 7 to 9), has been consistently demonstrated across all time scales used in this Report. This has also been exhibited with regard to recreational boat ownership, which displays a distinct correlation with population growth, resulting in significant projected increases in boat-based recreational fishing activity offshore from the Perth metropolitan region. In conjunction with greater disposable income, these trends could be tentatively associated with the stagnation or decline of active participation in the chartered boat industry which, although concentrated again in the Perth region, is likely to exert a limited overall impact on target species.

This analysis has also highlighted the likely trends in terms of species targeted under this scenario of increasing recreational fishing effort. Of particular note in South

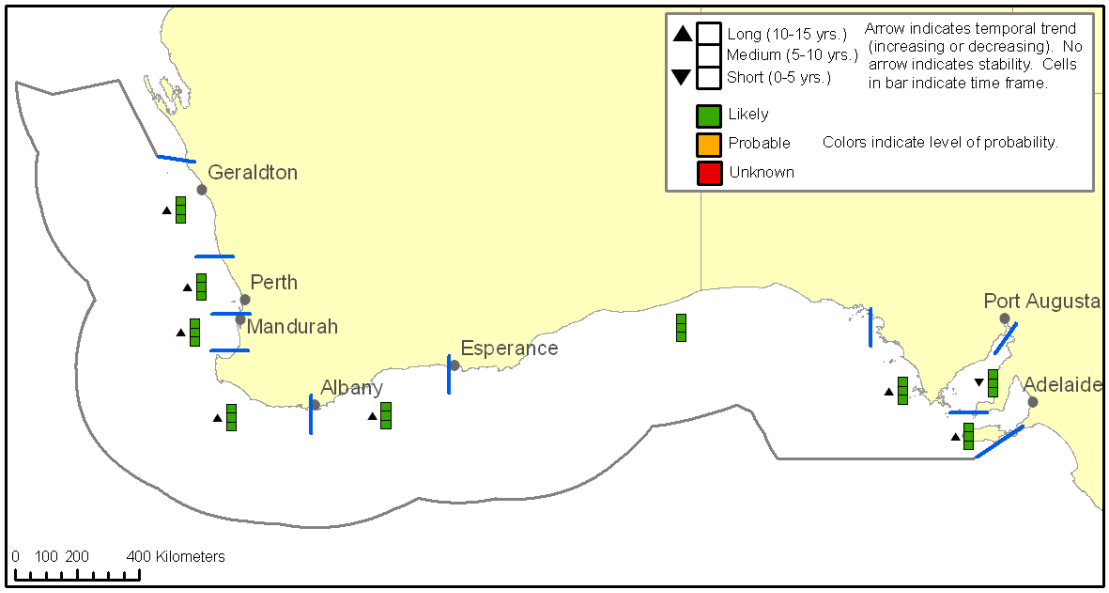
Australia where more detailed data were available is the focus of activity in the Spencer Gulf snapper and King George whiting fisheries (sub-regions 7 and 8) and the garfish and whaler shark fisheries of the Gulf of St Vincent (sub-region 9). Data relating to the coastal waters of Western Australia are not available; hence it appears imperative that catch surveys offshore from the Perth metropolitan region in particular are conducted in order to evaluate the impact of the inevitable increase in effort in this area.

Analysis of detailed catch data in coastal waters adjoining the SWMR has also been carried out in those recreational fisheries where licenses are required for participation. Interestingly, this has resulted in a contrasting situation of declining effort, participation and catch levels. However, it could be suggested that the licensed abalone and rock lobster fisheries are more associated with traditional forms of individual labour-intensive fishing activity rather than the costly, family-based mode of recreational fishing implied by the boat ownership data. There are no data to support this comment, yet the scenario of declining traditional specialized forms of recreational fishing being replaced by those involving urban residents investing in modern boats and technology undertaking fishing as a weekend pursuit seems feasible. The stringent regulations governing rock lobster and abalone collection would further detract from its attraction to the more casual recreational fisher.

Overall, this analysis has underlined the significant rate and spatial concentration of growth in recreational fishing activity, which is largely unconstrained by licenses other than those relating to boat ownership. Figure 7.18 utilises the sub-regions of the SWMR coastline identified in Chapter 1 in order to summarise these trends, highlighting the increase in this activity across the coastline adjacent to the SWMR and the level of confidence that can be associated with these projections. The only area where growth is not projected lies in association with sparsely populated coastal districts in the Esperance-Ceduna sub-region, whilst slight declines in numbers of recreational fishers but not intensity of fishing effort are projected for the area between Port Augusta and Yorketown. The focus of recreational fishing activity in waters in proximity to urban areas such as the Perth metropolitan region and the Gulf areas of South Australia near to Adelaide underlines the potential for long term

sustained growth in this sector underpinned by population growth and economic activity, with considerable potential impacts on target species.

Figure 7.18 Overall trends in recreational fishing activity adjacent to the SWMR



8 TOURISM

8.1 INTRODUCTION

The tourism industry in and adjacent to the SWMR is a highly significant component of industrial activity, generating approximately $4.6 billion in Western Australia in 2005-06 and just over $4 billion in South Australia in 2004-05. Tourism is a multi-faceted sector of the economy and accordingly can be analysed using a wide range of driving forces and indicators. Those deemed relevant to the characteristics of the marine tourism industry in the study area are summarised below.

Table 8.1 Driving forces and pressure indicators for the marine tourism sector in and adjacent to the SWMR

Driving forces	*Pressure indicators*
Growth in tourism sector	Numbers and location of tourism activity
Marina facilities	Trends in demand for marina berths
Nature-based tourism growth	Status of marine mammal watching industry
Gazettal of marine protected areas	Marine nature reserves and sanctuary zones

8.2 CURRENT STATUS OF PRESSURE INDICATORS

The following section will outline the current status of these pressure indicators before considering the significance of national and international socio-economic influences upon their development. This will be followed by an evaluation of likely trends in these indicators into the future.

8.2.1 Numbers and location of tourism activity

The monitoring and forecasting of tourism at the national level is undertaken by the Tourism Forecasting Committee, an independent body resourced by Tourism Australia. The most recent summary published in October 2006 provides an overview and forecast of inbound tourism from 2006 to 2015 which will be highlighted before analysis of international and national driving forces and detail of tourism activity in and adjacent to the SWMR is presented.

At the national level, the numbers of international inbound tourists in 2006 was forecast to amount to 5.47 million, representing a slight decline of 0.5% on the 2005 total. This represents a stabilisation of growth in international visitors from 4.86 million in 2001 to 5.5 million visitors in 2005. Domestic tourist numbers as indicated by annual tourist nights was forecast to increase slightly by 1.8% in 2006 to 280.9 million, representing a gradual decline from 289.6 million tourist nights in 2001. Trends with respect to domestic and international visitors to South Australia and Western Australia are illustrated in table 8.2.

Table 8.2 Tourism data for South Australia and Western Australia, 2005-06

	Intrastate visitors		*Interstate visitors*		*International visitors*	
	2006	*% change 2005-06*	*2006*	*% change 2005-06*	*2006*	*% change 2005-06*
South Australia	3,359,000	-1.0	1,876,000	7.0	350,700	8.0
Western Australia	5,414,000	8.1	1,349,000	40.7	624,000	-1.8

(Sources: South Australian Tourism Commission, 2006a; Tourism Western Australia, 2006)

The relative significance of domestic intrastate and interstate tourism is reflected in the above data, with international visitors accounting for 7.5% of total visitors to South Australia and Western Australia. However, their economic impact is enhanced by their greater length of stay, with an average spend six times greater than domestic visitors (Western Australian Tourism Commission, 2003b). The seasonality of international arrivals is acute, as illustrated by the fact that 40% of UK arrivals in Western Australia occurred in the October-December quarter in 2004 (Tourism Western Australia 2005), whilst January is the peak month for domestic visitors in Western Australia, placing increased pressure on locations popular with international and domestic arrivals at these times.

8.2.2 Trends in demand for marina berths

Marinas can be defined as docks, harbours, or basins with fixed moorings for yachts or other small vessels, along with the provision of recreational and other facilities centred on the mooring area. This differentiates marinas from fishing or boat harbours which are locations without fixed moorings or associated land-based facilities. Details of the 22 currently operational marinas adjacent to the SWMR are provided below.

Table 8.3 Current marina developments adjacent to the SWMR

Name and location	*Summary of facilities*
South Australia	
Lincoln Cove Marina, Eyre Peninsula	Commenced 1986, $60M facility for 100 recreational berths, 167 commercial berths. Integrated residential retirement and marina development. Stage 2 residential development to generate $100M 2007-2017
Tumby Bay Marina, Eyre Peninsula	10 recreational berths, no commercial berths. Associated housing development. Plans for expansion of berths in future.
Arno Bay Boat Harbor, Eyre Peninsula	18 commercial berths, no recreational berths. Plans for expansion of berths in future.
Whyalla Marina, Eyre Peninsula,	$3M facility with 32 recreational berths, no commercial berths. Associated recreational facilities. No current expansion plans.
Copper Cove Marina, Wallaroo, Yorke Peninsula	154 recreational berths, 24 commercial berths. Ongoing construction of associated housing, recreational facilities, motel.
Port Vincent Marina, Yorke Peninsula	90 recreational berths, no commercial berths. Sale of additional 19 larger recreational berths imminent.
Gulf Point Marina, North Haven, Adelaide	340 recreational berths, no commercial berths. Associated restaurants, residential development, retail outlets and a hotel. Plans for expansion of berths in future.
Cruising Yacht Club of SA, North Haven, Adelaide	238 recreational berths, no commercial berths. Associated recreational facilities. Plans for expansion of berths in future.
Royal SA Yacht Squadron, Outer Harbor, Adelaide	277 recreational berths, no commercial berths. Associated recreational facilities. Plans for expansion of berths in future.
Holdfast Shores Marina, Glenelg, Adelaide	Opened 1996. 59 recreational berths, no commercial berths. Associated accommodation, recreation and retail outlets. No plans for expansion in future.
Holdfast Keys Marina (formerly Patawalonga Marina), Adelaide	145 recreational berths, no commercial berths. Associated accommodation. No plans for expansion in future.
North Arm Marina, Adelaide	20 recreational berths, 72 commercial berths. Associated facilities. Plans for expansion of berths in future.
St Kilda Marina, Salisbury	56 recreational berths, no commercial berths. Associated facilities. Plans for expansion of berths in future.
Wirrina Cove Marina, SW Fleurieu Peninsula	Opened 1997, cost $2.5M. 210 recreational berths, no commercial berths. Associated residential and retail development. Plans to increase berth capacity to 350.
Western Australia	
Geraldton Batavia Coast Marina	Opened February 1995, 50 berths. Associated restaurants and MidWest Museum. Plans to extend marina following the completion of the Foreshore Redevelopment Project in 2010.
Hillarys Boat Harbour	Opened January 1988. Approximately 430 berths. Associated shops, restaurants, family-oriented attractions and Aquarium of Western Australia. Current 2004-08 investment programme of $6M into new pens, breakwater, road access, visitor facilities.
Aquarama Marina, Fremantle	Large scale redevelopment 1985. 210 berths, associated restaurant and boat management facilities.
Fremantle Sailing Club	Current site established 1977. 640 recreational pens, clubhouse.
Royal Perth Yacht Club	Two marinas, associated clubhouse
Mandurah Ocean Marina	Stage 1 opened August 2001. 174 recreational and 36 commercial berths. Associated accommodation, restaurants, shops and ongoing development.
Port Geographe Marina	Opened 1998. 104 berths. Associated accommodation and restaurant. Plans to expand berth capacity to 256 berths 2007-12
Bunbury Casuarina Boat Harbour	Opened November 1995. 48 recreational and 5 fishing berths. No facilities but planned incorporation into Bunbury Waterfront marina development to commence late 2008.

(Sources: DPI, 2007 personal communication; PIRSA, 2007 personal communication)

In addition to the above, there are seven new marina developments in the planning or construction stage adjacent to the SWMR, details of which are provided below.

Table 8.4 Planned marina developments adjacent to the SWMR

Name and location	*Summary of project*
South Australia	
Stansbury Marina, Yorke Peninsula	Proposal for 100 berth marina with associated 100 housing units and hotel. Assessed as Major Development March 2007. Awaiting formal application.
Port Wakefield Marina	Proposal for 200 berth mixed recreational and commercial marina, with associated 2700 housing units. Assessed as Major Development April 2007. Awaiting formal application.
Ceduna Keys	Application approved December 2005, construction planned to commence July 2007 for 10 yr period. Approximately 100 recreational and 50 commercial berths with associated restaurants, accommodation, hotel, convention centre, fishing and aquaculture service areas. Total cost approximately $100M.
Port Adelaide Waterfront	Two construction projects. Marina Adelaide with 180 berths due for completion March 2007, cost $21M. Application approved for widescale redevelopment including construction of 49 berths and associated 2000 housing units alongside Marina, costing $1.2bn due completion 2020
Western Australia	
Princess Royal Harbour Foreshore, Albany	Application approved April 2007 for 74 berth marina with future expansion envisaged. Associated restaurants, retail, hotel, entertainment centre. Due completion 2010. Total cost approximately $66M.
Mandurah Ocean Marina	Stage 2 development to commence in near future to include additional 300 berths and associated accommodation, restaurants, retail outlets due to be completed approximately 2015.
Bunbury Waterfront	Application approved 2006, construction due to start late 2008. Three stage development. Stage 1 to include 266 berth marina and associated retail and residential development. Further berths envisaged in Stages 2 and 3. Total cost approximately $45M for Stage 1.

(Source: DPI, 2007)

8.2.3 Marine mammal watching industry

Interaction with marine mammals including whales, dolphins and dugong is regulated by federal law (Department of Environment and Heritage, 2005) and at the State level licenses and additional regulations may be applicable. Within Western Australian state waters, the Department for Environment and Conservation (DEC) issues licenses for commercial activities involving marine mammal interaction, although similar licenses are not required in South Australian waters. The whale watching industry in and around the SWMR commenced in the late 1980s and operates out of Perth, Albany and Geographe Bay in Western Australia, focusing on migrating southern

right whales (*Eubalaena australis*) and humpback whales (*Megaptera novaeangliae*) from around September to November. In addition, dolphin watching tours operate out of centres including Perth and Bunbury from around November to April. In South Australian waters, the whale-watching industry is focused on southern right whales which visit areas such as Encounter Bay on the Fleurieu Peninsula and Head of Bight near Nullarbor during the winter. Much of this activity involves land-based watching rather than organised tours. The current activity levels of this industry are difficult to define as there is no single source of data referring to all forms of marine mammal interaction. However, data collected in 1998 provides a breakdown of marine mammal watching participants by origin. Combining these figures with total visitor numbers by origin for 2005-06 allows a broad estimation of the total number of marine mammal watching participants, indicating projected totals over 1.4 million and 1.1 million in South and Western Australia respectively in 2005-06 (Table 8.5).

Table 8.5 Estimated marine mammal watching participants, 2005-06

	Intrastate	*Interstate*	*International*
South Australia			
Total visitor numbers 2005-06	3,359,000	1,876,000	350,700
Marine mammal watching visitors by origin 1998	5%	57%	37%
Estimated participants in marine mammal watching 2005-06	167,950	1,069,320	129,759
Western Australia			
Total visitor numbers 2005-06	5,414,000	1,349,000	624,000
Marine mammal watching visitors by origin 1998	6%	23%	71%
Estimated participants in marine mammal watching 2005-06	324,840	310,270	443,040
TOTAL	**492,790**	**1,379,590**	**572,799**

(Sources: South Australian Tourism Commission, 2006a; Tourism Western Australia, 2006; Hoyt, 2001)

These figures are likely to be an underestimate as they refer to data collected from organised tours and do not include individuals who undertake land-based marine mammal watching on a recreational basis. Furthermore, the 1998 data include visitors to the whole of Western Australia and South Australia.

8.2.4 Marine nature reserves and sanctuary zones

The gazettal of marine protected areas reflects the need to plan adequately for the conservation of marine landscapes, flora and fauna in the face of increasing pressure from sectors including tourism, recreational and commercial fisheries, fossil fuel exploitation and others in an appropriately open, consultative and participatory manner. The designation 'marine protected area' is an umbrella term used in this Report to denote marine nature reserves, marine national parks, aquatic reserves and marine conservation parks.

Within the South Australian waters in and adjoining the SWMR, nine Aquatic Reserves, three Conservation Parks and one Marine National Park have been declared, with proposals currently under consultation for the Encounter Marine Park between Kangaroo Island and the Fleurieu Peninsula. The section of the SWMR adjoining Western Australian State waters includes one Marine Nature Reserve and five Marine Parks, with proposals currently under consultation for two others in the south west of the state (Geographe Bay/Leeuwin Naturaliste/Hardy Inlet Marine Park and Walpole Bay/Nornalup Inlet Marine Park).

Table 8.6 Marine protected areas in and adjacent to the SWMR

Name	*Area (ha)*	*Location*	*Date gazetted*
	South Australia		
American River Aquatic Reserve	1,549	137.7729E, -35.81871S	1971
Bales Beach Aquatic Reserve	1,030	137.355E, -36.00619S	1971
Blanch Harbour–Douglas Bank Aquatic Reserve	2,609	137.7982E, -32.74479S	1980
Cape Torrens Conservation Park	35	136.7453E, -35.72542S	1971
Goose Island Aquatic Reserve	68	137.364E, -34.45458S	1971
Great Australian Bight Marine National Park	125,640	131.135E, -31.56669S	1996
Nicolas Baudin Island Conservation Park	94	134.1308E, -33.01585S	2003
Point Labatt Aquatic Reserve	202	134.2513E, -33.15074S	1986
Seal Bay Aquatic Reserve	447	137.304E, -35.99801S	1971
Troubridge Hill Aquatic Reserve	328	137.6351E, -35.17076S	1983
Whyalla – Cowleds Landing Aquatic Reserve	3,600	137.5102E, -33.12085S	1980
Yatala Harbour Aquatic Reserve	1,139	137.9097E, -32.74945S	1980
Western River Conservation Park	167	136.9094E, -35.68378S	1971
	Western Australia		
Hamelin Pool Marine Nature Reserve	114,540	114.1E, -26.15S	1990
Jurien Bay Marine Park	82,368	115E, -30.5S	2003
Marmion Marine Park	9,499	115.7E, -31.8S	1987
Shark Bay Marine Park	711,863	113.75E, -25.65S	1990
Shoalwater Islands Marine Park	6,378	115.7E, -32.3333S	1990
Swan Estuary Marine Park	351	115.8247E, -31.9884S	1990

(Source: DEW, 2007)

8.3 MACRO-ECONOMIC DRIVERS AT THE INTERNATIONAL AND NATIONAL LEVEL

The performance of the international and domestic tourism sector is subject to a wide range of forces. International visitor numbers are often cited as being negatively impacted by the strength of the Australian dollar, although obviously this varies according to the visitors' country of origin. High oil prices and taxes increase air fares, which will be particularly significant with regard to medium and long haul travel to Australia, but again this will vary from country to country. The growth of low cost carriers is of more widespread significance in reducing the costs of travel from Europe to alternative destinations, whilst a decline in aviation capacity worldwide has been noted as contributing towards the reduced growth in international visitors to Australia (Tourism Forecasting Committee, 2006). Domestic interstate and intrastate visitor numbers have been negatively impacted by recent increases in fuel prices, which, despite having stabilised in recent years, will be of particular relevance to Western Australia where the costs of road travel to and within the region are more significant. Longer working hours and increases in housing prices have been linked with a decline in numbers of Australians taking domestic holidays, along with the availability of low cost flights to Asian destinations causing greater numbers choosing to holiday overseas.

With regards to marina development, the recent sustained growth in the Australian economy has, amongst other factors, underpinned the increasing value of land and real estate, particularly in Western Australia where coastal properties are increasingly at a premium. Residential property associated with marina developments is also often characterised by higher prices than adjacent coastal housing. This will be of significance in encouraging private corporations and public-private partnerships to finance large scale marina-related developments. Underpinning the demand for marina berths is the increasing ownership of recreational boats nationwide in association with greater consumer discretionary spending power and, arguably, the ageing of the population as a whole. As the demand for berths continues to outstrip supply, the price of berth leases continues to rise, thereby enhancing the economic attractiveness of marina developments.

The key driver to marine mammal tourism is clearly overall tourism numbers, which are currently experiencing a declining rate of growth as described above. However, marine mammal watching is a highly specialised form of tourism activity with a significant chance of failure; hence the motivations for participation may have little to do with other economic drivers of tourism. This is reflected in the fact that estimates of the annual growth in whale watching activities were around 15% between 1998-2003, far greater than the rise in tourist numbers overall (Whale and Dolphin Watch Australia, 2007). Furthermore, Australia is in a unique global position to capitalise upon this interest, given the reliability and frequency of sightings, the level of research into population levels and the infrastructure to support this activity. It is also possible that the continued debate over the resumption of commercial whaling in the media will drive public interest in marine mammal watching.

To give effect to international obligations, including those under the Convention on Biological Diversity, the Australian Government and the states and territories agreed in 1998 to the development of a National Representative System of Marine Protected Areas. All jurisdictions are progressing this commitment and for this purpose a national marine regionalisation has been developed, i.e. the Integrated Marine and Coastal Regionalisation of Australia v.4.0.

8.4 FUTURE TRENDS WITHIN THE SOUTH-WEST MARINE REGION

8.4.1 Numbers and location of tourism activity

Given the settlement pattern and environmental characteristics of the coastline adjacent to the SWMR, it is evident that much tourism activity will take place either in the marine environment or the immediate coastal hinterland. Activities such as visiting national parks, rainforests, wildlife parks or aquaria, which are predominantly in coastal locations, were undertaken by 25% of domestic visitors and 62% of international visitors in 2004 (Tourism Research Australia, 2005), whilst coastal and marine attractions and activities are heavily featured in promotional material, particularly for Western Australia. A key objective of tourism planning in the study area is therefore to develop a range of attractions following principles of sustainable tourism which increase visitor numbers whilst diversifying the range of attractions to avoid environmental degradation and reduced visitor satisfaction at existing tourist hotspots.

The principal aim for the tourism sector under the South Australian Strategic Plan is to increase visitor expenditure from $3.4 billion in 2001 to $5 billion in 2008 by increasing visitor numbers, length of stay and expenditure (South Australian Tourism Commission, 2002), although this is currently not on target due to factors causing a reduction in the rate of growth as outlined above (South Australian Tourism Commission (2006b). South Australia has undergone a rebranding of the State to visitors under the theme of a ‘brilliant blend’, recognising that the wine, food and heritage aspects of the state underpin its attraction, particularly to interstate domestic visitors (South Australian Tourism Commission, 2002). Concomitant with this is the acknowledgement that coastal assets are weakly developed as tourism attractions, with only 6% of visitors associating the state with coastal and beach experiences. With this in mind, one policy area is directed towards integrating coastal activities with the wine and heritage sector, developing a range of as yet unidentified coastal ‘focal points’ directed towards the coastal tourer market as part of the 2003-08 Tourism Plan (South Australian Tourism Commission, 2002). In addition, it is planned that by 2009 there will be the revitalisation or development of three to five ‘iconic’ nature-based visitor attractions including Kangaroo Island, the Fleurieu Peninsula, Yorke Peninsula and Eyre Peninsula (sub-regions 7 to 9 in Figure 1.2)

alongside other inland sites using the themes illustrated below (South Australian Tourism Commission and Department for Environment and Heritage, 2003).

Table 8.7 Regional nature-based tourism in the South Australian coastal area adjoining the SWMR

Region	*Core Theme*	*Key Differentiator*	*Associated Themes*
Kangaroo Island	Nature	Nature and wildlife	Coast, adventure, rural living, food and wine, heritage and culture
Eyre Peninsula	Nature	Wild uncrowded coast	Seafood, Aboriginal culture, adventure
Fleurieu Peninsula	Beaches and coastline	Diverse aquatic playground	Nature, food and wine, heritage and culture, rural living, adventure, Aboriginal culture
Yorke Peninsula	Coastal escape	Peace and relaxation	Coastal, nature, heritage, adventure

(Source: South Australian Tourism Commission and Department for Environment and Heritage, 2003)

Strategic plans for these locations are in the process of development. Those that have been completed include Kangaroo Island and the Fleurieu Peninsula. Kangaroo Island is already an established coastal nature-based attraction, receiving on average 152,000 visitors per year, a third of which are international travellers. The current Strategic Plan targets a visitor growth rate of 1-2% per annum over the period 2006-2026 (Urban and Regional Planning Solutions, 2006a). The recent approval in December 2006 of a resort proposal on Kangaroo Island which had been the focus of opposition on environmental grounds is seen to signal the means by which future high quality 'ecolodge' accommodation can be developed in line with this objective (South Australian Tourism Commission 2006b). The Fleurieu Peninsula Strategic Plan proposes an increase in visitation rates of 2.5% per annum over the period 2007-2012 (Urban and Regional Planning Solutions, 2006b).

With regard to Western Australia, the current Tourism Strategic Plan does not set goals in relation to visitor numbers but establishes objectives in relation to visitor expenditure, recognition and satisfaction, amongst others (Western Australian Tourism Commission, 2003a). These are to be implemented by the five tourism planning regions and structured around developing and promoting key iconic sites. The table below details those sites located adjacent to the SWMR together with their

ranking and categorisation in terms of iconic significance and market readiness on increasing scales of 1 to 10 (Tourism Western Australia 2005). Sites categorised as falling predominantly in the 'Leverage' range of the matrix are described as iconic and market ready, thus do not require investment and are amenable to leverage through marketing to attract visitors, whilst those in the 'Focus' range are deemed as iconic but requiring product or infrastructure development for their potential to be realised. Whilst subjective in nature, this exercise does serve to allow evaluation of future tourism trends through indicating locations and regions which are current tourist hotspots (the 'Leverage' sites) and those which could be the subject of future tourism development (the 'Focus' sites).

Table 8.8 Development of tourism sites in the Western Australian coastal area adjoining the SWMR

Tourism Planning Region	*Location / Activity*	*Iconic Status*	*Market Readiness*	*Combined Score*
	Leverage locations and activities			
Experience Perth	Marine wildlife experience	6	5.5	11.5
South West	Beaches / coastline / surf	8	6	14
South West	Albany	6	7	13
South West	Bunbury Dolphin Centre	5.5	5.2	10.7
South West	Busselton Jetty	5.5	5	10.5
South West	Whale World	5	8	13
South West	Dive wrecks	4	7	11
Golden Outback	Esperance / Cape Le Grand National Park	7	7.1	14.1
	Focus locations and activities			
Experience Perth	Beach / coastal activities	8	3	11
Experience Perth	Scarborough / Cottesloe	7.5	4	11.5
Experience Perth	Rottnest	7	2	9
Coral Coast	Shark Bay	8.2	3	11.2
Coral Coast	Kalbarri	7	7	14
Coral Coast	Nambung National Park	6.5	2	8.5
Coral Coast	Wind surfing / kite surfing	5.5	5	10.5
Coral Coast	Jurien Bay Marine Park	5.5	2	7.5
South West	Whale watching	7	4	11
South West	Denmark	6.5	2	8.5
Golden Outback	Fitzgerald River National Park	6	2	8

(Source: Tourism Western Australia, 2005)

The low scores for some Perth-based activities in the 'Focus' group reflects local issues such as accommodation shortages on Rottnest Island and facilities for children

and families in beach locations, although these do not detract from their popularity. It is evident from this exercise that tourism is best developed and catered for in terms of infrastructure and services in the South West region of Western Australia (sub-region 4). This is reflected in the fact that this region experienced the greatest increase in visitor numbers over the period 1999-2003 in the order of 12%. However, there are certain deficiencies in terms of road quality, electricity services, sewage facilities and mobile phone network access which are increasingly likely to be highlighted by ongoing tourism activity in the South West region (Tourism Western Australia, personal communication) and which will therefore require considerable investment in the medium term. However, tourism and other development within the South West is subject to the Leeuwin-Naturaliste Statement of Planning Policy which applies to the nearshore waters from Cape Naturaliste to Cape Leeuwin as far inland as the Bussell Highway (WAPC, 1998). This policy aims to focus development in the major settlements such as Busselton, Margaret River, Augusta and Dunsborough, with a presumption against rural residential development outside of existing rural areas. With regards to tourism, the consequences include a combination of major coastal tourism developments being focused within existing urban areas and promoting low-scale nature-based tourism in rural areas. It is likely that coastal tourism development within this area will be limited in terms of expanding outside of the existing centres and therefore the anticipated increase in visitor numbers will place an increasing demand in terms of services and infrastructure in these locations in the short to medium term (Tourism Western Australia, personal communication).

The table also demonstrates that there are a significant number of sites in the Coral Coast region (sub-region 1 in Figure 1.2) which are amenable to development to attract visitors. This is of significance given the stated objective of developing destinations outside of the Experience Perth region, in light of the fact that this region alone accounted for 47% of visitors in 2003 (Tourism Western Australia, 2005). Furthermore, visitor numbers have remained static over the period 1999-2003, indicating that investment is required to develop this region for tourism. The expected completion of the Lancelin-Cervantes stretch of Indian Ocean Drive in 2010-11 will play a crucial role in stimulating growth along this section of the coast, which is already subject to an increasing number of residential development proposals. In combination with the potential marketing activities centred upon Jurien Bay Marine

Park, it is felt that this area will experience rapid tourism growth in the medium term (Tourism Western Australia, personal communication).

However, many of these initiatives in both States are predicated on forecasts from the Tourism Forecasting Committee of a resumption of growth in international arrivals in the order of 4% per annum from 2006-2015. This in turn is premised on assumptions of a weakening in the exchange rate and a reduction in the price of oil creating a more conducive environment for foreign visitors (Tourism Forecasting Committee, 2006). The current strength of the Australian dollar and high oil prices may well delay the onset of forecasted renewed growth in international visitor numbers. This is reflected in the relaxation of tourism expenditure targets in the South Australia Strategic Plan from $5 billion in 2008 to $6.3 billion in 2014 (Government of South Australia, 2007). Recent projections are more optimistic, however, with a declining value of the Australian dollar and increases in aviation capacity resulting in higher rates of growth in international arrivals from 2008 onwards (The Australian, 2007).

It is therefore evident that tourism in the area adjacent to the SWMR and at the national level is undergoing a highly competitive phase with numbers of international arrivals remaining static or increasing very slightly. Therefore, locations such as Kangaroo Island, the Experience Perth region and to a lesser extent the South West of Western Australia are best placed to maintain their competitive advantage into the near future until the rate of international arrivals increases and investors are willing to develop locations in other regions. Domestic tourism as measured by visitor nights is forecast to increase marginally over the period 2006-2015 at an average rate of 0.5%, reflecting relatively high fuel prices and the availability of relatively cheap overseas holidays with low cost carriers for Australians, amongst other factors. This will again be to the advantage of existing popular sites and regions with well-developed infrastructure and accommodation affordable to domestic tourists. Whilst there is a greater effort in terms of State marketing to diversify tourism activity in the Region, these do have to compete increasingly with more ‘exotic’ overseas destinations serviced by low cost carriers which are popular amongst younger domestic tourists. It is therefore likely that the older and family segments of the domestic market will become increasingly significant to tourism within the study area, which could be to the advantage of South Australia rather than Western Australia given its marketing

initiatives described above and its relative proximity to the major urban centres of Melbourne and Sydney.

8.4.2 Trends in demand for marina berths

The South-west Marine Region is well placed to take advantage of the demand for marinas due to its climate and the reputation of its coastal attractions. Marinas are also seen as catalysts for development, with projects integrating marina construction with residential development, commercial fishing operations, tourist accommodation and other facilities being promoted as means to attract visitors to new areas or to regenerate former industrial waterfront. In this respect, the demand for multi-functional integrated marina projects reflects government economic development policies as much as tourism or boat ownership-led demand. However, marina developments adjacent to the SWMR are naturally restricted to suitably protected locations in reasonable proximity to centres of population. This results in the concentration of nine operational marinas in the Gulf of St Vincent in South Australia (sub-region 9) and the wider dispersal of marinas in Western Australia in association with relatively small embayments. Furthermore, marinas can constitute an exclusive form of marine resource use with respect to other activities such as aquaculture which tend to be located in similar environmental settings. Opposition to marinas can also originate from conservation or nature-based organizations as well as institutions responsible for the creation and management of marine conservation reserves.

As yet, no policy exists for the strategic planning and management of marina developments in either South Australia or Western Australia. An initiative within the South Australian government to prepare a strategy and guidelines for marinas was commenced in 2005 as an update to previous work in the late 1980s. However, this is currently in abeyance pending the outcome of applications for new marina developments (PIRSA, personal communication). Marina proposals are therefore evaluated on an individual basis in each State, with no overall policy statement to aid local planners. Given the economic and environmental impact of modern marina developments, such a strategy would appear imperative in order to manage this activity appropriately.

Under the current and forecast economic conditions, future demand for marinas from all quarters is likely to increase. In areas of existing or projected increased tourism use such as the South West peninsula of Western Australia, marinas are viewed positively as a means to diversify marketing strategies whilst maintaining policies designed to focus visitors to existing hotspots (Tourism Western Australia, personal communication). However, limits to supply include increasing opposition on environmental grounds, particularly as the designation of new marine conservation reserves proceeds. This can cause lengthy delays in the planning process, adding to the initial cost borne by investors. A lack of suitable locations for future marinas is likely to become more significant in the future, although this can be offset to some extent by coastal engineering works. Furthermore, demand for berths is concentrated near existing larger settlements, causing developers to focus their activity in a limited range of locations. It is therefore reasonable to predict that the development of new marinas will decline in the near future as environmental and economic constraints take effect, whilst those that are proposed will be subject to an increasingly rigorous and costly scrutiny.

8.4.3 Marine mammal watching industry

The prospects for marine mammal based tourism within and adjacent to the SWMR in the foreseeable future are highly positive. In terms of demand, it is likely that both domestic and international visitors will continue to provide a buoyant market, to a large extent unaffected by economic drivers of tourism. The fact that domestic visitors represent the vast majority also augurs well for the industry in circumstances of economic or political uncertainty at the international level. On the supply side, there are numerous locations where sightings can be made along the coastline of South Australia and Western Australia and operators do not require a considerable investment to become involved in the industry. As the activity takes place offshore, there are few occasions of conflict with coastal marine resource users. However, it is felt that there is a need to supply more jetties, particularly in Bunbury and Augusta and along the southern coast of Western Australia to cater for the increasing demand for charter boat trips in the whale watching sector, which would further support the growth of this industry (Tourism Western Australia, personal communication). The only spatial restrictions to the activity relate to sanctuary zones within marine conservation reserves, but these are currently highly limited in their extent. These

factors all contribute towards a continued growth in the sector, subject to any limitations on total permit numbers issued at State level. In the longer term, future whaling activity – such as an extension of the current Antarctic whaling program undertaken by the Government of Japan – could impact on the populations of humpback and southern right whales and hence the viability of the industry. However, the likelihood of this and the potential impact on whales passing through the SWMR and adjoining coastal waters is indeterminate.

8.4.4 Marine nature reserves and sanctuary zones

The designation of marine protected areas will occupy a prime position in the management of marine conservation over the next ten to fifteen years. This reflects the level of attention currently being given towards identifying sites under the NRSMPA which meet the environmental and economic criteria and the process of deriving potential MPA sites from this list. Currently South Australia is more advanced in this process, with 19 proposed sites being identified, 17 of which lie along the coastline bordering the SWMR. This is in line with the State Strategic Plan, whose objectives include the designation of 19 marine parks by the year 2010 (Government of South Australia, 2007).

One of the most controversial aspects of the establishment of the NRSMPA will undoubtedly be the percentage of each MPA zoned as a ‘sanctuary zone’, wherein no fishing or resource extraction of any type is permitted. Sanctuary zones within multiple use marine protected areas in the SWMR are currently very restricted in scale, covering 5% of the marine park estate in Western Australia and 25% of the sole existing multiple use marine protected area in South Australia. The draft zoning plan for the first of the new proposed marine parks in South Australia, the Encounter Marine Park located in sub-region 9, contains proposals for 16 sanctuary zones, although the size of these is not specified.

Conservationists and marine scientists emphasise the need to prioritise sanctuary zones as a management technique for marine protected areas, with organisations such as the IUCN recommending that 20-30% of each habitat be set aside as a sanctuary zone. This is also reflected in the Western Australia Biodiversity Conservation Strategy, which highlights the need to establish sanctuary zones across the full range

of representative marine habitats (Department of Environment and Conservation, 2006). It is too early to speculate on the likely spatial extent of sanctuary zones within the proposed marine protected areas under the NRSMPA, although indications are that these will occupy a more central management role than hitherto. This perceived imperative to increase the designation of sanctuary zones within habitats and individual marine protected areas represents a significant policy shift, particularly in Western Australia where one currently planned site, the Walpole Bay / Nornalup Inlet Marine Park, is proposed to be designated entirely as a recreational zone. The locations of proposed MPAs in South Australian waters include seven in the Spencer Gulf and four within the Gulf of St Vincent. Given the heavy usage of these areas by other sectors including recreational fishing, it is likely that the implementation of the NRSMPA will be a long drawn out process and will encounter significant opposition.

8.5 CONCLUSION

This section has highlighted the importance of tourism to the social and economic environment of the coastal areas adjoining the South-west Marine Region, highlighting recent trends in the number and characteristics of international and domestic visitors and the likely development of certain indicators of tourism development. With regard to overall visitor numbers, it is evident that the increased value of the Australian dollar and availability of alternative destinations has resulted in a stabilisation of growth in the international market but the domestic market has undergone continued expansion and is dominant in terms of overall numbers. The pressure points in terms of visitor numbers will reflect the success of each State's marketing strategy, but it can be projected that in the near term, increasing numbers of visitors will be encouraged to those locations deemed most suitable for continued tourism development. These include Kangaroo Island in sub-region 9, which is already a prime tourist destination and is predicted to maintain its ranking in South Australia, whilst there are various locations within the south-west peninsula of Western Australia in sub-region 4 that already attract large numbers of visitors. In the medium to long term, greater rates of tourism growth are projected for the Fleurieu, Yorke and Eyre Peninsulas (sub-regions 7 to 9) and locations along the west coast of

Western Australia north of Perth (sub-regions 1 and 2). Whilst these certainly have the potential to grow, it is unlikely that they will match the existing prime tourist destinations in terms of numbers over the timescale of this Report.

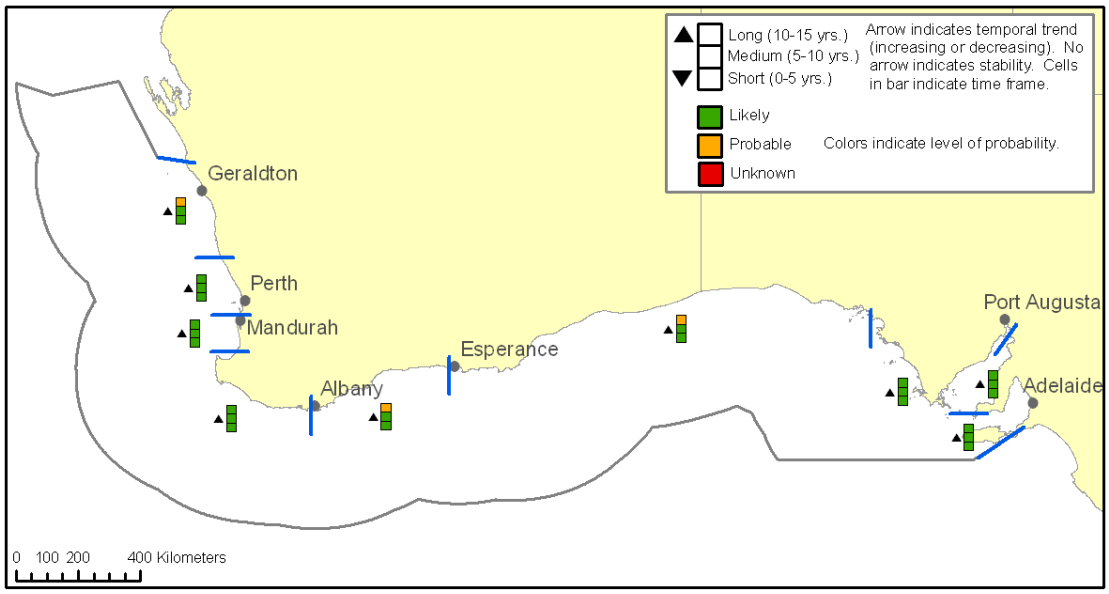
The analysis of marina developments and other indicators of tourism offer further insights into this sector. There are no economic or social indicators which would suggest a change in the continued demand for marinas throughout South Australia and Western Australia, but there are evident physical as well as planning constraints which will delimit their development. Currently marinas are highly concentrated around Adelaide and in the Peninsula regions of South Australia but are more diverse in location in Western Australia, albeit with some inevitable concentration in the Perth area. The lack of a strategy for marina development in either State is a source of concern, as this renders appropriate and unified planning approaches difficult. However, it is suggested in this Report that the rate of new marina developments are likely to decline simply due to environmental constraints on their development in proximity to centres of population, implying that this sector could well be near its capacity. This does not preclude an intensification of development at existing marinas which is already evident from the foregoing discussion, which would have significant implications for marine planners.

Specialised forms of tourism such as the marine mammal watching sector are seen to offer distinct potential for continued development into the long term. There is little reason for concern on environmental or other grounds, provided that the industry continues to observe regulations regarding interaction with marine mammals at sea. More controversy is likely to arise as new marine protected areas (MPAs) are established, with the delineation of sanctuary zones within each MPA likely to be the focus of much attention. Whilst comparison with other marine bioregions is tenuous, it can be noted that, within the currently planned network of 13 marine reserves in the South-east Marine Region, a total of 42% of the network area is under sanctuary zone designation. If the aim of establishing a comprehensive, adequate and representative MPA network within and adjacent to the SWMR is to be achieved, then there will inevitably be debate and delays in gazettal where multiple pressures and uses are already present. The Gulfs of South Australia are of particular concern here, given the

existing pressures and uses outlined elsewhere in this Report and the likelihood of their being included within a proposed network of MPAs.

Figure 8.1 summarises these trends in relation to the sub-regions of the SWMR coastline identified in Chapter 2. The overall increase in tourism activity reflects pressure indicators including marinas in proximity to urban areas, whale watching along the south west coastline and the likelihood of marine conservation areas being gazetted in the south west and along the coastline of South Australia. Logistical and transport issues are associated with a greater degree of uncertainty in the longer term in the more remote central southern area of the coastline, whilst increased tourism in sub-region 1 from Kalbarri to Yanchep will be largely dependent on the completion of transport links with more populated areas to the south.

Figure 8.1 Overall trends in tourism activity adjacent to the SWMR



9 AQUACULTURE

9.1 INTRODUCTION

Aquaculture can be defined as 'the commercial growing of marine and freshwater animals and plants for the purposes of trade, business or research' (Department for Environment and Heritage, 2007). In 2005-06, the national output of aquaculture products totalled 54,076 tonnes, an increase of 32% from the total of 41,044 tonnes in 2000-01 (ABARE, 2007; 2004). The total value of aquaculture products in 2005-06 was $748.3 million, representing an increase in real terms of 7.8% from the total of $707.5 million in 2000-01.

At the state level, aquaculture production in South Australia and Western Australia was valued at $214.5 million and $127.9 million respectively in 2005-06. This equated to South Australia contributing 29% and Western Australian accounting for 17% of the total national value of aquaculture in 2005-06. The value of aquaculture in South Australia in 2005-06 decreased by 35% in real terms from a total of $285.4 million in 2000-01, whilst the value of production in Western Australia in 2005-06 declined by 29% in real terms from a total of $157 million in 2000-01 (ABARE, 2007; 2004).

In South Australia, the dominant aquaculture product in terms of tonnage and value is southern bluefin tuna (*Thunnus maccoyii*), which was valued at $155.8 million in 2005-06, representing 73% of the state output by value. Cultivation of edible Pacific oysters (*Crassostrea gigas*) has increased its share of the South Australian aquaculture market to a value of $32.5 million in 2005-06. Cultivation of greenlip abalone (*Haliotis laevigata*) has also expanded in South Australia to a total of $8.5 million in 2005-06.

In Western Australia, the aquaculture sector is almost exclusively dominated in terms of value by pearl farming, which was estimated at $122 million in 2005-06, representing over 95% of the aquaculture sector by value. This has undergone a decline in the order of 29% in real terms over the period 2000-01 to 2005-06. However, data relating to pearl production in Western Australia is very limited due to commercial restrictions, with no information provided in the ABARE publications or

other sources relating to volumes of production. The discussion in this chapter is therefore restricted to blue mussels (*Mytilus edulis*), which represent the other aquaculture product of Western Australia. This activity represented a total value of $1.9 million in 2005-06.

The driving forces behind aquaculture activity within and adjacent to the SWMR include the demand for produce, the rate of expansion of the sector in recent years and the profitability of the sector. This section will examine the development of the aquaculture sector using indicators of these driving forces as outlined below.

Table 9.1 Driving forces and pressure indicators for the aquaculture sector within and adjacent to the SWMR

Driving forces	*Pressure indicators*
Demand for product	Trends in volume of production of key species
Expansion of sector	Number and location of licences
Profitability of sector	Gross value of product
	Projected price trends

9.2 CURRENT STATUS OF PRESSURE INDICATORS

9.2.1 Trends in volume of production

Table 9.2 details the annual volumes of production for the three main species of interest in areas adjacent to the SWMR from 2000-01 to 2005-06. Southern bluefin tuna from South Australia is the most significant in terms of tonnage, remaining relatively constant from 2000-01 to 2003-04, after which production declined by over 20% to around 7,500 tonnes. Subsequently, production increased by 18% in 2005-06 but is still below the average annual production sustained from 2000-01 to 2003-04. It must be remembered that southern bluefin tuna production differs from the other aquaculture sectors in that the total allowable catch is distributed between nine countries by the Commission for the Conservation of Southern Bluefin Tuna (CCSBT). The current Australian annual catch quota is 5,265 tonnes for the period 2007-2009. During the 1980s, rationalisation of the sector resulted in licences being bought up by operators in South Australia, with the fishery becoming based in Port Lincoln in sub-region 7. Virtually all of the Australian southern bluefin tuna quota is now caught by around 10 licensed purse seine vessels and towed back live to static

grow out cages off Port Lincoln and fattened for up to 6 months before being harvested. The recorded volume of production therefore reflects the process of feeding in captivity rather than the wild harvest quota, which has remained constant since the late 1990s. Oyster production fell sharply by 25% in 2004-05 following stability and expansion in the preceding four years, although in 2005-06 production rose by 64% to a new peak of over 5,000 tonnes. Abalone cultivation has only taken off in the past three years but has expanded rapidly from 27 tonnes in 2002-03 to 229 tonnes in 2005-06. Mussel production in Western Australia declined dramatically in 2002-03 by 30% to around 650 tonnes and has fluctuated around this figure in the three subsequent years for which data are available.

Table 9.2 Production of main aquaculture species within and adjacent to the SWMR, 2000-01 to 2005-06

Species and location	*Annual production (tonnes)*					
	2000-01	*2001-02*	*2002-03*	*2003-04*	*2004-05*	*2005-06*
Southern bluefin tuna (SA)	9,051	9,245	9,000	9,558	7,458	8,806
Oysters (SA)	2,055	2,425	2,364	4,382	3,255	5,340
Abalone (SA)	53	34	27	105	177	229
Mussels (WA)	964	989	653	763	531	671

(Sources: ABARE, 2007; 2005)

9.2.2 Number and location of licences

The number of licences in the southern bluefin tuna sector of South Australia remained at 40 from 2002 (the earliest date at which data are available) to 2004, then decreased to 31 in 2005 and rose to 35 in 2006 (ABARE, 2007; 2004). These will include pelagic longline and other fishing licences, which only account for around 2% of the catch, the vast majority being taken by the ten licensed purse seine vessels. The number of oyster licences in South Australia remained at 290 from 2002 to 2004, increasing to 346 in 2005 and 437 in 2006 (ABARE, 2007; 2004). Oyster production has been predominantly undertaken towards the west of the state from Ceduna to Cowell (sub-region 7) but has recently expanded into new locations on the Yorke Peninsula and Kangaroo Island (sub-regions 8 and 9). Abalone cultivation licences remained static at 64 from 2002 to 2004, then increased to 51 in 2005 and 101 in 2006 (ABARE, 2007; 2004). Abalone cultivation is centred around Port Lincoln and Streaky Bay on the Eyre Peninsula (sub-region 7) and on Kangaroo Island, although

projects are underway to expand production to other locations. Licence data relating to mussel cultivation in Western Australia is limited to the west coast, where numbers have increased from 14 in 2001-02 to 16 in 2002-03 and remained at 21 until 2004-05, which is the most recent year for which data are available (Department of Fisheries, 2006). Most mussel cultivation is undertaken in sheltered sites on the west coast such as Cockburn Sound and Warnbro Sound (sub-region 2), although there are sites in Albany harbour and Wilson Inlet (sub-regions 4 and 5) on the south coast.

9.2.3 Gross Value Product

Table 9.3 lists the annual gross value of product (GVP) for the main aquaculture species cultivated within and adjacent to the SWMR from 2000-01 to 2005-06. Taken together, these four products have declined in value by 38% in real terms from $280 million in 2000-01 to $199 million in 2005-06, with a particularly sharp decline in one year from 2003-04 to 2004-05 which amounted to 39% in real terms. Southern bluefin tuna as the dominant product in terms of value is the major contributor to this overall trend. The annual value of southern bluefin tuna is seen to have declined over the five year period by 48% in real terms, most of this taking place between 2003-04 and 2004-05 when the product value fell by 43% in real terms. Oyster production remained fairly steady between 2000-01 and 2004-05 but increased dramatically by 57% in real terms to $32.5 million in 2005-06. Abalone cultivation has increased substantially in value since 2002-03 by over 750% in real terms to $8.5 million in 2005-06. Mussel cultivation in Western Australia is seen to have fluctuated in the period 2000-01 to 2005-06 with no discernible trend, but has decreased overall in value by 27% in real terms to $1.9 million in 2005-06.

Table 9.3 Gross Value Product of main aquaculture species within and adjacent to the SWMR, 2000-01 to 2005-06

Species and location	*Gross Value Product ($ '000)*					
	2000-01	*2001-02*	*2002-03*	*2003-04*	*2004-05*	*2005-06*
Southern bluefin tuna (SA)	263,973	260,500	255,600	243,217	139,955	155,795
Oysters (SA)	11,011	13,303	14,008	21,152	19,995	32,480
Abalone (SA)	2,677	1,901	907	3,155	5,318	8,516
Mussels (WA)	2,267	2,817	1,607	2,063	1,515	1,897

(Sources: ABARE, 2007; 2005)

9.3 MACRO-ECONOMIC DRIVERS AT THE INTERNATIONAL AND NATIONAL LEVEL

The extent to which the aquaculture sector is dependent upon overseas demand is one of the main underlying causes driving recent growth and contraction in the industry. The high value niche products of the aquaculture industry are geared largely towards markets in east Asia, with southern bluefin tuna almost wholly destined for the Japanese sashimi market and greenlip abalone catering for Chinese demand, whilst oysters and mussels are directed towards both domestic and overseas markets.

However, the above sketch of the industry has highlighted the dominance of the southern bluefin tuna sector, which accounted for over 90% of the value of the aquaculture produce within and adjacent to the SWMR from 2000-01 to 2004-05. The rapid decline in the GVP of southern bluefin tuna in 2004-05 indicates its vulnerability, as this decline was induced by the depreciation in the Japanese yen which itself resulted from domestic Bank of Japan economic policies initiated in 2003. This depreciation, amounting to a loss of 20% against the US dollar, reduced the value of southern bluefin tuna product as the price of this export is denominated in Japanese currency (ABARE, 2006). Whilst this depreciation also induced a decline in demand, reflected in lower production totals for that year, the reduction in southern bluefin tuna value noted in 2004-05 (39% in real terms) exceeds the fall in production (22%).

Oyster and abalone cultivation are, on the other hand, seen to have sustained remarkable growth rates both in terms of tonnage and value. Oysters are predominantly geared towards domestic markets, with about 10% currently exported mainly to Japan, although there are plans to expand exports to Europe and North America (Australian Aquaculture Portal, 2007). The main drivers of growth in this sector include technological advances which enable growth to uniform sizes. Oysters also occupy a niche market position based upon the quality of the meat which reflects the pristine nature of the marine environment, this being featured prominently in advertising. Greenlip abalone production is directed towards the Chinese market in particular and is also marketed as a high value product. The main drivers of growth again relate to technological advances which allow rapid maturation, thereby speeding

up returns on investment, whilst considerable investment in technology to ensure a constant ambient environment for abalone cultivation imparts a competitive advantage over producers such as China and Taiwan. Furthermore, the increasing disposable income within the Chinese market should broaden the customer base for Australian produced abalone, enabling a greater volume of export in the future (PIRSA, personal communication).

Mussel farming is directed almost wholly towards the domestic and Western Australian market and has been influenced primarily by market factors. Competition with overseas imports, particularly New Zealand farmed green mussels, has constrained the industry to the extent where it predominantly caters for local and Australian markets, as reflected in trade volume and GVP data above.

9.4 FUTURE TRENDS WITHIN THE SOUTH-WEST MARINE REGION

9.4.1 Trends in volume of production

The southern bluefin tuna global total allowable catch (TAC) was reduced by 21% in 2006 from 14,925 tonnes to 11,810 tonnes for the period 2007-09 (CCSBT, 2007). This was undertaken in light of apparent historic under-reporting of catch over the past 20 years, with various indicators pointing towards the spawning stock now being a fraction of its original biomass, whilst since the 1990s recruitment levels have been well below those observed from 1950 to 1980. The research data are being reviewed in 2007 and it is therefore likely that TAC quotas will continue to decrease in the foreseeable future, with the consequence that any increase in the production of Australian farmed southern bluefin tuna will reflect farming practices and the fattening process.

Oyster and mussel production are geared towards the domestic market and both are relatively new industries hence face similar organisational issues affecting their future output. One area of concern highlighted in a recent survey (Econsearch, 2002) relates to the lack of integration amongst producers and consequent pressure by marketing companies resulting in reduced farm gate prices for oysters. This is typical of a newly developing industry sector and would require the formation of co-operatives or similar

to increase the bargaining power of the producers. Whilst it is unlikely that this on its own would affect production, an additional factor specific to oyster production is the time taken to secure a long-term lease, which leads to delays in obtaining loans and thereby increases financial insecurity. However, there are nascent producer organizations such as the Oyster Growers Association of South Australia, indicating a greater degree of integration which would work towards reducing these problems. It must also be borne in mind that the prime asset behind the niche status enjoyed by these sectors is the high quality marine environment in which cultivation takes place and this could lead to problems in the case of disease or contamination which would have severe, if short-term, impacts on both sectors. It should also be noted that, as both sectors service niche domestic markets, there is inevitably an upper limit on demand and expansion of the sector would not automatically result in commensurate profits, as greater supply could negatively affect prices in a limited demand situation. It is therefore likely that, in light of these factors and others discussed below, the production of oysters and mussels in the coastal areas adjoining the SWMR is unlikely to expand considerably in the foreseeable future and, in the case of mussel production, a limit to operations may already have been attained.

As a similarly new industry but one geared towards overseas markets, the abalone sector faces some similar issues to those described for oysters and mussels in terms of lack of integration and potential threats from disease but is arguably less constrained by demand, although the reliance on overseas markets gives rise to wider concerns regarding future output. Chief amongst these are the stability of the Chinese market, the presence of tariffs and extra costs associated with transport, particularly with fresh, frozen or chilled produce. However, the indications are that the Chinese economy will continue to grow, whilst negotiations regarding a free trade agreement are underway and could lead to improvements in the tariff situation. Similarly, the increasing GDP and spending power of the Chinese consumers could underwrite the extra costs associated with transport. The evidence thus far is that these economic constraints are not resulting in a reduced demand for Australian cultivated greenlip abalone and efforts are underway to diversify the sector into blacklip abalone suitable for the Japanese market. The sector as a whole is currently perceived as high risk, which is to be expected given its relative infancy, but the expectation is that abalone cultivation offers greater potential to continue to expand in the future, not least

because of the potential expansion in the Chinese market alluded to previously. This is reinforced by industry member surveys indicating that the abalone sector is expected to exhibit the fastest rate of increase in production amounting to around 65% between 2006-07 and 2008-09 (Econsearch, 2007).

9.4.2 Number and location of licences

In light of the above constraints on southern bluefin tuna harvesting and the static nature of license allocation to date, it is considered unlikely that the number of licenses will increase in the future. The concentration of the industry in Port Lincoln offers significant benefits to participants through the group branding of Australian exports and therefore there are few perceived advantages to any locational expansion of the sector.

Whilst oyster and abalone production has expanded in terms of licenses and location of cultivation, these sectors along with mussel cultivation are subject to particular environmental constraints limiting their future expansion. All three species require sheltered, uncontaminated marine environments for cultivation, whilst abalone in particular necessitates careful maintenance of ambient temperature and other environmental conditions. Mussel cultivation is additionally dependent upon the supply of nutrients, which, given the presence of the nutrient-deficient Leeuwin Current, necessitates the siting of farms close to the shore to benefit from nutrient-enriched runoff. All these factors constrain the number of suitable sites for cultivation and, in the case of mussels, are likely to lead to conflict with other nearshore marine activities.

Currently, management plans are in preparation in the South Australian Lower Eyre Peninsula designed to produce a specific policy relating to aquaculture zoning in accordance with the State Aquaculture Act of 2001. At present, these involve the delineation of 35,145ha and 6,076ha of intertidal and subtidal area as aquaculture zones in the Lower Eyre and Coffin Bay planning regions respectively (sub-region 7 in Figure 1.2). Both draft plans include an additional zonation of 26,334ha and 14,222ha respectively as aquaculture exclusion zones (PIRSA, 2007). It is therefore evident that some of the issues relating to the obtaining of licenses within this sector

noted above are being addressed through a planning process, although any final approval of these plans is not expected until 2008.

It is therefore reasonable to suggest that the future expansion of oyster, abalone and mussels is more limited by environmental than economic factors and it is logical to assume that many of the prime onshore sites for cultivation have already been developed. Any future planned expansion will therefore require considerable investment in ensuring that the environmental conditions are appropriate and will inevitably entail extra expenditure in transport networks as these sites are likely to be in more remote locations. Whilst this could be in line with State policies to generate regional employment and opportunities, the costs and risks associated with expansion into new areas are likely to be considerable and it is therefore reasonable to suggest that these will present significant obstacles limiting future expansion of these sectors.

In the longer term, there is potential for offshore development of aquaculture which is undergoing research within the Aquaculture Development Council of Western Australia, focusing in particular on sea cage aquaculture in sites including Geraldton, Jurien, Esperance, Albany and Two Rocks, the latter being the site for initial technical evaluation (ACWA, personal communication). Sea cage aquaculture would avoid the negative visual intrusion or conflict with other resource users present in nearshore areas through being sited up to 5 nautical miles offshore in water depths of 25-50m, whilst it is considered that the environmental conditions in terms of wave climate, water temperature and water quality are appropriate in these locations. The choice of location would also depend upon available land-based infrastructure, particularly communications and electricity, as well as proximity to processing plants, thereby favouring locations near to existing fish processing facilities. Whilst it is too early to be specific, sea cage aquaculture of species such as yellowtail kingfish, mulloway and mahi mahi could develop to the stage that a 10ha site would produce 1000-2000 tonnes of fish annually within five to ten years (ACWA, personal communication). Bearing in mind the planning requirements for offshore waters that this would entail, as well as the necessity for labour in remote areas, the costs of importing and distributing feed into Western Australia and the need for secure export market arrangements, it is feasible that this activity could extend the location and volume of aquaculture in Western Australia in the medium term.

9.4.3 Gross Value Product

In light of the factors discussed above, it is difficult to foresee a significant increase in GVP in the aquaculture sector resulting from greater volumes of output in the short term. With regard to the southern bluefin tuna sector and, to a lesser extent, the abalone sector, GVP is largely predicated on future exchange rates, which introduce further complications. If the currency market situation remains in a similar condition to that at present, increases in GVP are likely to reflect refinement and improvement in product quality as well as quantity. There is capacity to improve quality in all sectors, as indicated by efforts to lower stocking rates of tuna, hold stock for longer to achieve greater market prices and improve onshore product control to enhance the quality of oyster and abalone (PIRSA, personal communication). Furthermore, greater efficiency in abalone and oyster production is considered possible through general improvement of farming practices as experience increases and investing further in machinery (Econsearch, 2002). There are also essential requirements in terms of infrastructure including boat ramps and processing facilities in areas where aquaculture could potentially increase such as Streaky Bay and around Ceduna (PIRSA, personal communication). These views reflect the fact that all sectors discussed are relatively new and expertise and knowledge are increasing, which would be likely to enhance GVP over time. The potential for expansion into sea cage aquaculture also offers avenues to increase the GVP of the sector as a whole.

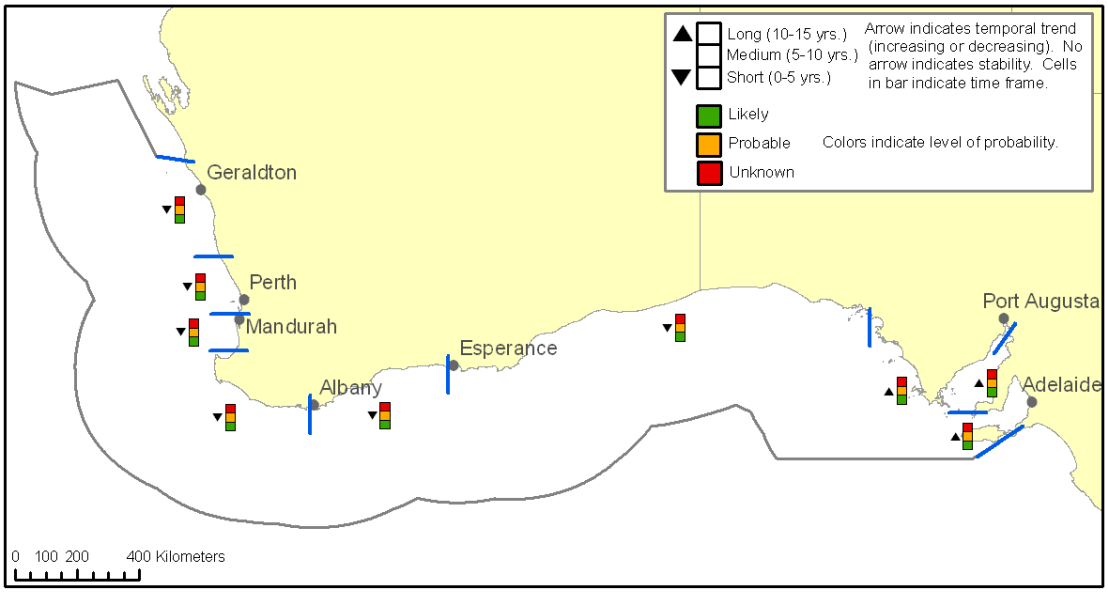
In the medium to long term, however, there are additional prospects for the sector which could enhance production by volume and GVP. These include lobster ranching, more marine based hatcheries for finfish farming, greater integration of operations allowing movement of stock during the lifecycle to enhance productivity and ship-based mobile abalone farms which have been trialled with some success in South Australia (PIRSA, personal communication). All of these offer scope for the sector to diversify in terms of produce and markets and thereby avoid over-reliance on single stocks or markets following the experience of the southern bluefin tuna sector in 2004-05. At present the main perceived obstacles to this relate to licensing procedures, onshore infrastructure, tariffs and limited labour availability. Furthermore, future gazettal of marine protected areas could significantly affect the ability of the industry to expand its operations.

9.5 CONCLUSION

This chapter has outlined aspects of growth and the likely future development of aquaculture within and adjacent to the South-west Marine Region. Analysis of recent trends in aquaculture is rendered difficult by the short timeframe over which cultivation of the major products has taken place in the area. Nevertheless, it is evident that a relatively new activity heavily dependent on foreign exports is vulnerable to sudden shocks, as demonstrated graphically in the southern bluefin tuna sector during 2004-05. This has distorted any overall trend in aquaculture output, although it is evident that production in all four sectors has increased from 2004-05 to 2005-06. In terms of location, the oyster and abalone sectors have expanded to include Kangaroo Island, the Yorke Peninsula and the Eyre Peninsula in sub-regions 7 to 9, whilst Port Lincoln in sub-region 7 remains the centre for southern bluefin tuna and abalone. Overall, it can be projected that there is restricted scope for further expansion into new cultivation areas due to a combination of limiting environmental and economic factors, although offshore sites for aquaculture remain a future possibility. There are, however, possible improvements in terms of technology, stocking practices and product handling to aid quality control, which would undoubtedly benefit the ability of the sector to benefit from the expansion of overseas markets in the medium to long term.

Figure 9.1 utilises the sub-regions identified in Chapter 1 to illustrate these overall trends in aquaculture activity. This underlines the greater degree of uncertainty in the medium and long term associated with this sector on account of its relative infancy and vulnerability to external influences as reflected in recent years. However, the current concentration of various forms of aquaculture within and adjacent to the Gulf of St Vincent and Spencer Gulf in sub-regions 7 to 9 and the potential for expansion outlined above are reflected in projected increases in activity in this sector. Further west, it is projected that limited sites and other competing uses in association with more population coastal districts will constrain the growth of this sector.

Figure 9.1 Overall trends in aquaculture adjacent to the SWMR



10 CONCLUSION

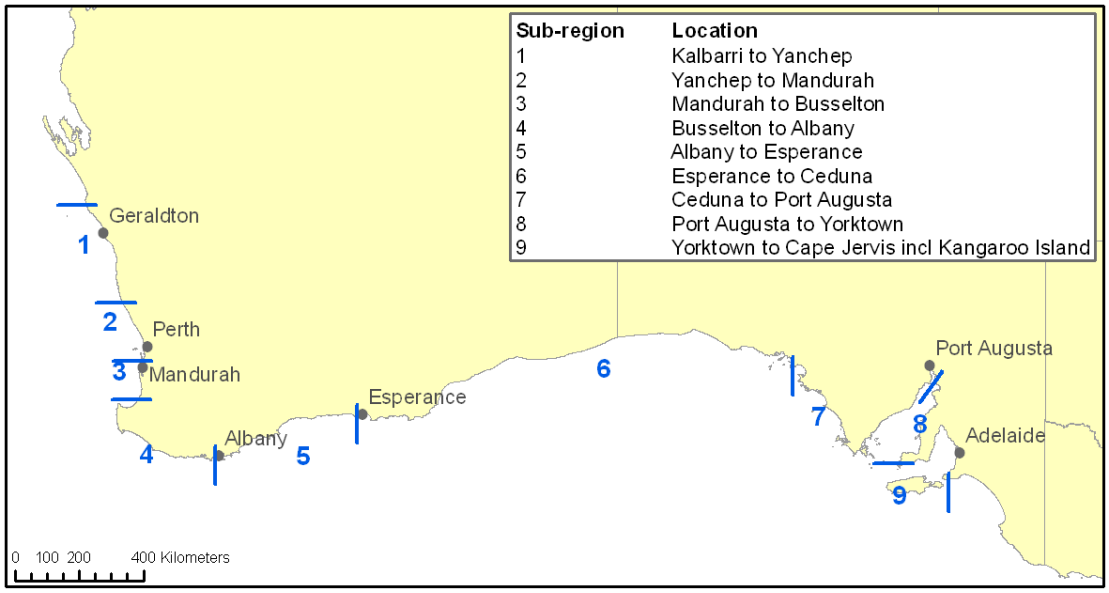
This Report has utilized a variety of pressure indicators in order to examine the likely future trends in key socio-economic sectors within and adjacent to the waters of the South-west Marine Region, which includes Commonwealth waters from Kangaroo Island in South Australia to Kalbarri in Western Australia. These trends are based upon the projected evolution of macro socio-economic drivers of growth and are specified where possible over the short (up to 5 years), medium (5 to 10 years) and long term (10 to 15 years).

The projections for the macro socio-economic drivers describe a reduction and stabilization of oil prices over the long term, which may be associated with a moderation of increases in national gross domestic product and a decline in the value of the Australian dollar. These developments take place in the context of a period of sustained high rates of economic growth, based mainly upon the value of exports from the minerals sector, with the effect that their adverse economic impacts may well be cushioned to a considerable extent. Projections of population at the national level are more precise, given the wealth of data available, and indicate that the rate of population growth will continue its gradual decline over the long term.

This Report has identified seven sectors of economic activity of significance to the South-west Marine Region and its coastal hinterland and examined the current status and future trends of pressure indicators associated with each sector. These have been detailed in the preceding chapters and illustrate the diverse range of pressures affecting particular parts of the Region, which are often highly specific at the local scale in particular urban or rural coastal environments.

This chapter will integrate these data through describing the likely trends in pressure indicators of relevance to each sub-region as discussed in preceding chapters. The data from each concluding section in Chapters 3-8 is summarized in Table 10.1 which will be used as the basis for the ensuing commentary. Figure 10.1 shows the location of each sub-region for ease of reference.

Figure 10.1 Coastal sub-regions adjacent to the South-west Marine Region



The increase in shipping activity associated with the new port at Oakajee and ongoing increase in port traffic through Geraldton in the short to medium term are the main pressure indicators in sub-region 1 from Kalbarri to Yanchep. Alongside this, tourism is expected to increase for at least the short to medium term as road links are completed, which along with natural population growth will add to recreational fishing pressure in the area. Given the currently relatively low number of visitors in this region in terms of the coastal areas adjoining the South-west Marine Region as a whole, tourism itself is not considered to be a significant pressure indicator. However, the pressure for marina development as transport links to the south improve is considered significant in this region in the short to medium term.

Table 10.1 Summary of projected trends in pressure indicators in sub-regions adjacent to the SMWR

	Short	Medium	Long
1) Kalbarri to Yanchep			
Increasing rate of urban development in south and around existing towns			
Declining rate of offshore oil and gas exploration			
Increased port activity at Geraldton and new port at Oakajee			
Stable or declining commercial fishing			
Population-led increase in recreational fishing			
Increasing coastal tourism at selected hotspots with marina expansion			
2) Yanchep to Mandurah			
Rapid increase in urban development, particularly towards south of sub-region			
Industrial expansion concentrated in south of sub-region			
Continued industrial and domestic discharges to water			
Increasingly severe transport congestion, particularly to south			
Declining rate of offshore oil and gas exploration			
Expansion of port activity, possible stabilisation medium to long term			
Stable or declining commercial fishing			
Rapid population-led increase in recreational fishing			
Increase in tourism activity all along the coast			
Extension of marinas and continued pressure for more development			
Stable or declining minor aquaculture towards south of sub-region			
3) Mandurah to Busselton			
Rapid increase in urban development, particularly towards north of sub-region			
Industrial expansion to north of sub-region			
Acute transport problems particularly in north of sub-region			
Declining rate of offshore oil and gas exploration			
Expansion of port activity			
Stable or declining commercial fishing			
Rapid population-led increase in recreational fishing			
Increase in tourism activity along the coast			
Extension of marinas and continued pressure for more development			
Stable or declining minor aquaculture			
4) Busselton to Albany			
Constant increase in urban development, particularly in coastal districts			
Declining rate of offshore oil and gas exploration			
Stable or declining commercial fishing			
Increase in recreational fishing			
Increase in tourism and whale watching activity all along coast			
Ongoing gazettal of marine conservation areas			
Stable or declining minor aquaculture			
5) Albany to Esperance			
Constant increase in urban development, particularly in urban districts			
Expansion of industrial activity within urban areas			
Declining rate of offshore oil and gas exploration			
Expansion of port activity			
Stable or declining commercial fishing			
Slight growth in recreational fishing effort, focused in urban districts			
Increase in coastal tourism activity, principally near urban districts			
Ongoing gazettal of marine conservation areas			

	Short	Medium	Long
6) Esperance to Ceduna			
Stable degree of urban development, declining in remote districts			
Declining rate of offshore oil and gas exploration			
Stable or declining recreational fishing focused around settlements			
Localised tourism development in association with marinas			
Gazettal of marine conservation areas			
7) Ceduna to Port Augusta			
Stable or declining rate of urban development, particularly in rural districts			
Declining rate of offshore oil and gas exploration			
Steady commercial fishing in specific locations			
Slow increase in recreational fishing activity			
Expansion of small-scale nature tourism into coastal and rural areas			
Extension of marinas and continued pressure for more development			
Expansion of aquaculture in specific locations			
Gazettal of marine conservation areas			
8) Port Augusta to Yorketown			
Stable or declining rate of urban development, particularly in rural districts			
Declining rate of offshore oil and gas exploration			
Steady commercial abalone fishing in specific locations			
Slight decline recreational fishers but sustained high effort and catch			
Expansion of small-scale nature tourism into coastal and rural areas			
Likely pressure to add new marinas around coastline			
Expansion of aquaculture into new locations			
Gazettal of marine conservation areas			
9) Yorketown to Cape Jervis including Kangaroo Island			
Increase in urban development in inner Adelaide, slow or stable elsewhere			
Industrial expansion in metropolitan Adelaide			
Continued industrial and domestic discharges to water			
Increasing traffic congestion at locations along interstate corridor			
Declining rate of offshore oil and gas exploration			
Expansion of port activity			
Steady commercial abalone fishing in specific locations			
Increasing recreational fishing activity, particularly in northern Gulf			
Continued expansion of tourism, particularly on Kangaroo Island			
Extension of marinas and intense pressure for more development			
Gazettal of marine conservation areas			

KEY

Likely

Probable

Unknown

Sub-region 2 from Yanchep to Mandurah constitutes the main Perth metropolitan area and surrounding districts and as such is subject to a variety of significant pressures, almost all of which can be safely predicted to increase in magnitude over the long term. The main driving force in this sub-region is evidently population growth, which is projected to sustain high growth rates in almost all metropolitan districts. The ongoing housing and infrastructure development towards the northern suburbs and also towards the south-west of Perth will reinforce this trend over the foreseeable future. The strength of the regional economy is demonstrated in the rate of industrial expansion centred in the south-western suburbs and along the coast, which is also reflected in the quantity of emissions recorded by the NPI originating from this sub-region. This is expected to continue over the timescales envisaged by this Report and could generate considerable pressures on amenity and environmental quality in adjacent coastal areas. In addition, the projected increase in port activity at Fremantle and the longer term development of new port facilities at Kwinana will serve to increase the pressure for industrial facilities and place increased stress on transport infrastructure in the vicinity of these ports. Recreational fishing and other tourism activity constitute highly significant pressures for coastal environments in this sub-region. Although detailed data are lacking, all the indicators point towards recreational fishing continuing to represent an important growth area, whilst coastal tourism in a broader sense and demand for marina berths in particular will also reflect the growth in population and income levels. There are evidently multiple areas of conflict arising from these predictions, particularly in relation to recreational pressure on coastal and nearshore resources which will need to be reconciled with housing, transport and industrial needs in this sub-region.

Sub-region 3 stretches from Mandurah to Busselton and represents an area which is increasingly interlinked with economic activity in the Perth metropolitan area. This is reflected in the projected increases in population, urban development, transport infrastructure and industrial expansion noted as being significant, particularly in the northern part of this sub-region. These projections are limited to the short to medium term as the full extent of this economic integration will depend largely upon transport infrastructure which is in the process of being developed. Port activity is again projected to expand in this sub-region which will add to the pressure for improved transport infrastructure to the distribution and retail centres in the Perth area.

However, this sub-region is more associated with the tourism sector which will lead to greater pressure for marinas and other tourism facilities along the coast, which could be at the expense of urban or industrial activity. Recreational fishing is projected to undergo sustained increases in growth in this sub-region as a result of population growth and high participation rates.

The area of the coastline between Busselton and Albany is closely associated with the tourism sector at present, which is recognized in State tourism planning documents and which is projected to increase in association with population growth in the metropolitan area and throughout the State. Recreational fishing, marine mammal watching and marina facilities are highlighted in this Report as being ongoing significant pressure indicators into the longer term in this sub-region. Marine conservation areas are also in the process of being gazetted and are likely to increase in extent over the medium term within this sub-region, which could lead to concerns from the commercial fishing sector, although present trends indicate that the latter is unlikely to be a growth sector into the future.

Sub-region 6 encompasses the coastline from Albany to Esperance and represents an area where the main pressure indicators are restricted to these urban centres. These include population growth and industrial activity, particularly in association with the ports in this sub-region. Recreational fishing and tourism activity are also considered likely to increase but the scale and extent of these sectors is limited. It is possible that this sub-region could be increasingly associated with marine conservation areas in light of the reduced potential for conflict with other resource users.

The coastline between Esperance and Ceduna is characterized largely by minor settlements and overall declining population levels; hence there are reduced indicators of pressure. Recreational fishing and marina developments are possible growth areas, albeit from a limited base, whilst tourism is similarly limited in extent.

Sub-region 7 includes the area of coast from Ceduna to Port Augusta and is characterized by an increased significance of commercial fishing, recreational fishing and tourism. Together with the aquaculture sector, these represent significant sources of income for coastal communities. However, current and projected population levels

in this sub-region are limited, therefore it is unlikely that fishing or tourism will constitute significant pressures on the coast. There is also a relatively high concentration of aquaculture activity along this stretch of coast, which could represent a growth sector in the future, although the industry is in its early stages of development at present. In addition, the establishment of a marina at Ceduna indicates that this could represent a future pressure indicator in this sub-region.

The area from Port Augusta to Yorketown is designated as sub-region 8 and incorporates the waters of the Spencer Gulf for the purposes of this Report. This sub-region is primarily characterized by the extent of recreational fishing activity which, although subject to probable stable or declining participants as a result of population trends, is likely to sustain or increase its catch and effort owing to the popularity of this pastime. This could be of concern with regard to the focus of activity on a limited range of target species, whilst the projected increase in demand for marina berths could also serve to increase the levels of effort. The Yorke Peninsula is also the focus of projected increases in rural and coastal tourism activity which could eventuate in the medium term as these plans are implemented. Another area of future pressure relates to the likely establishment of marine protected areas in the Spencer Gulf in the short term, which will again require careful integration with existing users.

Sub-region 9 includes the coast from Yorketown to the eastern boundary of the South-west Marine Region at Cape Jervis, incorporating Kangaroo Island, the waters of the Gulf of St Vincent and, most importantly, the Adelaide metropolitan area. Whilst overall population growth projections for Adelaide are less than those of Perth, there are pockets of similar projected growth rates within the Adelaide metropolitan area, particularly to the north-east and south-west, which are also the locations of future planned industrial development within the metropolitan area. However, it is apparent that these growth areas are not anticipated to generate congestion and traffic problems on the scale evident in Perth. Nevertheless, the growth of Port Adelaide and continued investment in its facilities is likely to continue into the longer term, which will require management with regard to the transport of bulk and, increasingly, containerised goods. The port area and its environs are heavily used by both commercial and recreational sectors, as indicated by the prevalence of marinas in the Adelaide area and plans for future waterfront development. This will in

turn increase the pressure exerted by recreational fishing activity as tourism attractions and boating facilities in the Adelaide area continue to be developed, which is already noted to be heavily focused on the waters of the Gulf of St Vincent. Tourism is present throughout the coastal and rural areas of this sub-region but is particularly focused on Kangaroo Island as an established resort which is likely to continue to maintain its prime position as a tourist destination into the foreseeable future. Again, the process of gazetting marine protected areas will inevitably include the Gulf of St Vincent, which may involve protracted planning and negotiation between stakeholders.

This summary has outlined the broad trends in the indicators selected to describe the current and future pressures on the coastal zone adjacent to the South-west Marine Region. It is evident from these that in the current and projected economic climate, increased pressure on coastal resources in urban areas and, increasingly, adjacent rural regions will continue to grow, albeit at higher rates in Western Australian regions than in South Australia. This will be reflected in the greater potential incidence of conflict over access and usage of coastal resources which will necessitate careful planning and sensitive regulation and it is hoped that the information presented here will assist that process within the South-west Marine Region.

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