



THE NORTH-WEST MARINE BIOREGIONAL PLAN

BIOREGIONAL PROFILE

CHAPTER 5

HUMAN ACTIVITIES AND THE NORTH-WEST MARINE REGION



A DESCRIPTION OF THE ECOSYSTEMS, CONSERVATION VALUES AND USES
OF THE NORTH-WEST MARINE REGION



Australian Government

Department of the Environment, Water, Heritage and the Arts

CHAPTER 5 HUMAN ACTIVITIES AND THE NORTH-WEST MARINE REGION

Planning for long-term ecologically sustainable use of the North-west Marine Region requires an understanding of the full range of human interactions with the marine environment. This chapter provides a broad overview of the nature and extent of the human activities that take place within and adjacent to the Region, as background information to assist in the next stage of the planning process.

This chapter is not intended to provide a detailed information-base for assessing the socio-economic costs and benefits of Marine Protected Areas (MPAs) and other conservation measures that may be proposed in developing the North-west Marine Bioregional Plan. In addition to finer-scale information, that assessment will also require consultation with stakeholders. More information on how the North-west Marine Bioregional Plan will be developed is provided in Chapter 6.

The North-west Marine Region supports a range of economic, social and cultural activities. At present, the major industries within the Region are petroleum exploration and production, commercial and recreational fishing, pearling and tourism. Other marine-based activities relevant to the Region include ports and shipping related to mining, defence training and border protection. These uses of the Region make an important economic and social contribution to settlements along the coast. These settlements range from small towns to the larger regional centres of Carnarvon, Exmouth, Onslow, Karratha, Port Hedland and Broome.

Specific and detailed consideration of the potential impacts of current and future human activities on the Region will be a focus of the next stage of the planning process. Information about interactions between specific activities and protected species that inhabit the Region is included in the protected species group report cards in Appendix D.

The information in this chapter has been drawn from a range of sources including the following works commissioned by the Australian Government:

- *Petroleum and Minerals Industries in the Northwest Marine Region*;
- *The Development, the Status and Socio-economic Linkages of Key Industries Within and Adjacent to the North West Marine Region*;

- *Sea Countries of the North West – Literature Review on Indigenous Connection to and Uses of the North West Marine Region*; and
- *A Socio-economic Overview of the Coastal Communities Adjacent to the North West Marine Region*.

Publications and other web-based resources are available at <www.environment.gov.au/coasts/mbp/north-west>.

5.1 The human dimension: an overview

The north-west of Western Australia supports a range of industries and communities reflecting a diversity of natural resources, environmental values and Aboriginal cultures.

The land adjacent to the Region has been inhabited by Aboriginal people for at least 50 000 years. Their use of the Region and adjacent coastal zone resources and ongoing connection to these areas are discussed further in Section 5.2.

Coastal and marine development since European settlement

Prior to European settlement, Aboriginal people were not alone in their use of coastal marine resources in the Region. Fishers from Makassar in South Sulawesi visited the Kimberley from the early 1700s. There is evidence that a significant trade in marine resources between the Makassans and local Aboriginal communities occurred in the Region. The Makassans collected trepang (sea cucumber), shark fin and turtle for trade with the Chinese.

The Region was one of the sites of first contact between European visitors and Aboriginal people. The Dutch navigator Dirk Hartog landed at Shark Bay in 1616, and in 1644 Abel Tasman mapped much of the coastline from Western Cape York to the Exmouth Gulf, recording many observations about the land and its people. In 1699, the English privateer William Dampier made a more thorough assessment of the coast between Dirk Hartog Island near Shark Bay and Roebuck Bay near Broome. Further exploration by the British took place in the 18th century but, like the Dutch before them, the British concluded the north-west lacked the necessary resources



and environmental conditions to make settlement a worthwhile proposition.

British colonisation of the north-west began on the Pilbara coast in the early 1860s, about 30 years after the establishment of the Swan River Colony (now Perth). Pastoralism was the first major industry in the north-west, and was followed by the establishment of small ports and service centres along the coast with towns emerging at Carnarvon, Roebourne, Point Samson, Port Hedland, Onslow, Broome, Derby and Wyndham.

The emergence of the pearling industry in the late 19th century influenced the development of towns such as Broome. By 1910, nearly 400 pearling luggers and over 3500 people were fishing for mother-of-pearl shell in waters near Broome. The advent of cheaper alternatives to mother-of-pearl led to the near collapse of the industry in the 1940s. However, the introduction of cultured pearl techniques from Japan led to the revival of the industry and today pearling is a significant contributor to the economy of the north-west.

Fishing also had an important early influence on the economic geography of the north-west. From the 1860s, most coastal communities had small fishing fleets that serviced local markets, but significant expansion of the industry occurred with the emergence of the valuable prawn trawling and demersal finfish fisheries.

The discovery of large deposits of iron ore in the Pilbara in the 1950s led to the emergence of the minerals industry in the 1960s and the transformation of the economy of the north-west and the socio-dynamics of its coastal communities. The rapid expansion of the mining industry in the Pilbara resulted in considerable development along the coast, with the construction of large ports at Dampier and Port Hedland, and associated railways and roads. New towns were established at Dampier, South Hedland, Wickham and Karratha to service the minerals industry.

The oil and gas industry emerged in the Region following the discovery of oil at Rough Range near North West Cape in 1954 and of more substantial quantities offshore on Barrow Island in 1964. In the early 1970s, major gas fields were discovered in the offshore Carnarvon Basin leading to the development of onshore Liquefied Natural Gas (LNG) processing facilities in the 1980s and additional infrastructure to support exploration and production.

The Ord River Irrigation Scheme was established in the 1960s to support the development of agriculture in the Kimberley region. The town of Kununurra was built to service the industry. Cotton was originally produced, but was phased out because of rising costs and replaced with crops such as sugar, fruits and vegetables.

The north-west today

Today, the North-west Marine Region and adjacent coastal areas support a number of industries including petroleum exploration and production, minerals extraction, ports, shipping, commercial and recreational fishing, pearling and aquaculture, marine tourism, salt production, agriculture and defence-related activities. In addition, carbon capture and storage associated with the petroleum industry may soon be an important activity.

The marine and marine-related industries operating within and adjacent to the North-west Marine Region are far from static and have experienced significant changes in their economic structure and location. Some major industries, particularly mining and petroleum exploration and development have grown rapidly over the past few decades. More mature industries, such as commercial fishing, while experiencing significant change, have tended to be more stable and in some cases have declined. All of these industries underpin economic growth, employment and social wellbeing in the towns and small communities of the north-west.

In 2006, 91 841 people lived adjacent to the Region (ABS 2006). The population count is based on place of enumeration (place of location on census night) rather than place of usual residence. Place of enumeration gives a better picture of the true population in areas with high tourist numbers or temporary residents (largely associated with mining and petroleum activities) both of which are present in the North-west.

The population is concentrated in the major coastal towns of Carnarvon, Exmouth, Karratha, Port Hedland, Broome, Derby and Kununurra although there are also a number of smaller towns that service specific industries such as mining, fishing and tourism. The north-west also has a large Indigenous population (15 195 or 17 per cent of the total population) with significant populations in Roebourne, where over 50 per cent of the town's 992 residents are of indigenous descent; Derby, 40 per cent; and Wyndham, 35 per cent; as well as the smaller Indigenous settlements of Bardi, Beagle Bay and Kulubaruru in the Kimberley region.

Between 2001 and 2006, the population in the north-west increased by 4610, or five per cent, and there was significant variation in population growth within the region. Of particular note is the 14 per cent increase in population in the Pilbara region. This growth can be attributed to the expanding petroleum and minerals sectors exemplified by an increase of nearly 25 per cent in residents in the largely industrial town of Karratha.

In contrast, the population in the Gascoyne region has declined by almost four per cent, particularly in Carnarvon (over seven per cent). This could be a reflection of the mature nature of the agricultural and fishing industries that form the basis of the Gascoyne economy. Table 5.1 shows the change in population over 2001–2006.

A feature of the north-west's population is its high mobility. Almost 21 per cent of people living in the north-west who took part in the 2006 Census were located at a different address one year earlier to the census and over 41 per cent had shifted home address

since 2001. This feature is particularly prevalent in the resource-dependent centres of Karratha and Port Hedland, and largely reflects the highly cyclical nature of the resource economy where labour is contracted for short to medium periods during the development and construction phases of major projects.

In 2006, the number of people employed in the north-west was 30 822, which was a four per cent increase from 2001 (1210 more employed people). The most significant employment sectors were construction (11.7 per cent), mining (10.8 per cent), retail trade (9.3 per cent) and health care (8.9 per cent). However, the aggregated labour force statistics tend to mask the relative importance of certain industry sectors to particular regional communities. For instance, the agriculture, fisheries and forestry sector is an important provider of employment in Carnarvon and Kununurra, while in Karratha, Dampier and Port Hedland, mining, construction, and transport and storage are significantly more important.

Table 5.1 Population change in areas adjacent to the North-west Marine Region, 2001–2006

	Population		Absolute change	Per cent change
	2001	2006	2001–2006	2001–2006
Western Australia	1 851 252	1 986 249	134,997	7.2
Total population of areas adjacent to the North-west Marine Region	87 231	91 841	4610	5.3
Sub-regions				
Gascoyne (G)	13 419	12 883	-536	-3.9
Pilbara (P)	35 961	40 837	4876	13.5
Kimberley (K)	37 851	38 121	270	0.7
Regional centres				
Carnarvon (G)	7273	6729	-544	-7.4
Exmouth (G)	3137	3156	19	0.6
Karratha (P)	10 796	13 253	2457	23
Port Hedland (P)	12 776	12 908	132	1.0
Broome (K)	15 906	17 355	1449	9.0
Derby (K)	3688	3479	-209	-5.6
Kununurra (K)	5485	5617	132	3.4

Source: Clifton et al. 2007



Figures from the Australian Taxation Office (ATO) indicate that in 2005–2006, the mean annual taxable income in the north-west was \$50 986, compared to the Western Australian average of \$48 696 (ATO 2008). However, as shown in Table 5.2, this masks significant sub-regional differences. For example, competition for skilled workers in the minerals and petroleum sector has resulted in the towns of Port Hedland, Karratha and Dampier recording average incomes of \$63 600, \$64 537 and \$72 458 respectively. While Dampier recorded the highest mean annual taxable income out of all towns adjacent to the Region, its population was relatively small with just over 2000 people. As a result mean

income may be skewed towards a small number of high earning individuals rather than being representative of the entire population.

In areas with a greater reliance on the service sectors and higher Aboriginal populations there tend to be lower wages and educational levels and a higher dependency on welfare and benefits. Centres with relatively large Indigenous populations and service-based economies include Carnarvon, Derby, Kalbarri and Broome, all of which had average incomes below the State average.

Table 5.2 Mean annual taxable incomes for individuals in townships adjacent to the Region (2005–2006)

Location	2004-2005(\$)	2005-2006(\$)
Western Australia	45 660	48 696
Regional centres		
Carnarvon	40 005	42 913
Exmouth	45 234	44 145
Karratha	59 230	64 537
Port Hedland	62 309	63 600
Broome	42 313	45 325
Derby	41 426	42 416
Kununurra	49 202	52 819
Smaller towns		
Kalbarri	36 393	39 844
Denham	38 807	41 251
Onslow	46 264	50 348
Dampier	64 879	72 458
Wickham	58 870	64 082
Roebourne	42 343	43 352
Wyndham	42 471	46 716

Source: ATO (2008)



Pier at Coral Bay, Western Australia. Photo: Photolibrary.

5.2 Indigenous links to the Region

Historical connection to the Region

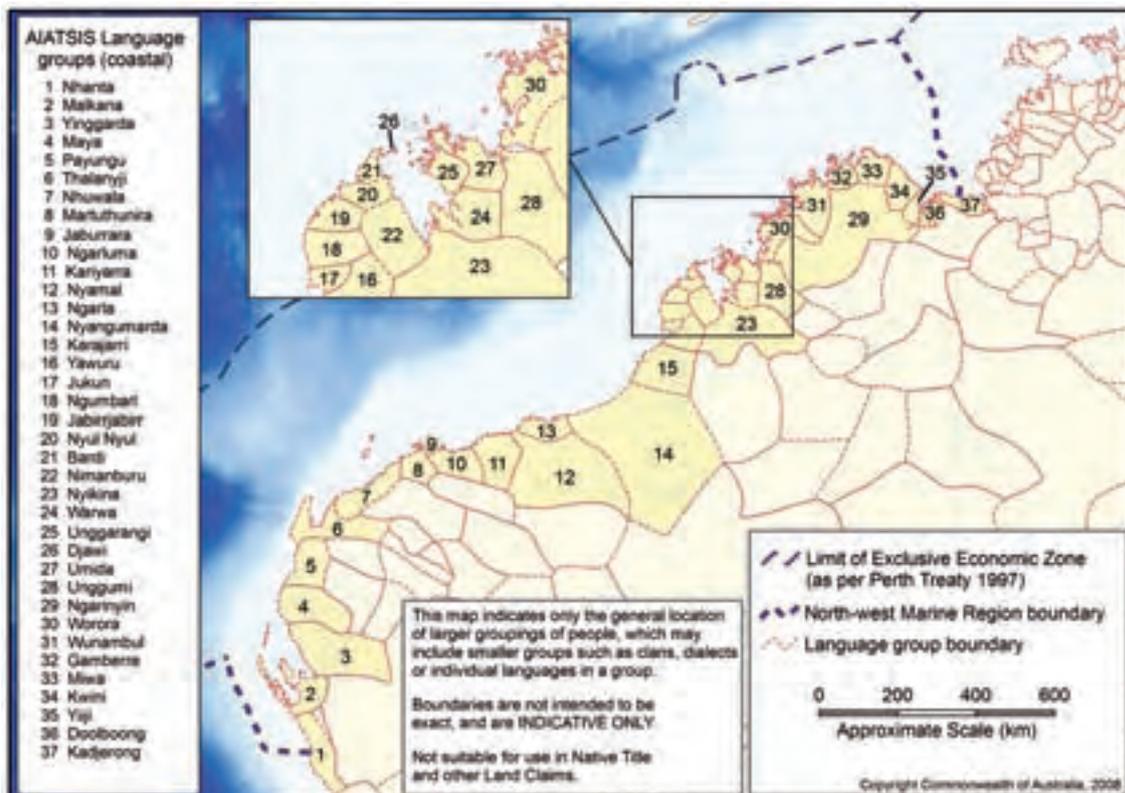
Indigenous people have a strong on-going association with the Region that extends from the beginning of human settlement in Australia some 50 000 years ago to the present. While sea level change over millennia has significantly altered many sites of significance to Indigenous people in the north-west, evidence of the close, long-standing relationship between Aboriginal peoples and the coastal and marine environments of the area is plentiful. The extensive and diverse assemblages of rock engravings (petroglyphs) at the Burrup Peninsula, which is one of the most significant collections of petroglyphs found anywhere in the world, is one of the most spectacular examples.

The saltwater peoples of the north-west continue to rely on coastal and marine environments and resources for their cultural identity, health and wellbeing, as well as their domestic and commercial economies. They are resident in most of the major population centres as well as in more remote areas adjacent to the Region. There are at least 35 different language groups in the area, as shown in Figure 5.1.

The Indigenous peoples of the north-west coast belong to discrete clan estates and language groups that occupy, or traditionally occupied, discrete areas or country. ‘Country’ refers to a place of origin – literally, culturally or spiritually (Australasian Legal Information Institute 2007) and ‘sea country’ or ‘saltwater country’ are terms that refer to an estate or cultural domain in which no separation between land and sea is made. Sea country may include bays, open ocean, beaches, dunes, reefs, coastal wetlands or other features, including remembered features of landscape long ago drowned by rising sea levels (see Box 5.1). Fishing, hunting and the maintenance of maritime cultures and heritage through ritual, stories and traditional knowledge continue as important uses of the nearshore region and adjacent areas.

The characteristics of each particular coastal environment as well as particular aspects of the culture of different Indigenous peoples in the north-west influence the relationship they had and continue to have with the sea. In some areas, such as Geraldton and Carnarvon, a high number of resident Aboriginal people have traditional connections to inland regions, and some of these people fish in others’ sea country for

Figure 5.1 Distribution of Aboriginal coastal language groups in the north-west



Box 5.1 Clans and saltwater country

Traditionally, the fundamental social unit around most of coastal Australia was the extended family or 'clan'. Intimately associated with each clan was their estate or 'country'. For coastal clans, their country always included the adjoining estuaries, beaches, coastal waters and ocean. The sea, or saltwater country, was not additional to a clan estate on land, it was inseparable from it. As on land, saltwater country contained evidence of the Dreamtime events by which all geographic features, animals, plants and people were created. It contained sacred sites, often related to these creation events, and it contained tracks, or song lines along which mythological beings travelled during the Dreamtime. The sea, like the land, was integral to the identity of each clan, and clan members had a kin relationship to the important marine animals, plants, tides and currents.

In the Region, the flooded countries of Aboriginal ancestors lie beneath Commonwealth waters and may be connected to cultural stories, sites and Dreaming tracks that may extend into Commonwealth waters. Dugongs, fish and turtles that move between coastal and Commonwealth waters in the Region are important components of Aboriginal people's culture and diet.

The relationship Aboriginal people have with the sea today is built on these traditional rights and responsibilities. The sea remains a part of their country, and is most evident in coastal communities where traditional activities such as turtle and dugong hunting, subsistence fishing and shell collecting are practiced (Smyth 2007).

purely social and economic reasons. In places that have large areas of sheltered waters, like Shark Bay, King Sound and the Dampier and Buccaneer archipelagos, saltwater people tend to make extensive sea journeys. In areas with more exposed coastlines and an absence of nearshore islands or reefs, use of the sea tends to be localised around intertidal and inshore areas. In many places, including Broome, Aboriginal people continue to rely heavily on sea resources for food and other needs (Smyth 2007).

Marine resource use by Indigenous people is generally restricted to coastal waters that are under State jurisdiction and lie adjacent to the North-west Marine

Region. However, while direct use by Aboriginal people of the Region's marine environment and resources is limited, many groups continue to have a direct cultural interest in decisions affecting the management of Commonwealth waters. The cultural connections Aboriginal people maintain with the sea may be affected, for example, by activities such as commercial, recreational and illegal foreign fishing, shipping, and oil and gas exploration and development. In addition, some Indigenous people are involved in commercial activities such as fishing and marine tourism, and so have an interest in how these industries are managed in Commonwealth waters with respect to their cultural heritage and commercial interests.

Legislation

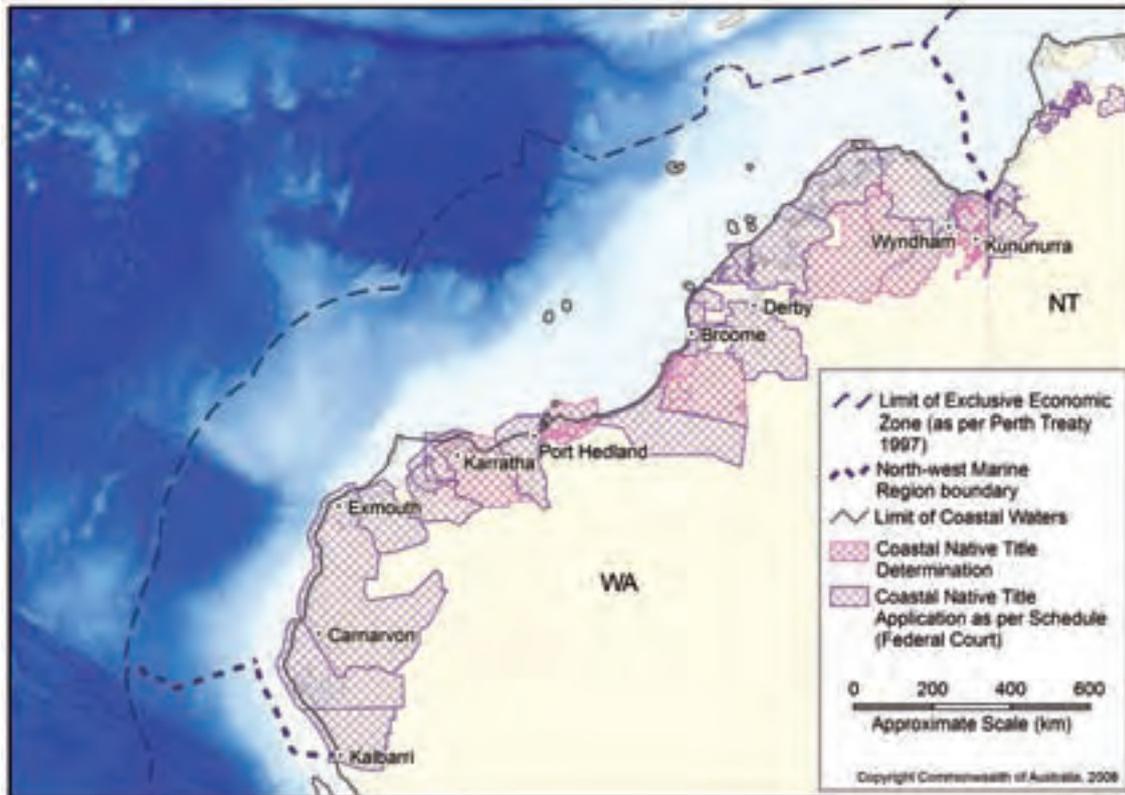
Native title is the recognition in Australian law that some Indigenous people continue to hold rights to their lands and waters that come from their traditional laws and customs (National Native Title Tribunal 2006). The *Native Title Act 1993* provides for the recognition of native title on land and in the sea. Native title rights may include traditional fishing rights.

In Western Australia, the Office of Native Title (ONT) is responsible for the implementation of the State Government's native title policy, which aims to mediate the determination of native title applications rather than going through the process of litigation. The emphasis is on reaching agreements about where native title exists, but where it is not possible to reach agreement, the State may provide alternative, non-native title land outcomes (ONT 2007), for example through the Aboriginal Lands Trust program.

The *Aboriginal Affairs Planning Authority Act 1972 (WA)* establishes the Aboriginal Lands Trust which is administered by the Western Australian Government Department of Indigenous Affairs (DIA). The primary purpose of the Aboriginal Lands Trust is to acquire and hold land and to facilitate the transfer of that land to Native Title Representative Bodies for the benefit of persons of Aboriginal descent (DIA 2007).

As of December 2007, 16 native title applications and six determinations had been made over sea country in or adjacent to the Region (National Native Title Tribunal 2008). The native title application/determination areas for the Northern Pilbara and Kimberley regions, including those that extend into Commonwealth waters, are shown in Figure 5.2.

Figure 5.2 Native title applications and determinations in and adjacent to the North-west Marine Region



L-R: Ju-Ju Wilson, Maureen Martin and Roy Martin, Lacrosse Island. Photo: Steve Kinnane.



Fisheries legislation in Western Australia recognises customary fishing by Aboriginal people as different to commercial and recreational fishing. Western Australia's Draft Aboriginal Fishing Strategy (2003) recognises Aboriginal Customary Fishing as a legitimate fisheries sector in terms of fisheries allocation and management, and promotes Aboriginal involvement in commercial fishing industries and their management. Some of the regulations that apply to recreational fishing also apply to customary fishing, for example, size limits, closed seasons and protected species. However, bag limits are different and some traditional fishing methods are permitted to allow for cultural events and passing-on of cultural knowledge (Aboriginal Fishing Strategy Working Group 2003).

Aboriginal involvement in resource management

Aboriginal people continue to actively manage their sea country in and adjacent to the North-west Marine Region in order to protect and manage the marine environment, its resources and cultural values. Some management arrangements involve collaboration with government agencies or other Aboriginal groups. For example, the Bardi Jawi people work with the Australian Customs Service and the Western Australian Department of Fisheries (DoF) as rangers patrolling the Kimberley coast for illegal foreign fishers (DoF 2007).

Through the North Australian Indigenous Land and Sea Management Alliance (NAILSMA), traditional owners are working to sustainably manage marine turtles and dugongs, including monitoring their populations and habitats, and identifying research and management needs (NAILSMA 2006). In the south Kimberley, Aboriginal people are involved in developing a management plan for Roebuck Bay and a coastal management plan to protect natural and cultural values along the coastline of Karajarri country south of Broome (KLC 2007).

In the Pilbara region, the Burrup Peninsula Conservation Reserve has been proposed to protect the significant cultural heritage sites in the area, including sacred sites, petroglyphs and archaeological sites containing evidence of early Aboriginal occupation and use and early contact with Europeans. The agreement between the Western Australian Government and the Ngarluma Yindjibarndi, Wong-goo-tt-oo and Yaburara Mardudhunera Traditional Owners to establish the reserve includes the transfer of freehold title for over 60 per cent of the Burrup Peninsula to the Ngarda-ngarli custodians. The reserve

will be the first statutory protected area in Western Australia to be owned by Aboriginal people and will be jointly managed by the Traditional Custodians and the Western Australian Department of Environment and Conservation (DEC), through an arrangement under the *Conservation and Land Management Act 1984* (DEC 2006).

Commercial interests

While involvement of Aboriginal people in the ownership or management of marine-based commercial activities remains at low levels, at Shark Bay the Yadgalah Aboriginal Corporation is part owner of the Monkey Mia tourist operation and Aboriginal fishers hold six of the 10 licences in the commercial Shark Bay Beach Seine and Mesh Net Managed Fishery (Fletcher & Santoro 2007).

In the Kimberley region, a number of Aboriginal-owned fishing charter enterprises operate out of One Arm Point. Aboriginal people also have a historical involvement in the trochus shell industry, which began at One Arm Point in the late 1800s. Licences are now held by the One Arm Point community and two Aboriginal corporations at Lombidina and Derby.



Trochus shell. Photo: Australian Institute of Marine Science.

5.3 Marine activities

This section provides a background to the most prominent non-Aboriginal industry sectors' activities in the North-west Marine Region and adjacent coastal areas.

5.3.1 Recreational fishing

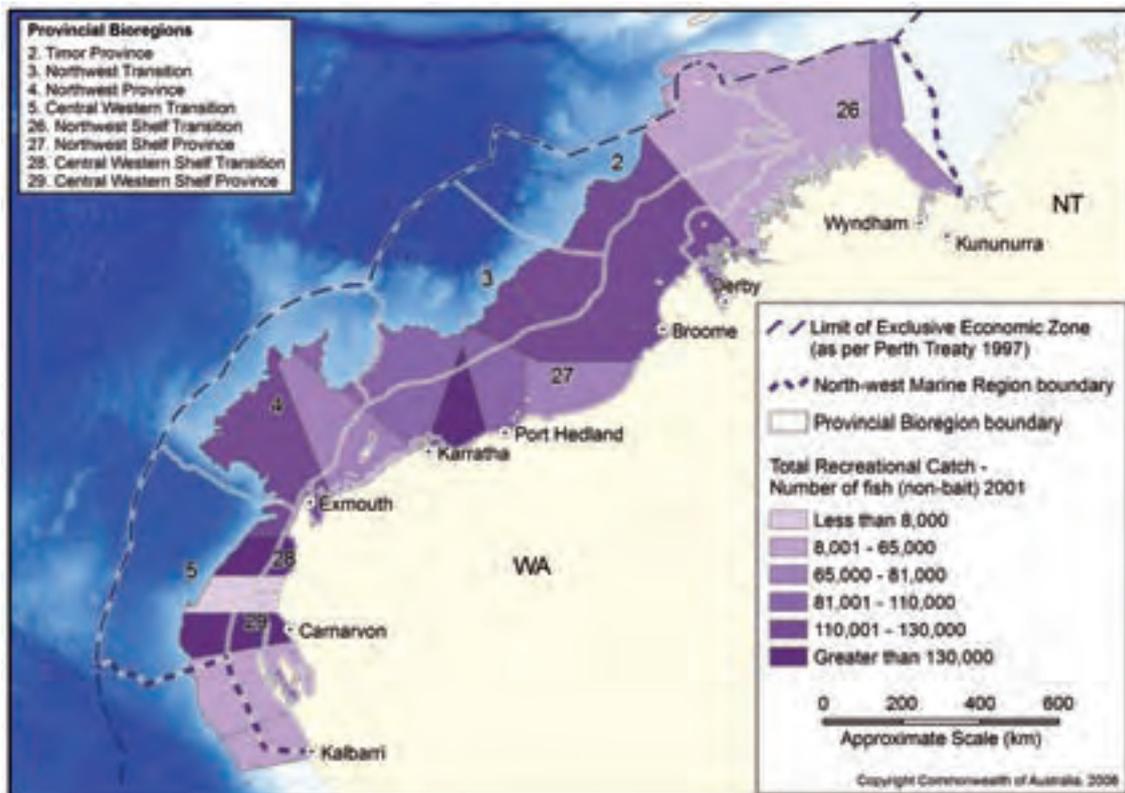
Recreational fishing is a popular activity in the North-west Marine Region, although most recreational fishing occurs in State waters adjacent to the Region. Commonly targeted species include members of the demersal sea perch family, emperors, coral trout, sharks, tunas, mackerels and species of gamefish.

Recreational fishing tends to be concentrated in State waters adjacent to population centres. Figure 5.3 presents information on total recreational fish catch in the north-west in 2001. It indicates that the highest recreational fishing effort is off Point Samson, (a favoured holiday location for people from the mining and petroleum towns of Dampier and Karratha), Coral Bay (reflecting high visitor numbers to Ningaloo Marine Park) and Carnarvon. Most recreational fishing effort occurs in the provincial bioregions on the

continental shelf south of the Kimberley: the Northwest Shelf Province, the Central Western Shelf Transition Province and the Central Western Shelf Province. Prime gamefishing locations are around offshore atolls and reefs, including the Rowley Shoals in the Northwest Transition, (although the Mermaid Reef Marine National Nature Reserve in the Rowley Shoals is closed to all forms of fishing). Recreational fishing effort is lowest in the Northwest Shelf Transition largely because of the remoteness and inaccessibility of these waters.

A 2005 survey of recreational fishers in Western Australia recorded that more than 536 000 individuals (or 31 per cent of the State population) participated in recreational fishing. The survey collected data on the basis of Western Australian Department of Fisheries (DoF) fishery regions and found that 11 percent of the State's recreational fishers fished in waters adjacent to the Gascoyne region (Shark Bay to Onslow) and seven per cent in the North region (Onslow to Kununurra) (Baharthah 2006). Recreational fishing is experiencing significant growth, particularly in the North region in winter months when tourists visit coastal areas around Onslow, the Dampier Archipelago and Broome (Fletcher and Head 2006).

Figure 5.3 Recreational fishing in the Region in 2001



Reliable information on the economic contribution made by recreational fishing to communities in the north-west is not available. However, DoF figures of participation provide an indication of the socio-economic importance of recreational fishing to townships adjacent to the Region as well as its potential impact on the marine environment.

Given the expanding population growth in the north-west region, particularly because of the growing petroleum and minerals sectors in the Pilbara, the popularity of recreational fishing is likely to continue to increase. High incomes, advances in technology and increases in vessel size are likely to result in increased recreational fishing effort in both State and Commonwealth waters.

The DoF regulates recreational fishing in offshore and State waters through its Integrated Fisheries Management Branch. Management methods include bag limits, gear restriction and zoning. Regional surveys are conducted to provide data on fishing effort at popular fishing sites as a means of managing important recreational fish stocks. Further information about Western Australian recreational fishing regulations can be found at <www.fish.wa.gov.au>.

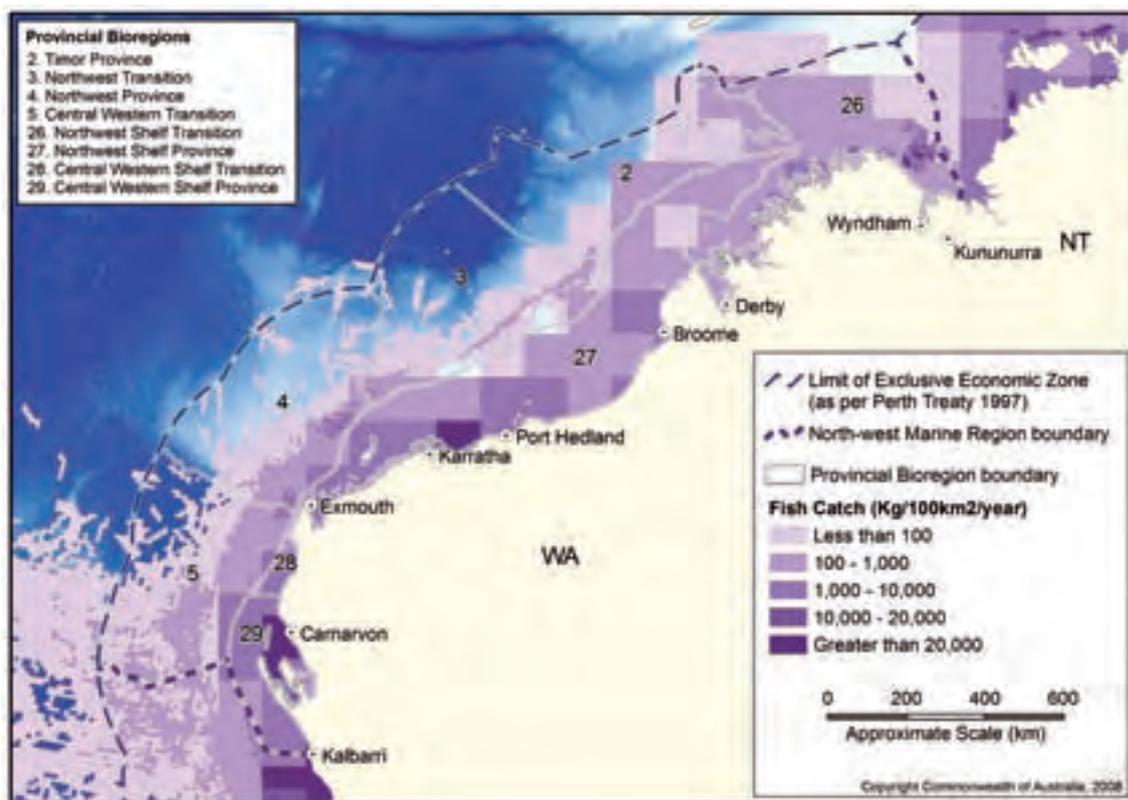
5.3.2 Commercial fishing

The waters off the north-west coast of Western Australia have been fished steadily over several decades by domestic fishers operating in both Australian Government- and Western Australian Government-managed fisheries. In the post-World War II period, the Region was also heavily fished by foreign vessels, most notably from Taiwan, Japan, China and Indonesia.

Today, there are 14 fisheries recording catch within the North-west Marine Region with another 12 primarily operating in State waters adjacent to the Region. All these fisheries are managed by either the Australian Government through the Australian Fisheries Management Authority (AFMA), or by the Western Australian Government through the DoF. The species targeted include prawns, scamp, shark, pearl oysters, crabs and bêche-de-mer (trepan or sea cucumber).

Based on 2005–2006 data for AFMA-managed fisheries and 2006 data for DoF-managed fisheries, the total commercial catch of fisheries operating in the Region was approximately 7000 tonnes of fish, prawns and crab, and 538 882 pearl oysters. The Gross Value of Production (GVP) of this catch was an estimated \$165 million, of which \$122 million was from the pearl

Figure 5.4 Combined catch for all commercial fishers operating in or adjacent to the North-west Marine Region (2000–2002)



fishery. The geographic scale and relatively low value of many fisheries in the north-west, combined with data confidentiality issues (where there are less than five vessels operating in an area), mean that data tend to be available only for the fishery as a whole, including when the fishery extends beyond the Region. The catch tonnage and GVP figures given above are therefore for entire fisheries and not just the proportion caught in the Region. The exception is the North West Slope Trawl Fishery, which operates entirely within the Region. The most recent available information on the spatial distribution of the combined commercial catch of all fisheries operating in or adjacent to the North-west Marine Region is from 2000–2002 (Figure 5.4).

Fisheries managed by the Australian Government

There are four AFMA-managed fisheries in the North-west Marine Region: the Western Deepwater Trawl Fishery, the North West Slope Trawl Fishery, the Western Tuna and Billfish Fishery and the Northern Prawn Fishery (Bonaparte Statistical Area). In 2005–2006, the combined catch value of these fisheries was \$7 million and the total landed catch was approximately 780 tonnes. While the Northern Prawn Fishery is the most valuable commercially managed fishery in the Region, only a small proportion of the fishery occurs in the Region, with the larger and more valuable component occurring in the adjacent North Marine Region.

In contrast to the Northern Prawn Fishery, the North West Slope Trawl Fishery and the Western Deepwater Trawl Fishery are small-scale and considered economically marginal because of high operating costs and low prices for product (Larcombe & McLoughlin 2007). Fishers active in these fisheries tend also to operate in other fisheries including the Northern Prawn Fishery. The Western Tuna and Billfish Fishery extends into the Region, but fishing activity in the Region is limited.

Table 5.3 provides a summary of the AFMA-managed fisheries operating in the Region, including the main locations of fishing effort, species caught, fishing method, catch volume and value, and number of licences/boats active within each fishery. As mentioned previously, because of the way data are collected, except where otherwise indicated, catch and GVP figures are for the entire fishery and not just the component occurring in the Region.

Fisheries managed by the Western Australian Government

There are 10 DoF-managed fisheries operating in both the North-west Marine Region and adjacent State waters. These fisheries generally have higher catch levels and value than AFMA-managed fisheries and include the Pilbara Demersal Finfish fisheries (comprised of the Pilbara Fish Trawl (Interim) Managed Fishery, the Pilbara Trap Managed Fishery, and a small line fishery component), the Northern Demersal Scalefish Fishery, the Western Australian North Coast Shark Fishery, the Pearl Oyster Fishery, the West Coast Deep Sea Crab Fishery, the Shark Bay Snapper Fishery, the West Coast Demersal Scalefish Fishery, the Mackerel Interim Fishery, the Kimberley Prawn Fishery and the Bêche-de-mer Fishery.

The most valuable fishery operating in the Region is the Pearl Oyster Fishery, which harvests wild pearl oysters as the first stage in the pearl production process. The fishery's value is measured in the price received for the end product, cultured pearls. The value of cultured pearls in 2006 was \$122 million, which is 74 per cent of the total value of commercial fishery catch in the Region. However, these figures do not reflect the true contribution of the pearl fishery to the value of the Region's fisheries because the main pearl fishing areas are in State waters. More information on pearling is in Section 5.3.5.

The Pilbara Demersal Finfish fisheries and Northern Demersal Scalefish Fishery are the principal finfish fisheries in the Region and target high-value tropical finfish, particularly emperors, snappers and cods. These profitable fisheries are the most valuable finfish fisheries managed by Western Australia, with a value of \$15.1 million in 2006.

In addition to the Western Australian fisheries operating in both Commonwealth and State waters, there are a wide range of DoF-managed fisheries active in State waters adjacent to the Region. These include three of the State's most valuable fisheries – the Shark Bay Prawn, Exmouth Gulf Prawn and Shark Bay Scallop fisheries, which have a combined landed catch value of \$40–50 million annually.

Table 5.4 provides a summary of the DoF-managed fisheries operating in the Region. Note that because of the way data are collected, except where otherwise indicated, the catch and GVP figures are for the entire fishery and not just the component occurring in the Region.



Table 5.3 AFMA-managed fisheries active within the Region (2005–2006)

Fishery	Main area of fishery by catch and bioregion	Relationship to North-west Marine Region	Main species targeted	Main fishing method	Tonnes caught	Number of licences/vessels	CVP (\$ million)
North West Slope Trawl Fishery ^{1,2,3}	Concentrated on muddy bottoms along depth contour lines, just outside the 200 m isobath. Fished in the vicinity of Rowley Shoals, Scott and Ashmore reefs (Bioregions: Timor Province, Northwest Transition and Northwest Province).	Active in the Region only.	Scampi, deepwater prawn.	Demersal trawling	43.4	7 vessels (2005–2006)	0.68
Western Tuna and Billfish Fishery ⁴	Minor activity in the far south of the Region from continental shelf outwards (Bioregions: Northwest Province and Central Western Transition).	Operates primarily in the South-west Marine Region but fishery extends into south of Region.	Yellowfin, bigeye, skipjack, albacore tuna, some billfish species.	Pelagic longline	480	7 vessels (2005–2006)	2.7
Western Deepwater Trawl Fishery ⁵	Concentrated along the 200 m isobath off the Gascoyne coast (Bioregions: Central Western Transition, Central Western Shelf Transition and Central Western Shelf Province).	Fishing effort primarily in Region with some in adjacent South-west Marine Region.	Mixed fish species.	Otter trawl	not available	3 vessels (2005–2006) permits	0.9
Northern Prawn Fishery ⁶ (Bonaparte Statistical Area – includes State and Commonwealth waters)	On the continental shelf in muddy and sandy substrates in coastal to deeper waters (Bioregion: Northwest Shelf Transition).	Fishery operates primarily in North Marine Region but extends into Joseph Bonaparte Gulf.	Largely banana prawn in North-west Marine Region and some tiger prawn.	Otter trawl	231 (Bonaparte Statistical Area estimate) 5400 (whole fishery)	52 vessels (whole fishery)	2.8 (Bonaparte Statistical Area estimate) 73 (whole fishery)

Sources:

- 1 Newton et al. (2007)
- 2 Moore et al. (2007a)
- 3 Larcombe & McLoughlin (2007)
- 4 Newton et al. (2007)
- 5 Newton et al. (2007)
- 6 Raudzens (2007)

Table 5.4 DoF-managed fisheries in the Region (2006)

Fishery	Main area of fishery by catch and bioregion	Relationship to North-west Marine Region	Main species targeted	Main fishing method	Tonnes caught	Number of licenses	GVP (\$ million)
Pilbara Demersal Finfish Fisheries (comprised of Pilbara Fish Trawl (Interim) Managed Fishery and the Pilbara Trap Managed Fishery)	North West Shelf (Bioregion: Northwest Shelf Province).	Fishery extends into North-west Marine Region.	Range of tropical finfish species – bluespot emperor, crimson salmon, threadfin bream, red emperor	Trawl, trap and line	2800 (Trawl, 2222; Trap, 473; and line, 105)	26 (Trawl, 11; trap, 6 and line, 9) vessels	10.5 (Trawl, 7.5; trap 2.5 and line 0.5)
Northern Demersal Scalefish Fishery	Waters from Broome to Western Australia/ Northern Territory border 30–200 m depth (Bioregions: Northwest Shelf Province and Northwest Shelf Transition).	Fishery extends into North-west Marine Region.	Goldband snapper, red emperor	Handline, dropline, traps	801	11	4.6
Pearl Oyster Fishery (wild caught) - most fishing in Western Australia waters	Inshore waters largely 10–20 m depth (Bioregion: Northwest Shelf Province).	Fishery extends into North-west Marine Region.	Silver lipped oysters	Hand collection	538 882 pearl oysters	17 licensees	122
West Coast Deep Sea Crab Fishery	Depths of 150–1200 m in Commonwealth waters around the shelf break parallel from Exmouth to Kalbarri (Bioregions: Central Western Transition, Central Western Shelf Province and Central Western Shelf Transition).	Fishery extends into North-west Marine Region.	Giant (king) crabs, crystal (snow) crabs, champagne (spiny) crabs	Pot	207	7 permits (5 full-time, 2 part-time)	2.4
Shark Bay Snapper Fishery	Continental shelf waters off Shark Bay (Bioregion: Central Western Shelf Province).	Fishery extends into North-west Marine Region.	Oceanic stock of pink snapper, goldband snapper, red emperor	Mechanised handlines	540 (318 pink snapper; 222 other species)	53 licences	3.4
Mackerel Interim Managed Fishery	Around reef, shoal and headland waters (Bioregion: Northwest Shelf Transition, Northwest Shelf Province and Central Western Shelf Province).	Fishery extends into North-west Marine Region.	Spanish, grey and other mackerel	Trolling or handline	291	18 permits	2.7



Fishery	Main area of fishery by catch and bioregion	Relationship to North-west Marine Region	Main species targeted	Main fishing method	Tonnes caught	Number of licenses	GVP (\$ million)
West Coast Demersal Scalefish Fishery	Waters adjacent to Kalbarri (26°30' S to 28° S). Inner shelf zone to 150 m contour (pink snapper). Outer shelf (150 m+) snapper and jobfish (Bioregions: Central Western Shelf Transition and Central Western Shelf Province).	Fishery extends into North-west Marine Region.	Pink snapper, emperors plus other scalefish.	Handlines and droplines	975	60 permits	7.8
Kimberley Prawn Fishery	Bioregion: Northwest Shelf Transition.	Extends into North-west Marine Region. and abuts western boundary of the Northern Prawn Fishery.	Banana prawns. Secondary species - tiger, endeavour and king prawns	Trawl	335	137 licences although only 22 boats actually operated in 2006	3.1
Bêche-de-mer (trepang) Fishery	Muddy, sandy bottomed areas from waters adjacent to Exmouth Gulf to Northern Territory border.	Fishery extends into North-west Marine Region.	Sandfish	Hand collection by diving	56	6 endorsements	0.45
Western Australian Tropical Shark fisheries (2004–2005 season) (includes Western Australia North Coast Shark Fishery (WANCSF) and the Joint Authority Northern Shark Fishery (JANSF))	Continental shelf waters (Bioregions: Northwest Shelf Province, Timor Province and Northwest Shelf Transition).	Fishery extends into North-west Marine Region.	Blacktip, tiger, hammer-head, lemon and sandbar sharks	Demersal longline and some gillnetting.	189	14 permits 9 in WANCSF and 5 in JANSF	0.49

Sources: Fletcher & Santoro (2007); Heupel & McAuley (2007)

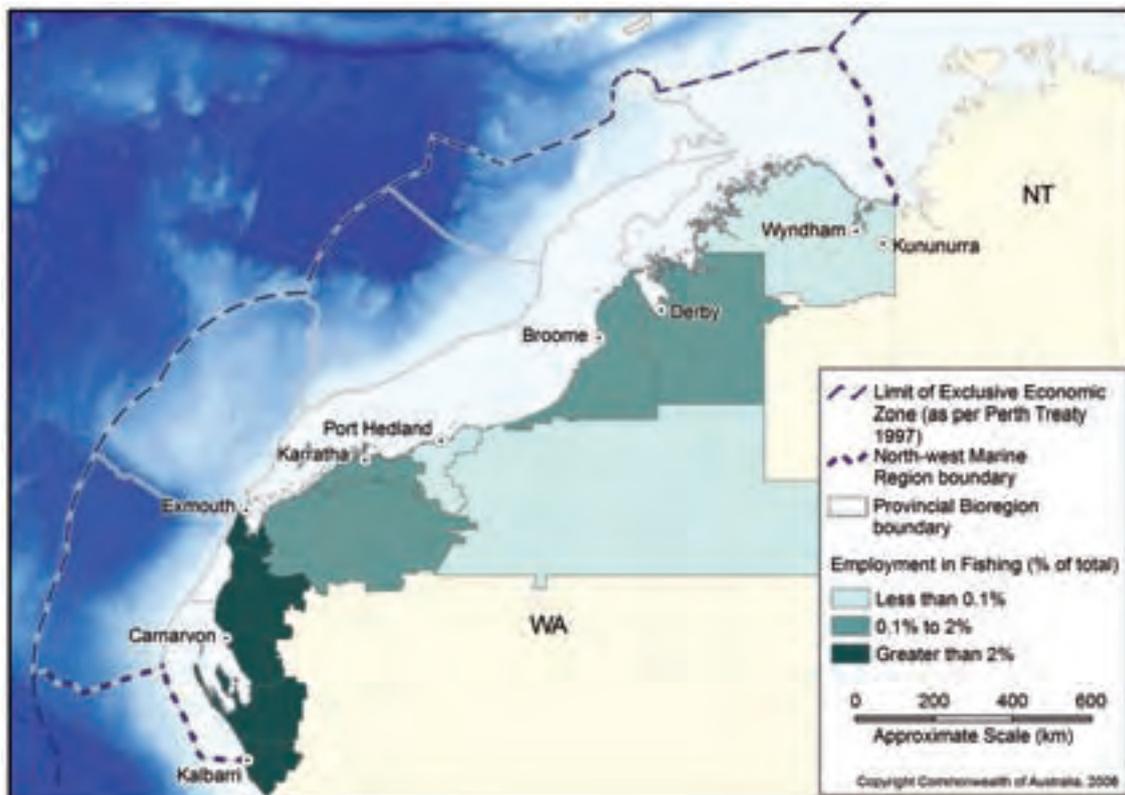
Employment

The fishing industry and related businesses are important sources of employment in the coastal communities adjacent to the Region as reflected in Figure 5.5. In 2006, the estimated number of individuals directly employed in State-managed fisheries that operate in the Region was around 330 (Fletcher & Santoro 2007). Employment in AFMA-managed fisheries in the Region is more difficult to determine because operators tend to be active in more than one fishery. For example, the North West Slope Trawl Fishery and Western Deepwater Trawl Fishery are opportunistically and seasonally fished by Northern Prawn Fishery operators (Clifton *et al.* 2007). Nonetheless, the number employed in AFMA-managed fisheries would be considerably fewer than in the DoF-managed fisheries. Because skippers and crew may work in more than one fishery, employment figures may overestimate the number of individuals directly employed in commercial fishing. However, it is more probable that they underestimate total employment in commercial fishing, because the majority of employment is either part-time or seasonal, and direct employment figures tend not to account for the contribution of family members to the fishing business. Nor do employment figures for the industry reflect

the importance for communities of jobs generated downstream by fishing.

The main fish processing and wholesaling facilities adjacent to the Region are located at Denham, Carnarvon, Exmouth, Onslow and Broome. Figures from the ABS (2006) indicate that 137 individuals were directly employed in fish processing and wholesaling in towns adjacent to the Region in 2006. The Pearl Oyster Fishery directly employed 72 individuals in 2006 but the downstream pearl industry employed an estimated 500 people in north-west coastal communities (Fletcher & Santoro 2007). The future of fisheries in the Region is dependent upon a number of factors, including the long term availability of adequate stocks, costs associated with accessing fishing grounds, price received for catch and the distance from ports and markets. Also significant is the shortage of labour in the industry (particularly individuals experienced in the industry) with crew shortages adversely affecting the number of fishing days per trip. The shortage of skilled labour in the fishing industry is exacerbated in the Region by the current strong growth of the petroleum and minerals sectors in the north-west, which are typically able to offer higher wages than the fishing industry.

Figure 5.5 Percentage of total population adjacent to the Region employed in fishing and related industries



Fisheries sustainability

Most fish stocks within the Region are either classified as uncertain or adequate (Table 5.5). An important exception is the Western Australian Tropical Shark Fishery where catch levels increased significantly from 591 tonnes in 2003–2004 to 1294 tonnes in 2004–2005. This included an increase in the catch of the slow growing, long lived sandbar shark from 209 tonnes in 2003–2004 to 762 tonnes in 2004–2005. However, new management arrangements have been introduced, and the total catch of shark in this fishery reduced by 85 per cent in 2006–2007 to 189 tonnes, with sandbar shark comprising less than one tonne of the total catch (Fletcher & Santoro 2007).

Breeding stocks of oceanic pink snapper, which are targeted in the Shark Bay Snapper Fishery, are considered depleted and as a result, DoF has reduced the Total Allowable Commercial Catch of this species. Future reductions in the Total Allowable Commercial Catch may be required to rebuild stocks (Fletcher & Santoro 2007).

Both Australian and State government fisheries agencies have a range of initiatives in place to reduce the potential for adverse environmental impacts by fisheries. The sustainable management of fisheries by the Australian Government is undertaken through the *Fisheries Management Act 1991*. Supporting initiatives include the *National Policy on Fisheries Bycatch 2000*,

which sets a requirement for by-catch actions in each major Commonwealth fishery to improve the protection of threatened species and minimise adverse impacts upon the marine environment. Similarly, State fisheries agencies use a range of measures to minimise adverse impacts on both target and non-target species. Measures include output controls to limit the amount of target species landed, and input controls such as gear restrictions and seasonal or area closures, to avoid wider impacts on the marine environment, protected species and/or the target species itself.

The Australian Government also assesses all export and AFMA-managed fisheries under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) against criteria designed to ensure that all fisheries are managed in an ecologically sustainable way. Fisheries in the Region are known to interact with some species listed under the EPBC Act, including cetaceans, marine reptiles, sharks and seabirds. More information on interactions between listed species and fisheries can be found in Appendix D.

Interactions between fisheries and listed species are governed by a range of regulations and codes of conduct. Assessments for specific fisheries may include progress in implementing practices to minimise impacts on the marine environment and protected species. Further information on fisheries assessments can be found at www.environment.gov.au/coasts/fisheries.

Table 5.5 Status of selected fish stocks in the Region

Jurisdiction	Fishery	Status of stock
Australian Government (AFMA) ¹	North West Slope Trawl Fishery	Uncertain.
	Western Deepwater Trawl Fishery	Uncertain.
	Western Tuna and Billfish Fishery	Bigeye tuna not overfished; yellowfin tuna and broadbill swordfish uncertain; overfishing of bigeye tuna is occurring in the broader Indian Ocean.
	Northern Prawn Fishery	Banana, brown tiger and grooved prawns not overfished; endeavour and king prawns uncertain.
Western Australian Government (DoF) ²	Pilbara Demersal Finfish Fishery	Breeding stock levels adequate.
	Northern Demersal Scaleshell Fishery	Breeding stock levels adequate.
	West Coast Deep Sea Crab Fishery	Breeding stock levels adequate.
	Shark Bay Snapper Fishery	Spawning biomass of oceanic pink snapper depleted.
	Pearl Oyster Fishery (wild caught)	Breeding stock levels adequate.
	Mackerel Interim Managed Fishery	Breeding stock levels adequate.
	West Coast Demersal Scaleshell Fishery	Dhufish and pink snapper overfished.
	Kimberley Prawn	Breeding stock levels adequate.
Western Australian Tropical Shark fisheries	Sandbar shark overfished, other species uncertain.	

¹ Larcombe & McLoughlin (eds.) 2007

² Fletcher & Santoro (eds.) 2007

5.3.3 Traditional Indonesian fishing

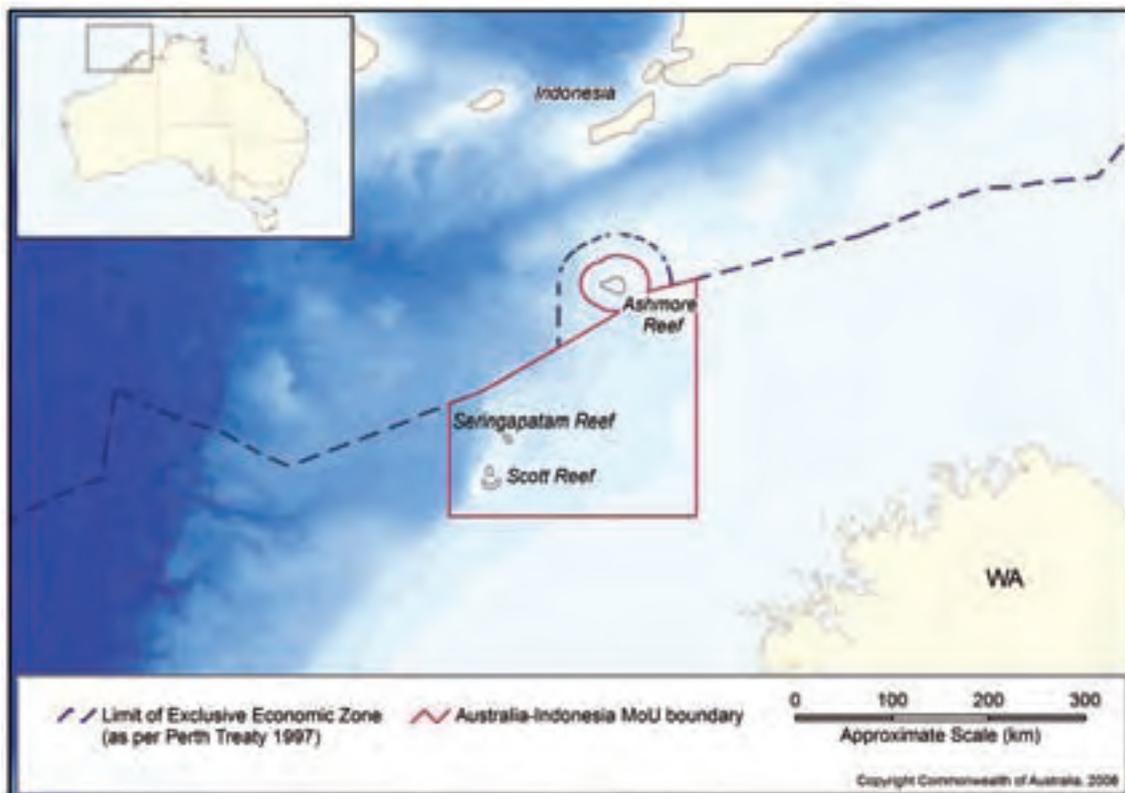
Indonesian fishers have visited the northern coast of Australia and its islands and reefs for almost three centuries. In recognition of this and the importance of parts of Australia’s marine jurisdiction for the livelihoods of some traditional fishers, a Memorandum of Understanding (MoU) was signed between Australia and the Republic of Indonesia in 1974 to allow traditional Indonesian fishers to fish in an area known as the ‘MoU Box’ (Figure 5.6). The MoU defines ‘traditional fishermen’ as fishers who have traditionally taken fish and sedentary organisms in Australian waters using traditional fishing methods and non-motorised sailing vessels. Under the MoU, the taking of protected wildlife including marine turtles, dugongs and clams is prohibited, as is fishing within the Ashmore Reef National Nature Reserve and Cartier Island Marine Reserve. Fishers may access the reefs of Cartier Island, Scott Reef, Seringapatam Reef and Browse Island, and visit Ashmore Reef for access to fresh water and to visit graves (EA 2002).

a result of overfishing (including through illegal foreign fishing), Australia and Indonesia have agreed to work towards the development of a joint management plan over the next two years with the objective of conserving the MoU Box resources whilst observing the needs of traditional fishers.

More information about the MoU on traditional fishing in the Region can be found in Appendix A.

Target species include trochus, trepang (bêche-de-mer or sea cucumber), abalone, green snail, sponges, molluscs and finfish including shark. In recognition that target stocks in the MoU Box have decreased significantly as

Figure 5.6 Boundary of Australian-Indonesian MoU Box



5.3.4 Illegal fishing

Illegal fishing, primarily by foreign fishers, is an important issue in the northern waters of the Region. It is a significant threat to the sustainability of fish stocks and the ecological values of the Region, as well as a quarantine and security risk.

Illegal fishers also have an impact on trochus aquaculture activities managed by the Bardi Aboriginal community at One Arm Point. In addition to catching shark, sea cucumber, trochus and finfish species in the Region, apprehended vessels have been found with protected species on board, including dugongs, marine turtles, sawfish and dolphins.

Coastwatch sightings of illegal fishing vessels within Australia's Exclusive Economic Zone (EEZ) indicated a substantial increase in illegal fishing in Australia's northern waters up to 2004–2005. In response, the Australian Government increased marine surveillance and enforcement patrols significantly and has stationed a dedicated Customs vessel at Ashmore Reef. Measures have also included improved coordination of border security agencies (through the establishment of Border Protection Command (BPC)), increased resources to undertake investigations and prosecutions and the development of cooperative arrangements with the

Indonesian Government to combat the problem at its source (BPC 2007). These measures appear to have been effective with sightings of illegal vessels falling by nearly 60 per cent between 2005–2006 and 2006–2007 (Abetz & Johnston 2007). In 2007 a Regional Plan of Action was signed by Australia, Indonesia and other nations in the region to promote responsible fishing practices including combating illegal fishing in South-east Asia (Regional Fisheries Minister's Meeting 2007).

Aboriginal communities also play an important role in monitoring illegal activities in the North-west Marine Region. The Bardi Indigenous Ranger group at One Arm Point in the Kimberley works with Western Australian fisheries officers to conduct joint patrols in waters off the Kimberley coast.

5.3.5 Pearling and aquaculture

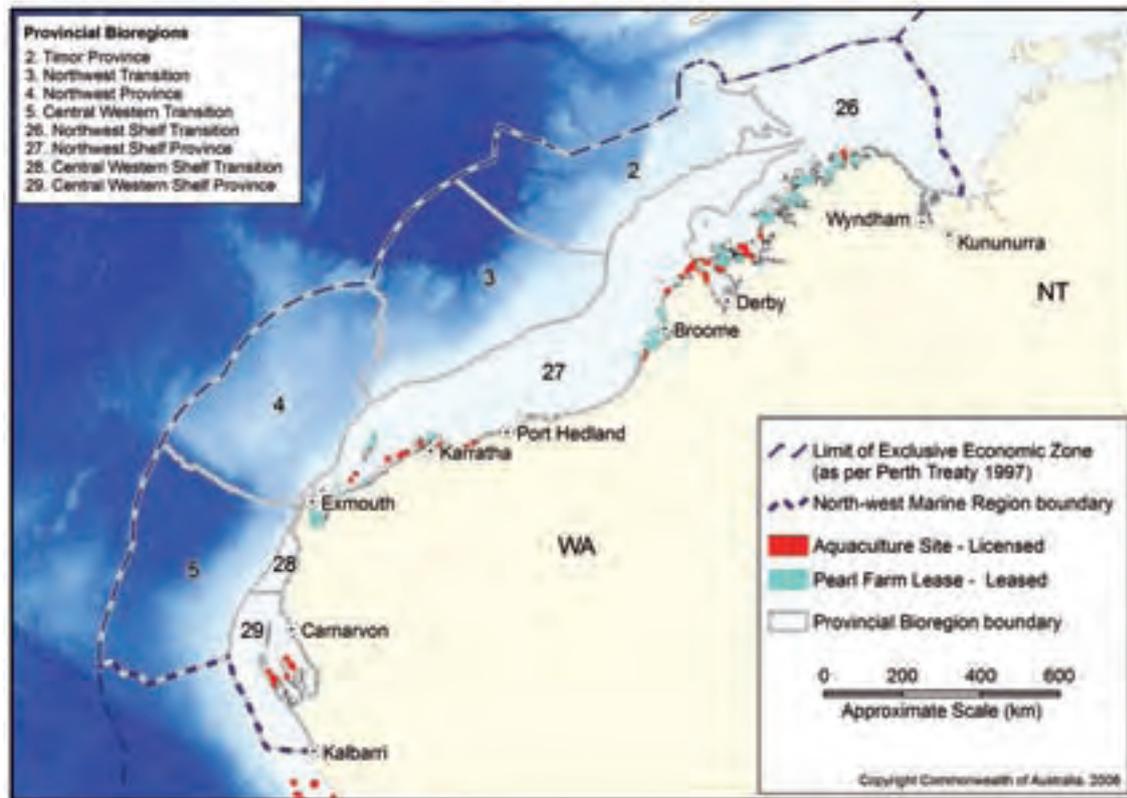
Pearling

Western Australia is the world's largest source of quality south sea pearls, and the history of the industry in the north-west stretches back to the 19th century. The production of pearls commences with the collection by divers of silver lipped oysters from wild stocks in waters from Exmouth to Cape Leveque. Pearl oyster spat is also now produced in hatcheries (PPAA 2004).



Pearl aquaculture. Photo: Katarina Wos, Paspaley Pearling Company Pty Ltd.

Figure 5.7 Location of pearl farms and aquaculture sites



The DoF regulates the industry in accordance with the *Western Australian Pearling Act 1990*. Quotas limit the total amount of wild shell that can be harvested as well as the total amount of hatchery shell that can be seeded. To assist in the sustainable management of wild stocks, the fishery is split into management zones that limit the number of licensees operating in each area. In 2006, there were 17 licensees operating in the fishery (Fletcher & Santoro 2007).

Following seeding, oysters are placed in panels and transported to pearl farms for the grow-out phase of pearl production (Fletcher *et al.* 2006). Pearl farms are located along the north-west coast, with Broome and the Kimberley coast accommodating for around 75 per cent of the value of production (Figure 5.7). Most pearl farms are in State waters, although the farms south of Broome adjacent to Eighty Mile Beach are largely in the North-west Marine Region.

This valuable industry was worth approximately \$122 million in 2005–2006, making it one of the largest and most successful aquaculture industries in Australia, and the second most valuable fishery in Western Australia after the Western Rock Lobster Managed Fishery, which operates in the South-west Marine Region. Pearling is

also a significant contributor to regional employment (Fletcher & Santoro 2007).

Aquaculture

Apart from pearling activities, no offshore aquaculture currently occurs in the Region (i.e. Commonwealth waters) although it is feasible that aquaculture in Commonwealth waters could be developed in the future. The farming of other marine species is confined to State waters and onshore areas. In the Kimberley area, the tropical aquaculture facility near the Bardi Aboriginal community at One Arm Point has been producing trochus shell for a number of years (DoF 2007). Sea-cage barramundi farming occurs in Lake Argyle and a project is underway to commercialise the farming of black tiger prawn by the Kimberley Aquaculture Aboriginal Corporation (Fletcher & Santoro 2007).



5.3.6 Marine-based tourism

Charter fishing, diving, snorkelling, whale, marine turtle and dolphin watching and cruising are the main commercial tourism activities in and adjacent to the North-west Marine Region. With the exception of offshore charter fishing, most marine tourism activities occur in State waters. Nevertheless, many of the species and areas that underpin marine tourism in the north-west are either protected and/or regulated under Australian Government legislation, or have significant ecological links with the Commonwealth marine environment.

Charter fishing

Charter fishing is regulated by the DoF, except in the Ningaloo Marine Park (Commonwealth Waters), where charter fishers require a permit from the Director of National Parks. All fishing boat tour operators must be licensed and are required to submit daily trip returns on the overall number of tours, number of fishing-only tours, catch and effort estimates and tourist numbers. Charter fishing is a popular tourist activity in the Region, and most tours operate out of Broome and Exmouth.

In 2005–2006 there were 181 licensed fishing tour operators and 35 restricted fishing/eco-tour operators, although only around 50 per cent of the 181 operators used their licences during that year. Activities conducted on these tours included fishing, diving, snorkelling, wildlife observation and sightseeing. Of the 2594 tours

conducted in the Gascoyne (i.e. south of Onslow), a third were fishing-only tours, with pink snapper and emperors the most targeted fish. In the Pilbara/Kimberley area, fishing-only tours accounted for two thirds of all trips, the higher proportion perhaps because of the popularity of fishing for species such as barramundi and larger gamefish offshore including Spanish mackerel, sailfish and swordfish (Fletcher & Head 2006).

Fishing tournaments

There are several offshore pelagic sport and gamefishing tournaments held each year in or adjacent to the Region. These include the Exmouth Gamex, the Dampier Classic and the Broome sailfish tournament. Species targeted include marlin, sailfish, mackerel, tuna and swordfish (Game Fishing Association of Australia 2007).

Marine mammal watching

In Western Australia in 2006–2007, there were 110 active whale watching permits, 95 dolphin watching permits and two dugong watching permits (DEC 2007). Whale watching is popular with tourists, particularly during the southward migration of humpback whales from September to late November. Adults and calves are numerous and accessible in Exmouth Gulf during this period.

Dolphin watching occurs at several locations, primarily in State waters. The best known location is Monkey Mia in Shark Bay, where a pod of dolphins regularly visits shallow waters and interacts with humans. There



Dolphins in Shark Bay World Heritage Area. Photo: Ian Anderson, Department of Environment and Conservation, WA.



Dugong at Shark Bay. Photo: Paul Anderson, Department of Environment and Conservation, WA.

are two dugong watching permit holders licensed to operate in the Shark Bay World Heritage Area, which has extensive beds of seagrass and is home to one of the world's largest populations of dugongs (DEC 2007).

The Australian Government has responsibility for ensuring that human activities around marine mammals are conducted in a manner that minimises potential threats to them. Whale and dolphin watching is regulated in Australian waters, and regulations apply to all people interacting with whales and dolphins, including commercial tourism operators and people engaged in recreational activities. The *Australian National Guidelines for Whale and Dolphin Watching 2005*, which were developed jointly by the Australian and all State and Territory governments, set out standards required for whale and dolphin watching while minimising the potential for adverse impacts on the animals. These guidelines are available at www.environment.gov.au/coasts/publications/whale-watching-guidelines-2005.html.

Other marine tourism or recreational activities

The North-west Marine Region and its adjoining waters support important coral reefs and a diversity of tropical marine animals and include popular diving, snorkelling and nature viewing areas. Primary dive locations include Ningaloo Marine Park (State Waters), the Rowley Shoals (including the Commonwealth marine reserve at Mermaid Reef), Scott Reef, Seringapatam Reef, Ashmore Reef and Cartier Island (Ashmore and Cartier are also Commonwealth marine reserves). The Muiron Islands, which are in State waters, are the destination for most of the dive charters operating out of Exmouth.

Broome, Exmouth and Monkey Mia are destinations for the cruise shipping industry and visitation is likely to

increase into the future. At the port of Broome, cruise ship numbers have increased from 9 in 2004-2005, to 14 in 2005-2006 and 19 in 2006-2007 (BPA 2007).

Ningaloo Reef is a major tourism drawcard. Not only is Ningaloo one of the largest fringing coral reefs in the world, but it is one of only a few places worldwide where annual aggregations of whale sharks occur in nearshore waters. Diving and viewing whale sharks has become a popular tourism activity. In 2006 there were 15 licensed whale shark guides, 12 of whom operated out of Exmouth and three out of Coral Bay. In 2006, these guides took 520 tours and approximately 7590 passengers. Participation numbers are now more than double those of 10 years ago. To minimise potential adverse impacts on whale sharks and to ensure the long term sustainability of the industry, whale shark tourism operations are regulated by the Western Australian Department of Environment and Conservation (DEC) in conjunction with Tourism WA. For operators in the Ningaloo Marine Park (Commonwealth Waters), the Department of the Environment, Water, Heritage and the Arts issues permits for whale shark tour operators. Tour operators are required to operate according to a code of conduct and undergo eco-tourism training (Wilson *et al.* 2006).

The Kimberley region is fast becoming a desirable tourism destination because of its pristine marine and terrestrial environments. The operation of the Kimberley marine tourism industry is reliant on these remote wilderness values and is expected to undergo substantial growth in coming years. While most marine tourism activities are located in State waters, luxury cruises take tourists along the coastline and increasingly out to isolated coral atolls for fishing and diving (Kimberley Marine Tourism Association 2007).



5.3.7 Ports and shipping

The Region has experienced a substantial boom in the resources sector in recent years and this trend is predicted to continue as demand for oil, gas and minerals from countries such as China, Korea, Taiwan and Japan increases. Given the reliance of these industries on export markets, and the long distances involved, adequate port facilities and reliable and effective shipping services are vital. Australia's two largest ports in terms of tonnage, Dampier and Port Hedland, are located adjacent to the North-west Marine Region. The major commodities exported through the north-west ports are iron-ore, natural gas and other petroleum products, and salt. Other commodities include lead, zinc, manganese, nickel and copper.

Ports

There are 12 ports adjacent to the North-west Marine Region, including the major ports of Dampier, Port Hedland and Broome, which are operated by their respective port authorities. These authorities are autonomous bodies operating under the Western Australian Government's *Port Authorities Act 1999* and are responsible for overseeing safety, environmental management and traffic movements (DPI 2006). The main customers and managers of operations at loading facilities are largely the minerals and petroleum companies using the ports. These ports also play an important oil and gas offshore support role and export facilities for smaller mining and salt operations. Each of the major ports is discussed in detail later.

Complementing these major ports are eight non-port authority ports (Table 5.6). While the Western Australian Government has jurisdiction over these ports, it is not involved in the day-to-day administration of activities. Its primary role is to ensure the safety of port operations. Private sector firms own, manage and operate the dedicated port facilities, services and related infrastructure at the sites. Of these non-port authority ports, Onslow and Barrow Island ports are likely to expand in the future as BHP Billiton proceeds with its Pilbara Liquefied Natural Gas (LNG) activities, and Chevron begins processing LNG on Barrow Island from the giant Greater Gorgon gas fields. The location of the ports adjacent to the Region is shown in Figure 5.8.

Other commodities exported from the various ports in the Region include nickel and copper.

Potential new ports

The Western Australian Government has been considering potential sites for a new export port in the Pilbara region to meet the increasing global demand for iron ore and other commodities. Ronsard Island, which is located between Dampier and Port Hedland, was identified in 2007 as having the potential to host a 300 million tonnes per annum (Mtpa) iron ore export facility (DPI 2007). Consideration is also being given to the development of an outer harbour iron ore export facility at Port Hedland. The outer harbour would involve the dredging of a major new channel. New port facilities are also likely to be required in the vicinity of Dixon Island to service a planned industrial estate at Mount Anketell between Wickham and Karratha (Shire of Roebourne 2005).

Another port is planned for Cape Preston to support iron ore exports from the CITIC Pacific Ltd owned Cape Preston Iron Ore Project. This project will produce around 45 Mtpa of iron ore (IRC 2007).

Port Hedland

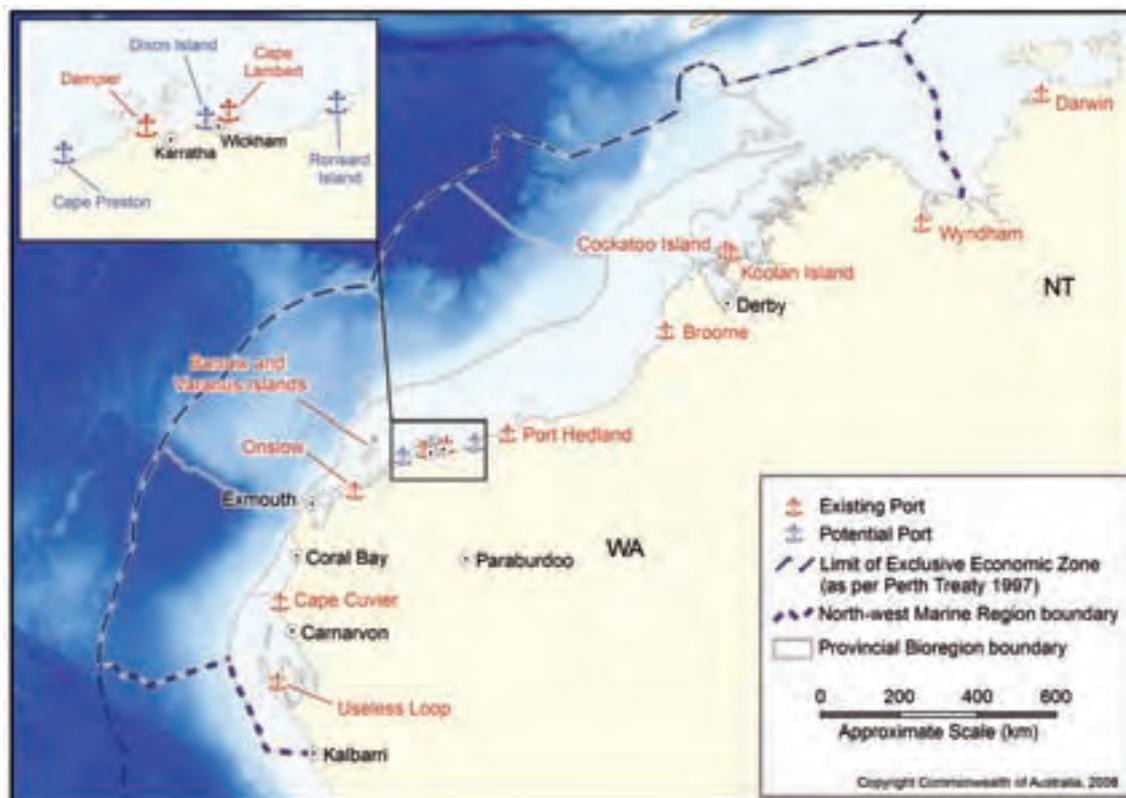
Port Hedland services the mineral-rich eastern Pilbara region, with its main bulk export commodities being iron ore and salt. It is currently the second largest Australian port based on total annual tonnage, having been eclipsed by Dampier in 2006–2007. However, the current expansion of the port is expected to re-establish its position as the largest port in Australia. In 2006–2007, throughput was 112 Mtpa, with iron ore exports accounting for approximately 95 per cent (107 Mtpa) of all trade, while salt made up 2.4 per cent (2.7 Mtpa). A number of other bulk commodities are also exported from the port including manganese, chromite and feldspar (PHPA 2007). Other key functions of the port include the provision of offshore oil and gas support and export facilities for smaller mining and salt operations.

With bulk carriers in excess of 260 000 tonnes docking at the port, ongoing maintenance dredging of the port area and the shipping channel occurs every three to four years with the approximately 700 000–1 million tonnes of dredge spoil dumped offshore under a Commonwealth permit. The current spoil site is close to capacity and a new location in Commonwealth waters (within the Northwest Shelf Province) is likely to be required in the near future (PHPA 2007).

Table 5.6 Non-port authority ports adjacent to the Region (IRC 2007)

Location	Operator	Export commodity/use
Carnarvon	Dampier Salt (Rio Tinto) (Cape Cuvier)	Salt
	Shark Bay Salt (Useless Loop)	Salt
Onslow	Onslow Salt	Salt
	Chevron Australia (Thevenard Island)	Crude oil
	Apache Energy (Airlie Island)	Crude oil
Varanus Island	Apache Energy	Domestic natural gas, crude oil
Barrow Island	Chevron Australia	Crude oil
Port Walcott	Pilbara Iron (Rio Tinto)	Iron ore
Derby	Shire of Derby/West Kimberley	Lead, zinc, tourism
Yampi Sound	Portman/Henry Walker Eltin (Cockatoo Island)	Iron ore
	Mt Gibson Iron Ore (Koolan Island)	
Wyndham	Ord River District Cooperative	Cattle (Malaysia), sugar (Indonesia)

Figure 5.8 Current and potential future ports in the Region



The increasing demand for iron ore, which is largely driven by China’s economic growth, is expected to exceed 200 Mtpa by 2010–2011. To ensure the port has capacity to meet these requirements, there are several expansions planned, including BHP Billiton’s development of four new berths designed to accommodate vessels in excess of 300 000 tonnes. Fortescue Metals Group is also building two additional berths to provide capacity to export 45 Mtpa of iron ore (PHPA 2007).

Port of Dampier

The Port of Dampier is located at the base of the Burrup Peninsula, and is one of the major tonnage ports in Australia with 3404 ships visiting over 2006–2007 (DPA 2007a). The port had a throughput in 2006–2007 of 126 million tonnes (the highest in Australia) with a value in excess of \$8.5 billion. The prime commodities exported were iron ore (83 per cent by tonnage), LNG (10 per cent) and salt (three per cent) (DPA 2007b). In



comparison, the Port of Sydney had a throughput of 22.5 million tonnes between March 2007–2008, although its value of trade was much higher at \$50 billion (Sydney Ports 2007).

There are several industry operators at the Port of Dampier including Pilbara Iron Pty Ltd, Dampier Salt Ltd (both subsidiaries of Rio Tinto Ltd), Woodside Energy Ltd and Burrup Fertilisers (which produces liquid ammonia). Three berths are used to export iron ore and one to export salt, while liquid ammonia is exported from the Dampier Bulk Liquids Berth. Salt is exported to countries including Japan, South Korea, Taiwan and Indonesia, iron ore is exported principally to China and Japan and liquid ammonia to India, Indonesia and Japan. The iron ore and salt export berths account for 81 per cent of the port's trade throughput. Pilbara Iron is planning to construct an additional berth and service wharf to support the growth in iron ore exports, which will require dredging to increase ship size, berthing and handling capacity to 140 Mtpa.

The North West Shelf Venture, with Woodside as operator, exports LNG, liquefied petroleum gas (LPG) and condensate from the North West Shelf Venture processing facility, located adjacent to the port. In 2006–2007 12.5 million tonnes of LNG were shipped to markets in Japan, South Korea and China (DPA 2007b). With the global demand for petroleum products including LNG increasing, a fifth processing train at the North West Shelf Venture facility is being constructed which will increase LNG production to 16.3 Mtpa (Woodside 2007).

To support its offshore Pluto gas developments, Woodside is planning to construct onshore processing facilities at Burrup Industrial Estate. The plant will be located at a new site between the existing North West Shelf Venture Gas Plant and the Dampier Port. Complementing this facility will be a new loading jetty for LNG vessels.

Port of Broome

Broome is the primary deepwater port servicing the Kimberley area. In 2006–2007, the port recorded 3931 trading vessels (up from 128 vessels in 2005–2006) and doubled its total throughput to 274 905 tonnes (BPA 2007). Of the 183 019 tonnes imported, 80 per cent were petroleum products for servicing petroleum exploration and development and other industries in the north-west. The port also exports livestock and services offshore oil

and gas exploration and supply vessels, pearling and fishing vessels, charter boats and large cruise ships. The port also serves as a stopover port for Royal Australian Navy and Australian Customs vessels (BPA 2007).

To meet increasing demand, particularly from the petroleum and tourism sectors, the Port of Broome recently extended its jetty to allow room for a third berth and increased the depth to handle ships up to 50 000 dead weight tonnes. This extra berth allows the port to continue operations with rig tenders, charter boats, cruise ships and trading vessels whilst tankers are discharging at the port. This has significantly increased the current capacity of the port and provides for its continued growth. Major offshore oil and gas exploration activities are underway in the Browse Basin and the development of the Basin's resources is expected to increase demand on the Port of Broome.

Cape Lambert (Port Walcott)

Cape Lambert's Port Walcott is the third major iron ore port in the north-west and is owned by Robe River Iron Associates and operated by Pilbara Iron (IRC 2007). The operations consist of an iron ore handling, processing and ship loading facility. Current annual ship loading capacity is approximately 55 Mtpa, although plans to increase capacity to 85 Mtpa are currently undergoing approval. Expansion would require dredging for additional berths and a deepening of the main shipping channel. Pilbara Iron also operates a 105 megawatt gas-fired thermal power station at Cape Lambert <www.riotintoironore.com/ENG/operations/301_pilbara.asp>.

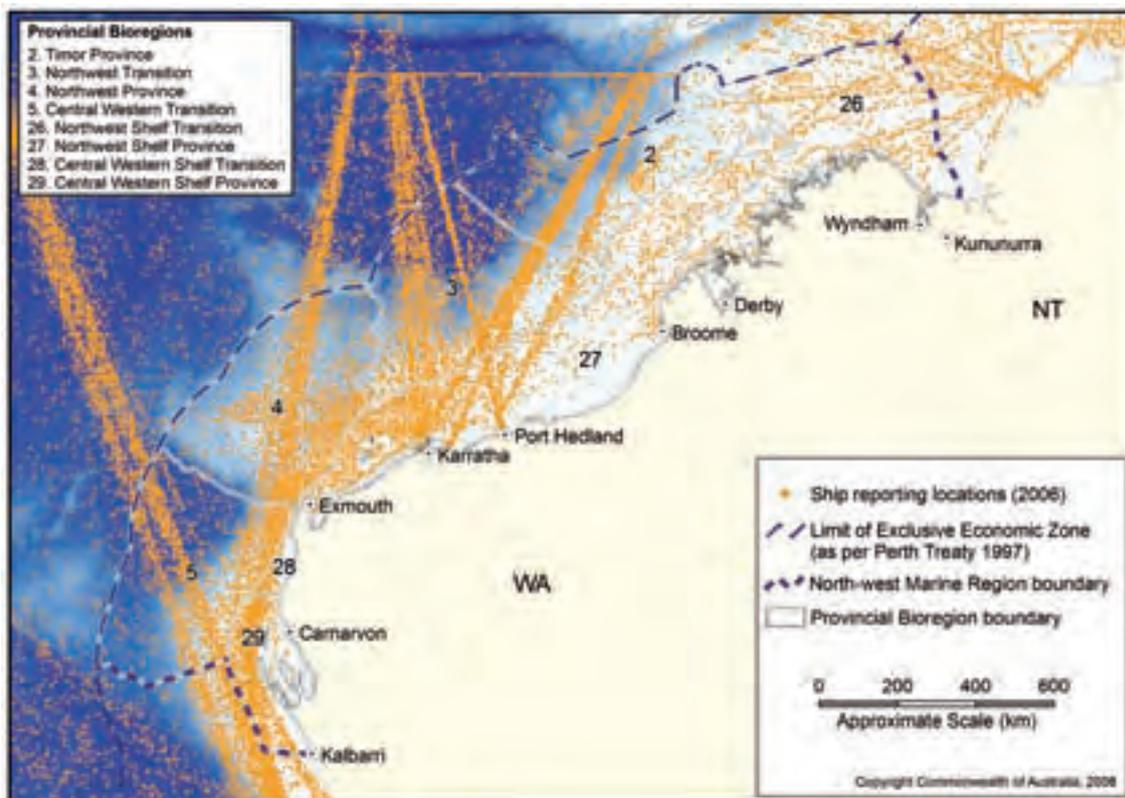
Shipping

The ports in the north-west, in particular Dampier and Port Hedland, handle large tonnages of iron ore and petroleum exports in addition to salt, manganese, feldspar chromite and copper. The massive expansion of the north-west's economy is reflected in the number of vessel visits to the Region's ports and the intensification of shipping activity. Dampier receives the highest number of vessel visits in Western Australia with 3404 recorded in 2006–2007 (Table 5.7). Port Hedland was third after Fremantle with 888 ship visits. Figure 5.9 shows the main shipping routes in the north-west in 2006, and reflects the intensity of ship movements out of Dampier and Port Hedland but also highlights the extent of traffic moving through the Region to and from the south.

Table 5.7 Number of vessel visits to Western Australian ports in 2006–2007

Port	Vessel visits
Albany	119
Broome	393
Bunbury	353
Dampier	3404
Esperance	181
Fremantle	1687
Geraldton	305
Port Hedland	888

Figure 5.9 Main shipping routes 2006



Changes in economic activity are reflected in changes in the proportions of different vessel types active in the provincial bioregions of the Region (Figures 5.10 and 5.11) (IRC 2007). Of note is the significant increase in Offshore Support Vessels in the Northwest Province, Northwest Shelf Province and Northwest Shelf Transition bioregions, which are areas of intense interest for petroleum exploration and development companies. These vessels service offshore drilling and production facilities and support construction and maintenance work for offshore petroleum activities. In 2004, around three per cent of vessels reported in the Northwest Province were Offshore Support Vessels. However, just two years later these vessels made up 40 per cent of total vessel movements in this bioregion. The proportion

of iron ore bulk carriers also increased in the Northwest Province and Timor Province, reflecting the increased transit of these vessels through the Region to east Asian markets.

An increase in shipping and port expansion associated with the growth of the resources sector in the north-west has potential implications for the marine environment. Potential threats include: loss or contamination of marine habitat as a result of dredging and sea dumping, oil spills, interactions between vessels and protected species, and the introduction of marine pests through ballast water exchange and biofouling of ship hulls.



Australia manages environmental risks associated with port and shipping activities through a range of national and international legislation and agreements. Under the EPBC Act, proposed dredging operations must be referred to the Minister for the Environment, Heritage and the Arts if the activity is likely to have an impact on a matter of national environment significance. If the dredged material is to be dumped in Australian waters, the activity is subject to Commonwealth approval under the *Environment Protection (Sea Dumping) Act 1981*. Sea dumping is discussed further in section 5.3.8. More information on legislation can be found in Appendix B.

Australia meets its obligations as party to the international *Convention for the Prevention of Pollution from Ships 1973 (MARPOL)* through the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983*. To manage marine pest incursions, Australia has mandatory ballast water management requirements with which all international vessels must comply if intending to discharge ballast water anywhere inside the Australian territorial sea. These requirements are administered by the Australian Quarantine Inspection Service. More information on these arrangements is in Appendix A.



Northern Endeavour floating production storage and offload vessel. Photo: Woodside.

Figure 5.10 Distribution of vessel type by bioregion – 2004

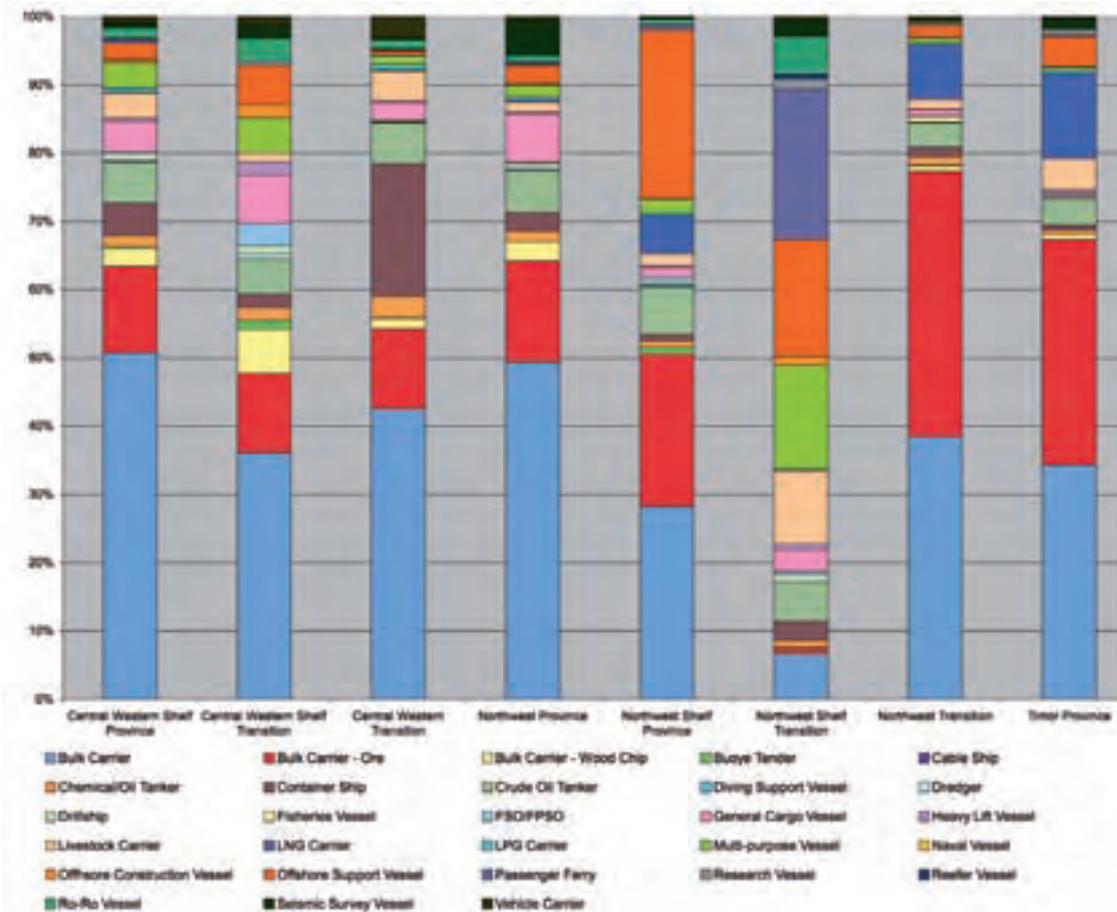
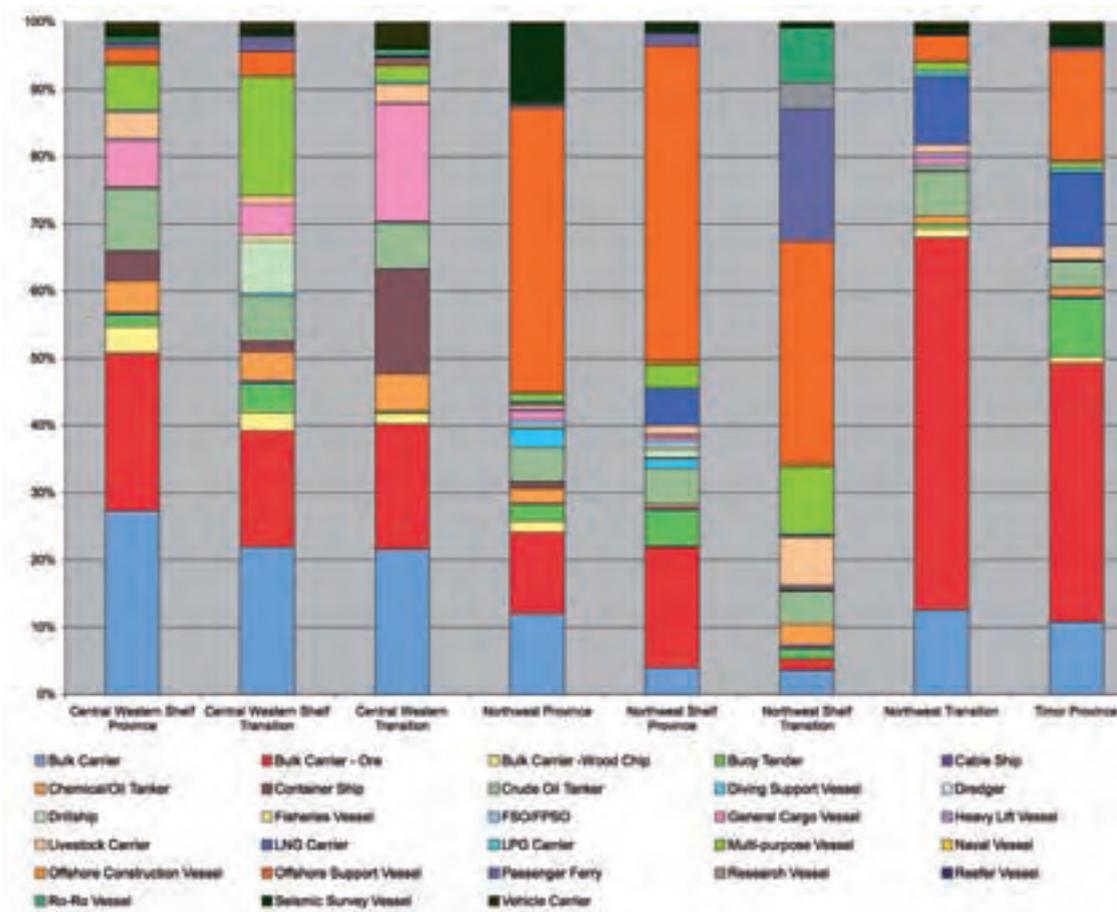


Figure 5.11 Distribution of vessel type by bioregion – 2006



5.3.8 Sea dumping

Prior to 1981, waste including vessels, ammunition and chemicals were dumped in the Region. Since 1981 the dumping of waste at sea has been regulated under the *Environment Protection (Sea Dumping) Act 1981*. This act was enacted to fulfil Australia's international responsibilities under the London Convention of 1972 and is administered by the Department of the Environment, Water, Heritage and the Arts. It applies from the low water mark out to the limits of Australia's EEZ. In 1996 the Act was amended to enact the 1996 Protocol to the London Convention. Today little dumping occurs. Permits from the Department are required for all dumping operations in Commonwealth waters. If a sea-dumping activity is likely to have a significant impact on a matter of national environmental significance it will also trigger the EPBC Act.

Dredged material is dumped at a number of ports adjacent to the Region including Port Hedland, Dampier and Cape Lambert. This is a result of ongoing maintenance, upgrading and expansion of the ports. Dredging and hence dumping is likely to increase markedly in the future as ports increase in size to handle

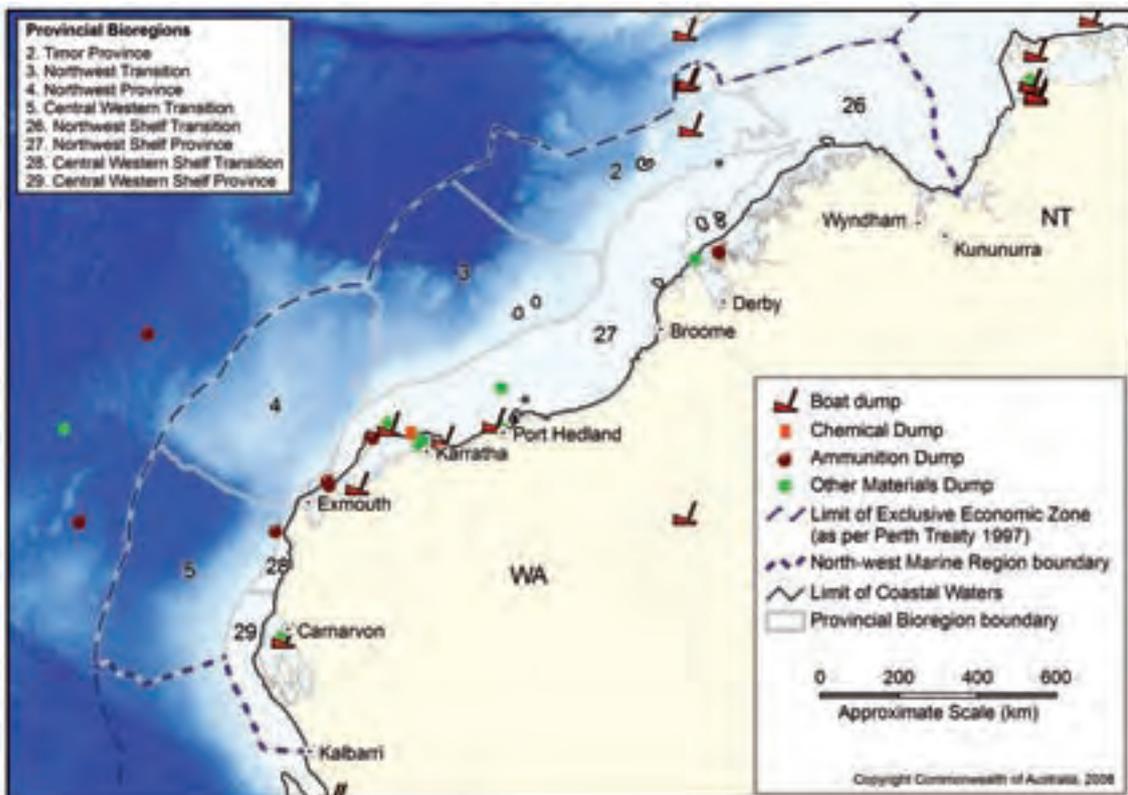
the significant rise in exports as a result of the resources boom.

Generally, no spatial closures or exclusion zones are in effect around dump sites, but the location of dredge material disposal sites and vessel placements are reported on hydrographic charts. The past disposal of ammunition, boats and chemicals has largely been in State waters and occurred prior to the enactment of the *Environment Protection (Sea Dumping) Act 1981*. There are also some boat dump sites in the Timor Province (Figure 5.12).

Further information on the *Environment Protection (Sea Dumping) Act* can be found in Appendix B and at www.environment.gov.au/coasts/pollution/dumping.

Operational discharges from ships, such as sewage and galley scraps, are regulated by the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* administered by the Australian Maritime Safety Authority (AMSA 2007).

Figure 5.12 Sea-dumping in the Region prior to the 1996 amendment to the *Environment Protection (Sea Dumping) Act 1981*



5.3.9 Offshore oil and gas exploration and production

Offshore oil and gas exploration and production is a large and rapidly growing industry in the North-west Marine Region. It contributes significantly to regional, State and national economies, provides new investment, infrastructure development, employment, and a range of other socio-economic benefits. Rapid growth of the industry in the Region is likely to continue, driven by high global demand for oil and gas and concomitant high prices.

In 2007, there were 68 petroleum producing fields in Western Australia, with most of these occurring within the Region (Jonasson 2008). Nineteen new offshore exploration permits were granted across Australia in 2007, with 12 of these in the Region (DITR 2007). Around 67 per cent of Australia's oil and condensate and 69 per cent of its gas reserves are located in Western Australia (Jonasson 2008). Figure 5.13 shows the petroleum leases current in the Region as at July 2007.

Value of production

As shown in Table 5.8, the value of petroleum sales in Western Australia in 2006–2007 was \$16.4 billion (DoIR 2007). This was an increase of 11 per cent (or \$1.6 billion) over 2005–2006 and reflects high world oil prices and increased LNG shipments. The strong growth in LNG production is likely to continue, as it is anticipated that global demand for LNG will increase by more than eight per cent per annum to 2015. In the absence of any new major discoveries, Australian crude oil and condensate production is projected to remain flat over the longer term despite the expected continuation of strong world demand for crude oil.

Petroleum basins, exploration and major projects in the North-west Marine Region

There are seven sedimentary petroleum basins in the North-west Marine Region: the Northern and Southern Carnarvon basins, Perth, Browse, Roebuck, Offshore Canning and Bonaparte basins (Figure 5.14). Of these, the Northern Carnarvon, Browse and Bonaparte basins hold large quantities of gas, and comprise most of Australia's reserves of natural gas (Figure 5.15).

Figure 5.13 Offshore petroleum exploration and production permits in the Region

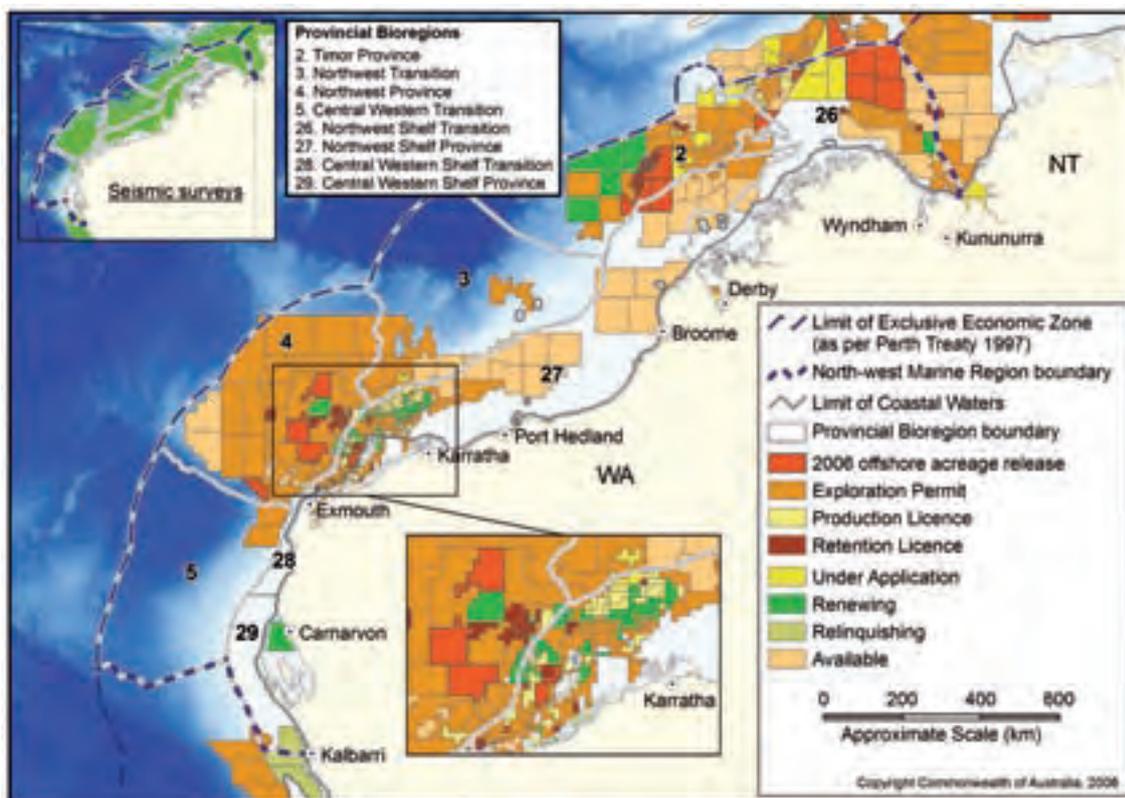


Table 5.8 Value and quantity of petroleum products for 2004-2005, 2005-2006 and 2006-2007

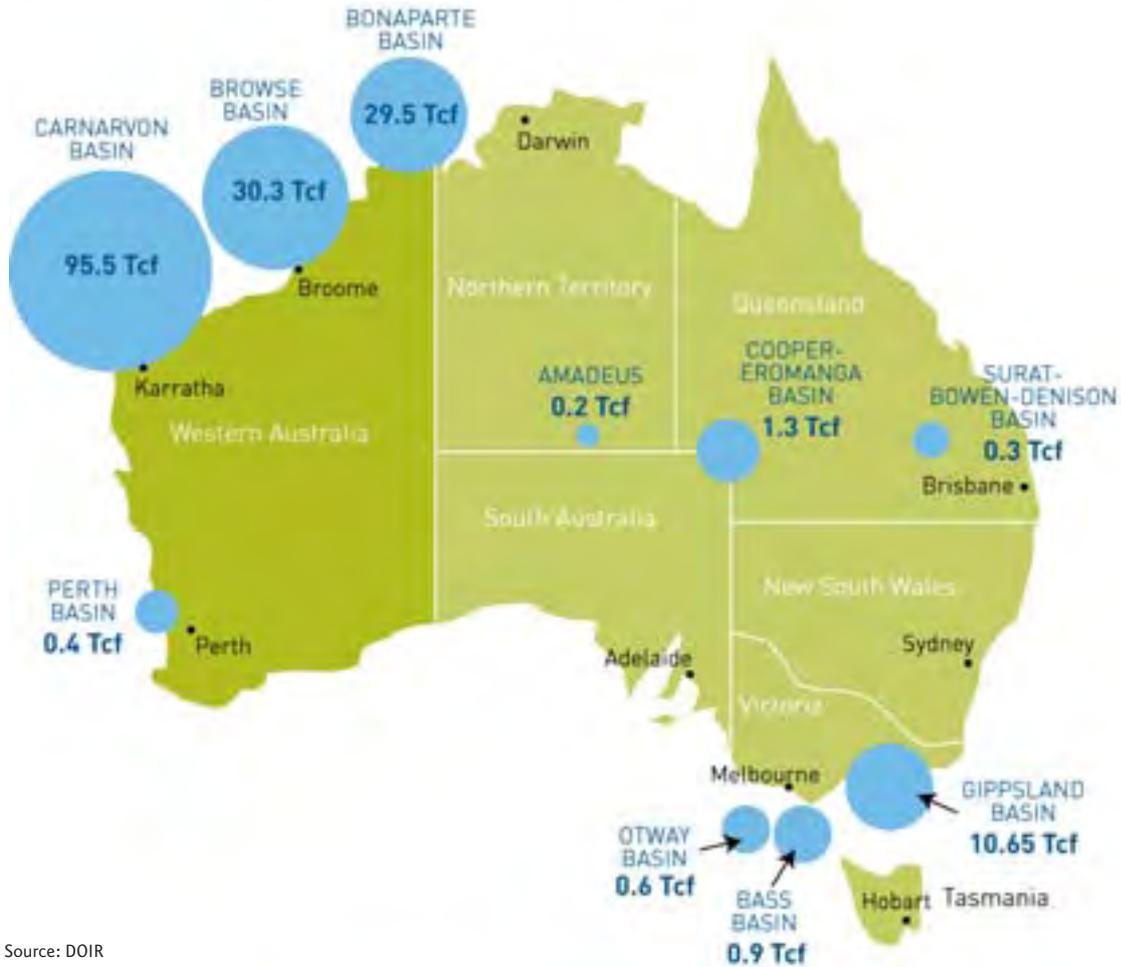
PETROLEUM	Unit	2004-2005		2005-2006		2006-2007	
		Quantity	Value (\$M)	Quantity	Value (\$M)	Quantity	Value (\$M)
Condensate	Gigalitre (Gl)	5.63	2 203.11	5.63	2 791.73	5.86	2 972.29
Crude oil	Gigalitre (Gl)	12.80	5 146.61	11.516	5 935.12	14.49	7 621.48
LNG	Million Tonnes (Mt)	11.04	3 953.10	11.68	4 625.22	12.21	4 237.23
LPG - butane and propane	kilotonnes (kt)	77.17	421.74	871.98	654.42	898.61	605.09
Natural gas	Giga cubic meters (Gm³)	7.64	678.72	7.71	703.28	8.71	919.42
TOTAL			12 403.29		14 709.77		16 355.51

Source: (DoIR 2007)

Figure 5.14 Sedimentary basins in the Region

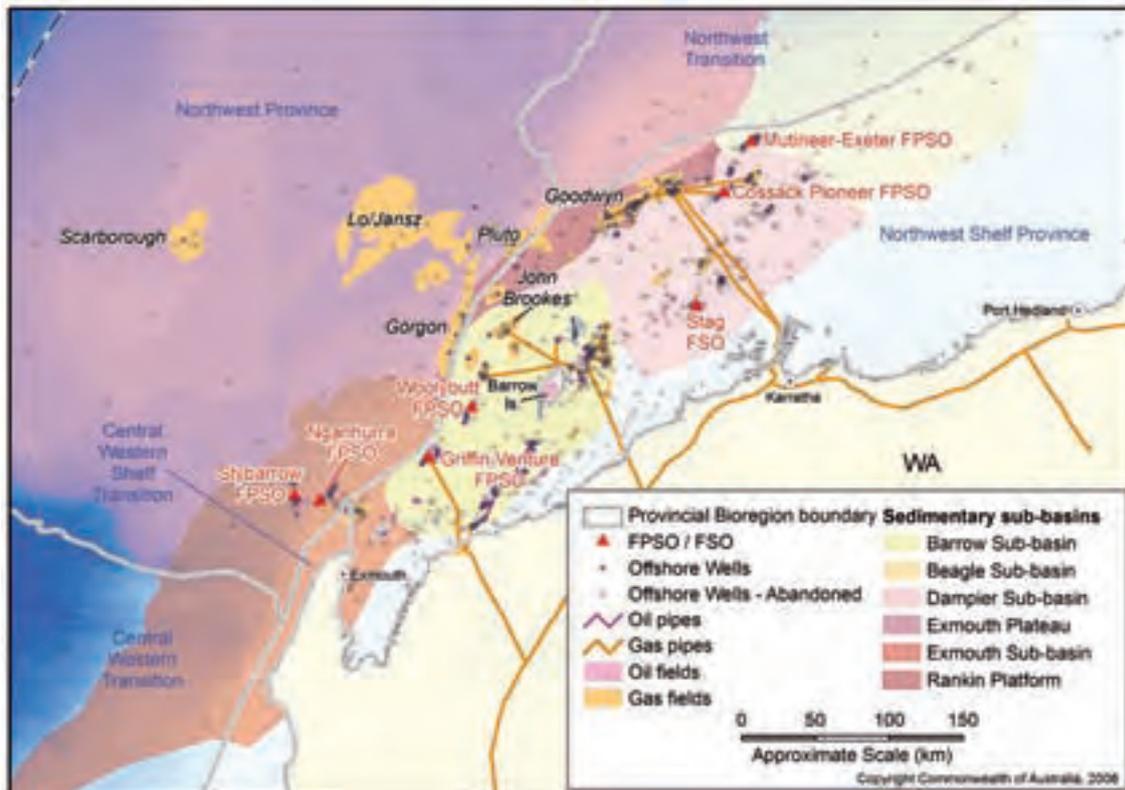


Figure 5.15 Australian gas resources - 2006 in trillion cubic feet (Tcf)



Source: DOIR

Figure 5.16 Petroleum fields and operations in the North West Shelf (Northwest Shelf Province)

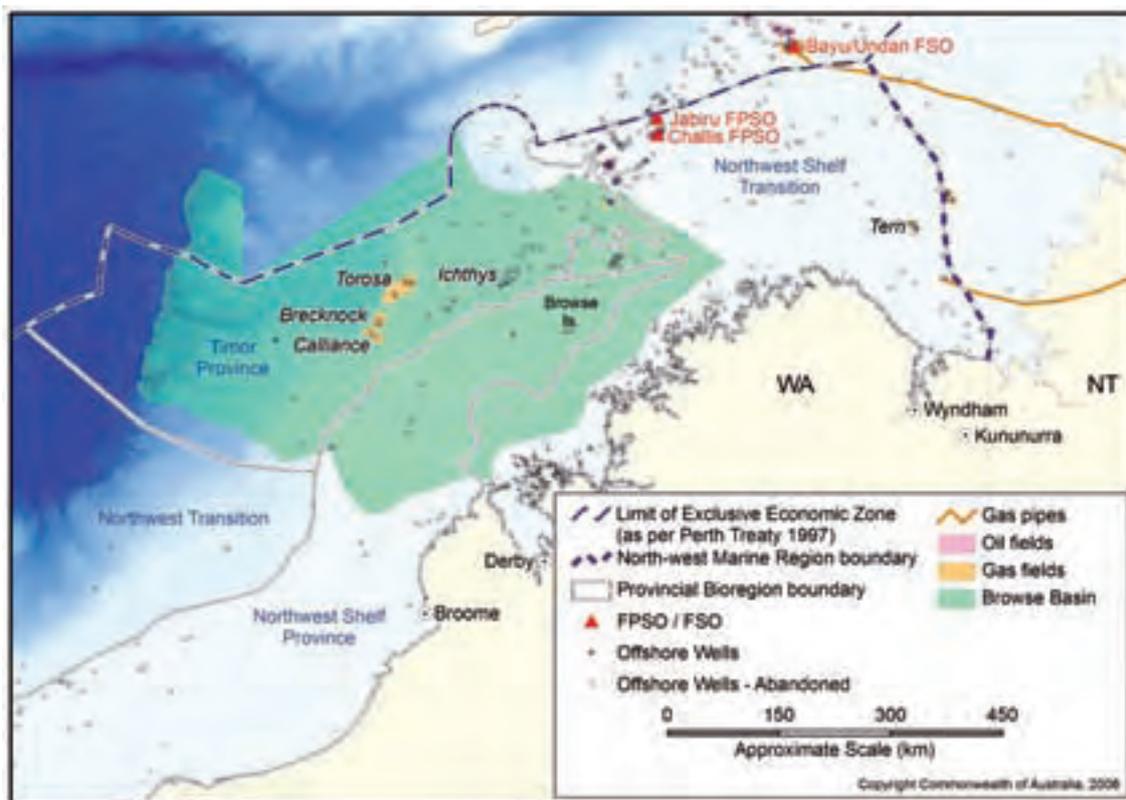


Source: IRC 2007



Figure 5.17 Petroleum fields and operations in the Browse Basin

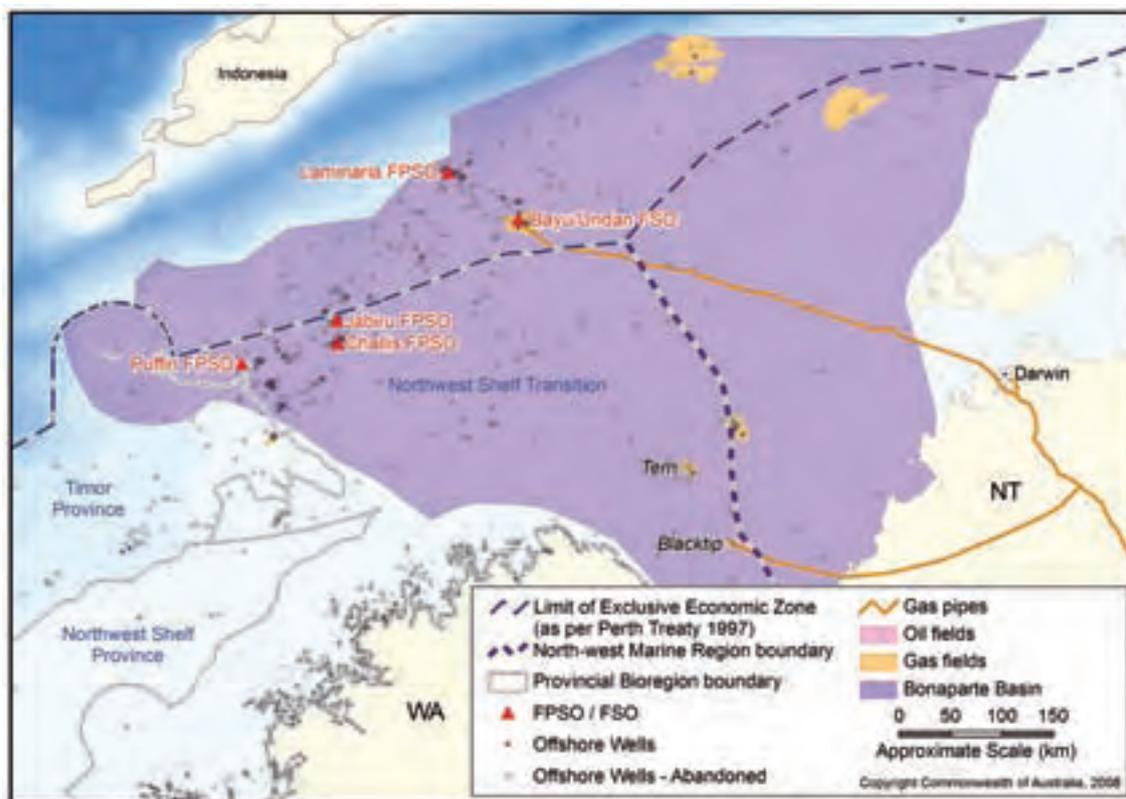
(Northwest Shelf Province, Timor Province and Northwest Shelf Transition)



Source: IRC 2007

Figure 5.18 Petroleum fields and operations in the Bonaparte Basin

(Timor Province and Northwest Shelf Transition)



Carnarvon Basin

The Carnarvon Basin is the most important producing area. It supports more than 95 per cent of Western Australia's oil and gas production, and accounts for 63 per cent of Australia's total production of crude oil, condensate and LNG. It is also the most heavily explored, with almost 80 per cent of the oil and gas wells drilled in Western Australia.

Most of the petroleum production and development in the Carnarvon Basin occurs in the Northern Carnarvon Basin on the North West Shelf (Northwest Shelf Province – Figure 5.16). One of the major established projects in this area is the North West Shelf Venture (see Box 5.2). Significant new gas fields including Gorgon and Pluto are currently undergoing development in the Northwest Province. These two future projects are discussed further below. Enfield, Vincent, Pyrenees, Stybarrow and Laverda (in the Northwest Province) are recent oil field discoveries and, combined, contain over 48 gigalitres.

Browse Basin

The Browse Basin is offshore of the Kimberley region and traverses the Northwest Shelf Province, Timor Province and Northwest Shelf Transition bioregions (Figure 5.17). It is considered to be relatively under-explored, but is expected to be Australia's biggest LNG province outside the Carnarvon Basin. It holds more than 30 trillion cubic feet of gas, which is sufficient to provide more than 600 million tonnes of LNG (DoIR 2006). It includes the yet-to-be-developed large and remote Torosa (Scott Reef), Brecknock, Calliance and Ichthys gas fields. The Browse Basin is likely to be a focus of intense development in the next decade.

The need to develop the gas reserves of the Browse Basin while protecting the natural and cultural values of the Kimberley prompted the Australian Minister for the Environment, Heritage and the Arts and the Western Australian Minister for State Development in February 2008 to jointly announce a strategic assessment of the Kimberley, under Section 146 of the EPBC Act. The first part of the assessment will identify a common-user LNG site for the Browse Basin. The strategic assessment will provide certainty for industry and reduce the impacts that would otherwise occur if piecemeal development of onshore LNG processing facilities were to occur along the Kimberley coastline. More information on the strategic assessments under the EPBC Act can be found in Appendix B.

Bonaparte Basin

The Bonaparte Basin is located in the Timor Sea (in the Northwest Shelf Transition bioregion) and is considered to be a highly prospective region. It contains significant oil and gas fields under various stages of operation, construction and consideration. These include the Blacktip, Tern, and Petrel fields (Figure 5.18). This basin extends into the North Marine Region.

Future projects

The Greater Gorgon gas fields (Gorgon and Jansz), located in the Northwest Province, contain approximately 40 trillion cubic feet of gas, making them Australia's largest known undeveloped gas resource. The project operator, Chevron, plans to process 5 Mtpa of LNG at facilities on Barrow Island. Socio-economic benefits of the project include an initial \$11 billion investment, \$17 billion in taxes and royalties, additional export income of \$2.5 billion per annum, and 6000 direct and indirect jobs, 1700 of which will be located in Western Australia (Chevron 2007). Chevron was granted approval to undertake the project by the Western Australian and Australian Governments in late 2007.

Barrow Island is home to a number of endemic and rare species, and is free of introduced predators such as foxes and cats. Development of the Gorgon LNG processing facility will need to manage quarantine risks to ensure species are protected from potential pest species. Migratory whales, dolphins and dugongs are also common around the island and it is a nesting site for flatback and hawksbill turtles. As part of the environmental approvals process, the developers have been required to put in place actions to mitigate potential impacts on terrestrial and marine species.

Greenhouse gas emissions associated with LNG projects are an increasing concern for government, industry and the broader community. The carbon dioxide emissions from Gorgon are estimated to be 4 Mtpa, and Chevron plans to geosequester carbon dioxide into aquifers under Barrow Island to reduce emissions (IRC 2007). Geosequestration on this scale has not been attempted in Australia before.

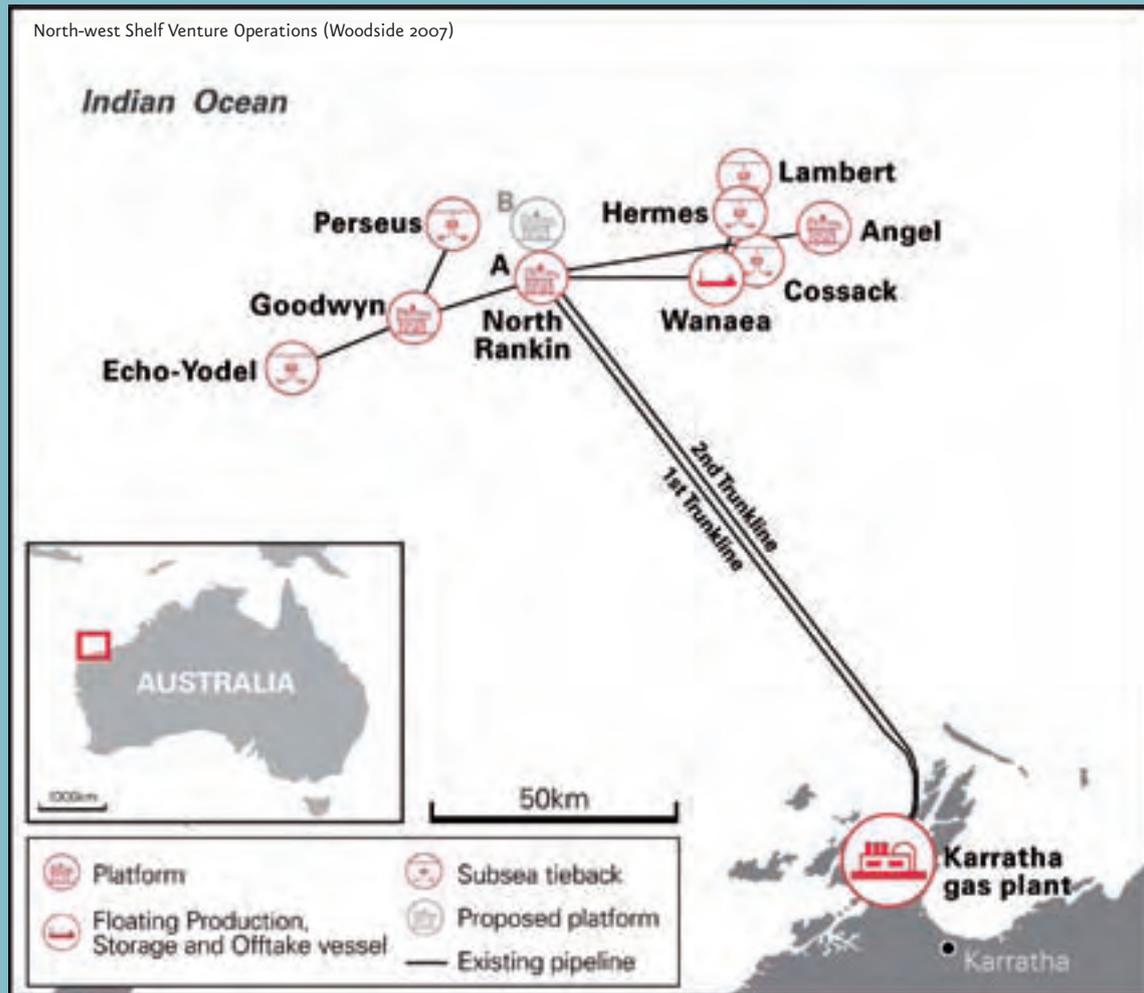
The Woodside-owned Pluto gas field is also situated in the Northwest Province, and contains approximately 5 trillion cubic feet of gas. The project is expected to produce 4.3 Mtpa of LNG at an onshore gas processing plant located on the Burrup Peninsula. In addition to Woodside's \$11.2 billion investment, the development



Box 5.2 North West Shelf Venture

The North West Shelf Venture is Australia’s largest resource development project, with investment in onshore and offshore oil and gas facilities valued at more than \$20 billion. The venture involves six equal share companies: BHP Billiton Petroleum (North West Shelf) Pty Ltd, BP Developments Australia Pty Ltd, ChevronTexaco Australia Pty Ltd, Japan Australia LNG (MIMI) Pty Ltd, Shell Development (Australia) Pty Ltd and Woodside Energy Limited, which is also the project operator (Woodside 2007).

More than 40 per cent of Australia’s oil and gas production comes from the North West Shelf Venture and it supplies Western Australia with 65 per cent of its gas needs.



The North West Shelf Venture has three offshore facilities: North Rankin A, which is one of the world’s largest gas producing platforms, Goodwyn A, which produces large volumes of gas and condensate, and Cossack Pioneer floating production, storage and off-take facility, which produces oil. The project also produces crude oil from the Cossack, Wanaea, Lambert and Hermes oil and gas fields.

North West Shelf Venture gas is piped onshore to the Burrup Industrial Estate on the Burrup Peninsula near Karratha. The Burrup Industrial Estate processing facility includes four LNG production trains with a current output of 11.7 million tonnes of LNG a year. Development of a fifth LNG production train is due for completion in 2008. When completed, it will increase the project’s annual capacity to about 16.3 million tonnes, making it one of the biggest LNG plants in the world. The venture has significant LNG export arrangements with countries including Japan, China and Korea. An agreement to deliver more than 3 Mtpa of LNG to China over 25 years represents Australia’s single largest dollar value export agreement and is worth \$20–25 billion.

is expected to provide 300 direct jobs and to inject \$28 billion into the national economy over the life of the project (Woodside 2007). Potential impacts on the marine environment associated with the project include noise emissions from offshore drilling and platform construction, and light spill from facility operations that could affect nesting turtles and migratory species.

The Burrup Peninsula, which is part of the Dampier Archipelago, is a National Heritage listed site that contains one of the world's largest and most important collections of Aboriginal petroglyph galleries, standing stones, camp sites and middens, which date back as far as the last ice age. Combined, these features make this area one of the world's most important monuments of prehistoric culture. To ensure the Pluto operations do not have significant impacts on the heritage listed values of the site, Woodside has entered into a conservation agreement with the Commonwealth under the EPBC Act.

Employment

The petroleum production sector in Western Australia is a significant employer, with approximately 5000 people working in petroleum operations in 2005–2006 (DoIR 2006). This figure does not take into account those industries or individuals employed servicing the sector, such as engineers or those employed in the construction of the sector's infrastructure. While a very capital intensive industry, the significant oil and gas projects currently underway or planned for the near future will result in continued high demand for labour. Finding sufficient skilled workers for projects is a growing problem for the industry (APPEA 2006) and is likely to intensify.

Petroleum administration and legislation

Onshore and in coastal waters, management of the petroleum industry in the North-west Marine Region is overseen by the Australian Government in partnership with the Western Australian Government. The Australian Government is responsible for broad economic policy settings including tax, foreign investment guidelines, international agreements and trade. The Western Australian Government owns and allocates petroleum rights, administers petroleum operations and collects royalties from operations onshore and in coastal waters.

Petroleum titles within the Territory of Ashmore and Cartier islands are administered by the Northern Territory Department of Industry, Fisheries and Mines on behalf of the Australian Government.

Offshore petroleum operations beyond 5.5 km (3 nautical miles) from the territorial sea baseline are governed by the Commonwealth's Offshore Petroleum Act 2006 which replaced the Petroleum (Submerged Lands) Act 1967 in 2008.

The Commonwealth owns the petroleum rights in Commonwealth waters, while the operation of the permit system is jointly administered by the Australian Government and the Western Australian Government. The Commonwealth's Petroleum Resource Rent Tax applies to all petroleum projects in Commonwealth waters, except the North West Shelf project, to which royalty and crude oil excise applies. Fees are collected by the Commonwealth and distributed to the Western Australian Government to cover the cost of administering petroleum titles in the area.

In the North-west Marine Region, petroleum companies are required to conduct their activities to a high standard of environmental performance and protection. Current Australian Government legislation relevant to environmental management of offshore petroleum exploration and development activities includes:

- The EPBC Act;
- *Petroleum (Submerged Lands) (Management of Environment) Regulations 1999*;
- *Environment Protection (Sea Dumping) Act 1981*;
- *Protection of the Sea (Prevention of Pollution from Ships) Act 1983*; and
- *Historic Shipwrecks Act 1976*.

More information on these acts can be found in Appendix B.

Petroleum activities such as seismic surveys have the potential to cause physical, behavioural and perceptual effects on whales. Seismic operations are regulated by the Australian Government's *Interaction Between Offshore Seismic Exploration and Whales, EPBC Act Policy Statement 2.1, March 2007* (DEW 2007). The petroleum industry has taken an active role in the development and implementation of measures to minimise the potential impacts of exploration on cetaceans.



5.3.10 Offshore mineral occurrences and mining

The occurrence of offshore minerals and prospective mining locations in the Region is uncertain as systematic mineral exploration has not occurred outside State waters. However, it is possible that iron ore deposits extend offshore both as hard-rock and as heavy mineral magnetite sand deposits.

The technology of offshore mineral exploration and mining in deeper waters is still in very early stages of development although it is undergoing trials elsewhere in the world.

In State waters adjacent to the Region, mining is occurring at both Koolan and Cockatoo Islands where iron ore deposits extend offshore. At the Cockatoo Islands site, significant iron ore deposits extend in depth to at least 200 m below the sea level.

Recorded offshore mineral occurrences within the Region or in adjacent State Waters include diamonds at the north-eastern end of the Region in the Joseph Bonaparte Gulf (GA 2008). Other offshore mineral occurrences include heavy mineral sands in the King Sound and the Fortescue River Mouth.

5.3.11 Submarine cables and pipelines

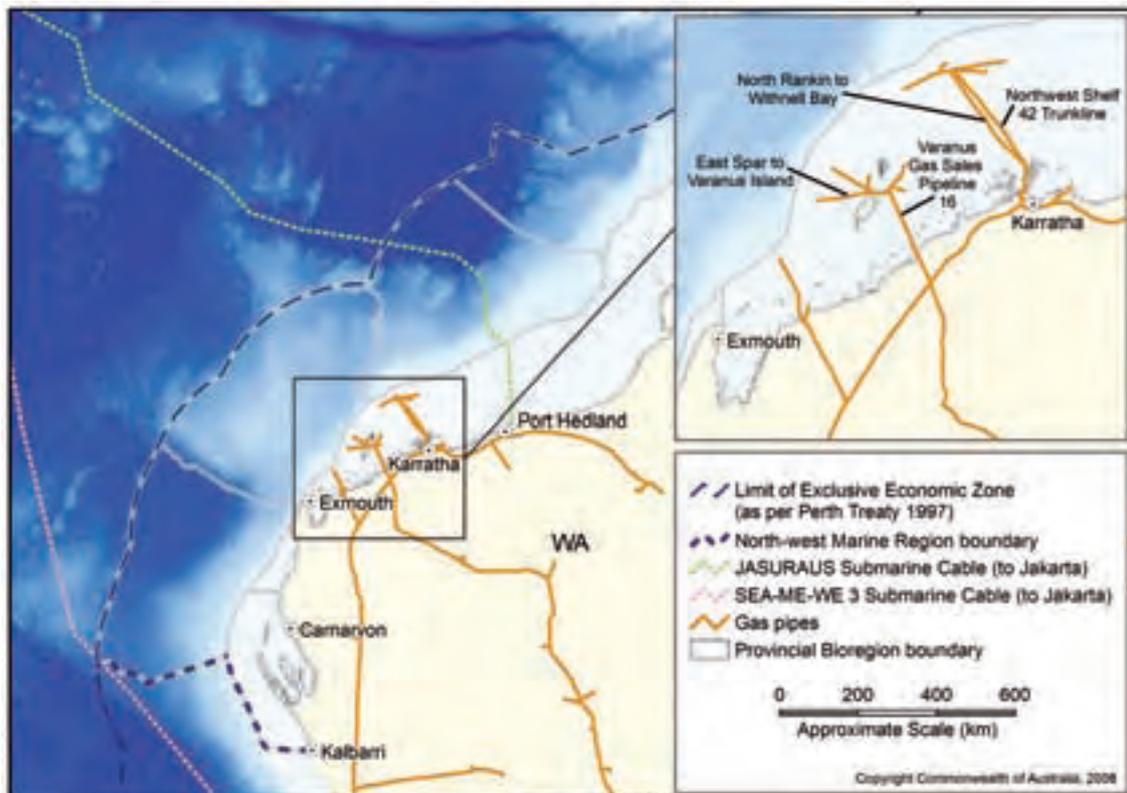
Cables

Submarine telecommunications cables are the underwater infrastructure linking Australia with other countries. Australia's submarine communications cables carry the bulk of our international voice and data traffic and are a vital component of our national infrastructure.

The JASURAUS and the SEA_ME_WE3 cables are two submarine telecommunications cables of national significance currently in service in the Region (Figure 5.19). Under the *Telecommunications and Other Legislation Amendment (Protection of Submarine Cables and Other Measures) Act 2005* protection zones cover the cables to prohibit and/or restrict activities that may damage them. Protection zones are generally the area within 1.8 km (1 nautical mile) on either side of the cable and include the waters above the area and the seabed and subsoil under the area (ACMA 2007).

The JASURAUS Cable is a fibre optic cable routed from Jakarta through the Sunda Strait to Port Hedland. It then has a dedicated terrestrial link to Perth. The cable traverses through the Northwest Shelf Province and Northwest Transition bioregions where the seabed is

Figure 5.19 Submarine telecommunication cables and pipelines in the Region



hard limestone. The cable is buried from the coast to 100 km offshore to protect it from damage and breakage in shallower water. The JASURAS Cable was laid in 1997 has a technical life of 25 years.

The South East Asia, Middle East and Western Europe submarine cable 3 (SEA-ME-WE3) Cable, established in 2000, is also a fibre optic cable. It is a spur of the greater SMW3 system, which travels from Japan to the Middle East and Western Europe; the longest cable in the world. The relevant section for Western Australia travels from Singapore via Jakarta to Perth. The SEA_ME_WE3 cable dissects the boundary between the North-west Marine Region and the South-west Marine Region at the outer edge of the EEZ and hence is almost entirely outside the Region (see Figure 5.19). The cable has a protection zone and extends to a depth of 2000 m (approximately 94.5 km from land). Two submarine cables currently proposed for Western Australia will travel through the Region. These are the Singapore-Indonesia-Australia Cable which will connect Western Australia, Indonesia and Singapore, and the Ochre networks cable between Perth and Singapore which will enhance the broadband infrastructure for each country (Ridder *et al.* 2006).

Pipelines

There are a large number of offshore gas pipelines that either enter or pass through the Region, as shown in Figure 5.19. Many of these are located on the North West Shelf (Northwest Shelf Province) and are associated with connecting the North West Shelf Venture petroleum fields with the onshore Karratha Gas Plant located on the Burrup Peninsula. The biggest of these is the WA-10PL, which is the largest offshore LNG pipeline installed in Australia. Another is the North Rankin A gas and condensate pipeline, which travels 134 km from the North Rankin A platform in Commonwealth waters to the Karratha Gas Plant. Onshore, the North Rankin A pipeline is connected to the Dampier to Bunbury Natural Gas pipeline, which travels 1500 km overland to provide natural gas to Perth and other major regional centres along its route (IRC 2007).

The East Spar pipeline is also located in the Northwest Shelf Province and connects oil and gas fields to processing facilities on Varanus Island in State waters. Oil and gas is then transmitted to the mainland via the Varanus Export Gas pipeline where it connects to the terrestrial Goldfields Gas Transmission pipeline (IRC 2007).

The Bayu-Undan to Darwin Gas pipeline is predominantly in the North Marine Region and Timor Gap Zone but just passes through the top of the Northwest Shelf Transition bioregion. It pipes gas and condensate from the Bayu-Undan gas field to Darwin (Santos 2007).

The construction, operation and decommissioning of pipelines is administered in Commonwealth waters pursuant to the *Offshore Petroleum Act 2006* and the *Petroleum (Submerged Lands) (Pipelines) Regulations 2001*. In Western Australian waters, the *Petroleum Pipelines Act 1969* and *Petroleum Pipelines Regulations 1970* apply.

The EPBC Act is the main legislative instrument concerned with the environmental impact of cables and pipelines. Under the Act, any proposals for submarine cables and pipelines must be referred to the Minister for the Environment, Heritage and the Arts for assessment and approval if they are considered likely to have a significant impact on the Commonwealth marine environment or other matters of national environmental significance.



5.3.12 Defence and border protection

The North-west Marine Region, and the land adjacent to it, is generally sparsely populated and distant from major population centres. This vast coastline and marine area requires ongoing surveillance, reporting and response mechanisms to guard against offshore maritime threats including illegal fishing, unauthorised immigration, prohibited imports/exports, biosecurity breaches, illegal activities in protected areas and pollution. The defence of Australia from maritime threats is coordinated through the Border Protection Command, established in 2005. It is a multi-agency command centre that utilises the resources and expertise of Customs, the Australian Defence Force, the Australian Fisheries Management Authority, the Australian Quarantine and Inspection Service and other Australian Government agencies, to deliver a coordinated approach to the protection of Australia's maritime borders (Border Protection Command 2007)

The principal military component of Border Protection Command is Headquarters Northern Command based in Darwin. The Headquarters coordinates and controls military operations in Australia's north, including waters adjacent to the Northern Territory, northern Western Australia and northern Queensland. It also coordinates Defence's regional relationships with Indonesia and Papua New Guinea. The Headquarters also collates and

analyses information on illegal immigrants and fishers as well as having responsibility for operational control of the Australian Defence Force surveillance and response efforts.

Customs operations in northern Australia include Coastwatch aircraft missions, which provide aerial surveillance of Australia's coastline and offshore maritime areas. Australian Customs patrol vessels also operate in collaboration with the Australian Fisheries Management Authority, the Royal Australian Air Force and the Royal Australian Navy to combat illegal foreign fishing in Australia's northern waters.

There are few Australian Defence Force bases or training areas located in the North-west Marine Region (Figure 5.20), although as a result of the Australian Government's Securing Australia's North West Shelf Policy, an operating logistics base has recently been established at Dampier to support vessels patrolling the waters around offshore oil and gas facilities in the Region. A dedicated navy administrative support facility is also being constructed at the nearby township of Karratha.

The Royal Australian Air Force currently maintains two 'bare bases' in remote areas of Western Australia: The Royal Australian Air Force Base Learmonth is located near Ningaloo Marine Park at Exmouth, and the Royal Australian Air Force Base Curtin is located further north at Derby. The Royal Australian Air Force maintains the



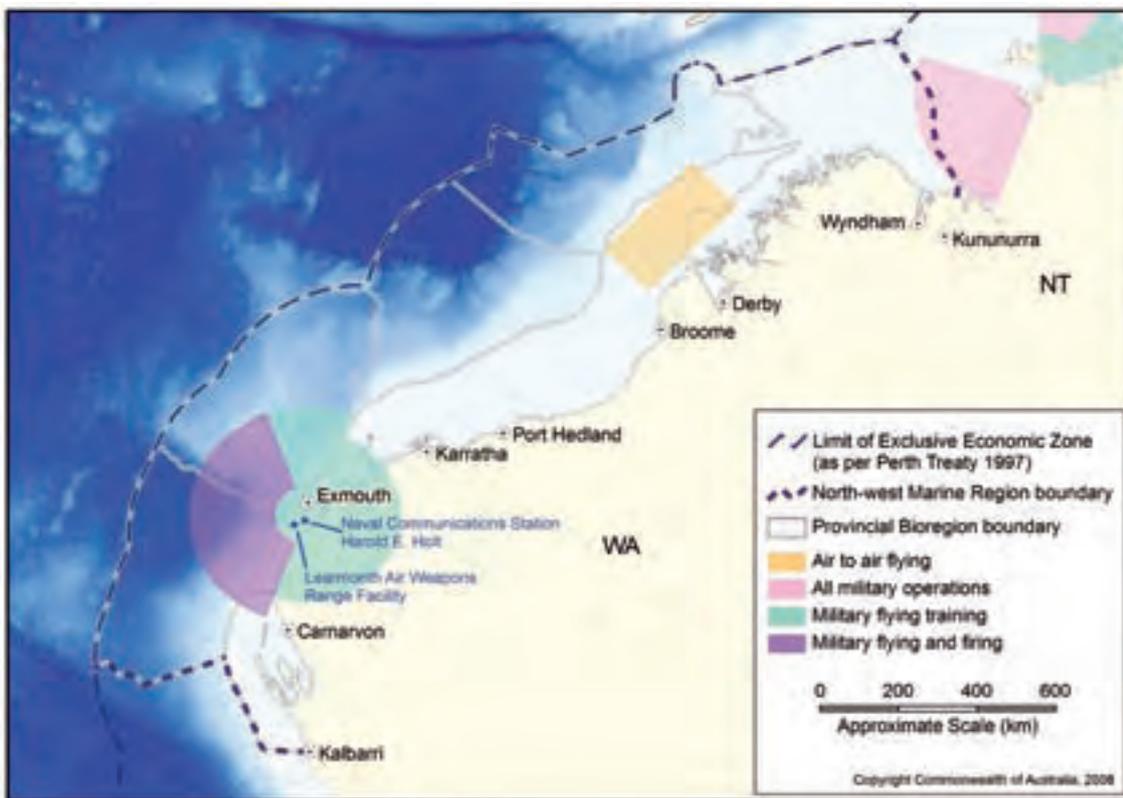
The Customs Coastwatch Dash 8 air fleet detect and report unlawful activity in Australian waters. Photo: Australian Customs Service.

Commonwealth Heritage listed Learmonth Air Weapons Range Facility (Lyndon Location 97), which is located between Ningaloo Station and the Cape Range National Park. This facility is used for military exercises and as a bombing range (Defence 2007a).

The Naval Communications Station Harold E. Holt is also located at North West Cape in Exmouth (Defence 2007b). The main role of the station is to communicate at very low frequencies with Australian and United States submarines in the Indian Ocean and the western Pacific.

The Australian Defence Force has policies in place to ensure maritime activities are conducted in accordance with their environmental obligations and responsibilities under the EPBC Act and relevant international conventions (Defence 2007c). Mitigation procedures have been developed to avoid interference with whales when operations are conducted in areas frequented by whales. These procedures provide guidance to ships and exercise planners, and include establishing safe distances from whales within which certain activities (e.g. sonar operations) are not conducted (Royal Australian Navy 2007).

Figure 5.20 Defence bases/training areas within and adjacent to the Region



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Figure 5.1 Distribution of Aboriginal coastal languages groups in the north-west

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Figure 5.2 Native title applications and determinations in and adjacent to the North-west Marine Region

Australian Bureau of Statistics (1991): *Australia, Populated Places*

Department of the Environment, Water, Heritage and the Arts (2006): *Commonwealth Marine Planning Regions*

ESRI Australia Pty Ltd (Canberra) (2001): *ARCWORLD Map of the World 1:20 million*

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Figure 5.3 Recreational fishing in the Region in 2001

Australian Bureau of Statistics (1991): Australia, Populated Places
 Bureau of Rural Sciences (2001): Australian National Recreational and Indigenous Fishing Survey – Recreational Catch Mapping
 Department of the Environment, Water, Heritage and the Arts (2006): Commonwealth Marine Planning Regions
 Department of the Environment, Water, Heritage and the Arts (2006): Integrated Marine and Coastal Regionalisation of Australia v4.0 - Provincial Bioregions
 ESRI Australia Pty Ltd (Canberra) (2001): ARCWORLD Map of the World 1:20 million
 Geoscience Australia (1998): Australia, TOPO-2.5M Topographic Data - Coast and State Borders
 Geoscience Australia (2005): Australian Bathymetry and Topography
 Geoscience Australia (2006): Australian Maritime Boundaries (AMB) v2.0
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Figure 5.4 Combined catch (2000-2002) for all commercial fishers operating in or adjacent to the North-west Marine Region

Australian Bureau of Statistics (1991): Australia, Populated Places
 Bureau of Rural Sciences (2005): National Atlas of Marine Fisheries and Coastal Communities
 Department of the Environment, Water, Heritage and the Arts (2006): Commonwealth Marine Planning Regions
 Department of the Environment, Water, Heritage and the Arts (2006): Integrated Marine and Coastal Regionalisation of Australia v4.0 - Provincial Bioregions
 ESRI Australia Pty Ltd (Canberra) (2001): ARCWORLD Map of the World 1:20 million
 Geoscience Australia (1998): Australia, TOPO-2.5M Topographic Data - Coast and State Borders
 Geoscience Australia (2005): Australian Bathymetry and Topography
 Geoscience Australia (2006): Australian Maritime Boundaries (AMB) v2.0
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Figure 5.5 Percentage of total population adjacent to the Region employed in fishing and related industries

Australian Bureau of Statistics (1991): Australia, Populated Places

Australian Bureau of Statistics (2006): Australia, Census of Population and Housing
 Australian Bureau of Statistics (2006): Australia, Statistical Local Areas
 Department of the Environment, Water, Heritage and the Arts (2006): Commonwealth Marine Planning Regions
 Department of the Environment, Water, Heritage and the Arts (2006): Integrated Marine and Coastal Regionalisation of Australia v4.0 - Provincial Bioregions
 ESRI Australia Pty Ltd (Canberra) (2001): ARCWORLD Map of the World 1:20 million
 Geoscience Australia (1998): Australia, TOPO-2.5M Topographic Data - Coast and State Borders
 Geoscience Australia (2005): Australian Bathymetry and Topography
 Geoscience Australia (2006): Australian Maritime Boundaries (AMB) v2.0
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Figure 5.6 Boundary of Australian-Indonesian MoU Box

ESRI Australia Pty Ltd (Canberra) (2001): ARCWORLD Map of the World 1:20 million
 Geoscience Australia (1998): Australia, TOPO-2.5M Topographic Data - Coast and State Borders
 Geoscience Australia (2005): Australian Bathymetry and Topography
 Geoscience Australia (2006): Australian Maritime Boundaries (AMB) v2.0
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Figure 5.7 Location of pearl farms and aquaculture sites

Australian Bureau of Statistics (1991): Australia, Populated Places
 Department of the Environment, Water, Heritage and the Arts (2006): Commonwealth Marine Planning Regions
 Department of the Environment, Water, Heritage and the Arts (2006): Integrated Marine and Coastal Regionalisation of Australia v4.0 - Provincial Bioregions
 ESRI Australia Pty Ltd (Canberra) (2001): ARCWORLD Map of the World 1:20 million
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 Geoscience Australia (1998): Australia, TOPO-2.5M Topographic Data - Coast and State Borders
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Geoscience Australia (2006): Australian Maritime Boundaries (AMB) v2.0

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Figure 5.8 Current and potential future ports in the Region

Australian Bureau of Statistics (1991): Australia, Populated Places

Department of the Environment, Water, Heritage and the Arts (2003): Australian Ports (National Geospatial-Intelligence Agency)

Department of the Environment, Water, Heritage and the Arts (2006): Commonwealth Marine Planning Regions

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Geoscience Australia (2005): Australian Bathymetry and Topography

Geoscience Australia (2006): Australian Maritime Boundaries (AMB) v2.0

International Risk Consultants (2007): Facilities, Ports, Moorings Points of Interest – North-west Marine Region

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Figure 5.9 Main shipping routes 2006

Australian Bureau of Statistics (1991): Australia, Populated Places

Australian Maritime Safety Authority (2006): Australian Ship Reporting Records

Department of the Environment, Water, Heritage and the Arts (2006):

Commonwealth Marine Planning Regions

Department of the Environment, Water, Heritage and the Arts (2006):

Integrated Marine and Coastal Regionalisation of Australia v4.0 - Provincial Bioregions

ESRI Australia Pty Ltd (Canberra) (2001): ARCWORLD Map of the World 1:20 million

Geoscience Australia (1998): Australia, TOPO-2.5M Topographic Data - Coast and State Borders

Geoscience Australia (2005): Australian Bathymetry and Topography

Geoscience Australia (2006): Australian Maritime Boundaries (AMB) v2.0

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Figure 5.12 Sea dumping prior to the 1996 amendment to the Environment Protection (Sea Dumping) Act 1981

Australian Bureau of Statistics (1991): Australia, Populated Places

Department of the Environment, Water, Heritage and the Arts (1998): Sea Dumped Waste Material off Australia and its Territories

Department of the Environment, Water, Heritage and the Arts (2006): Commonwealth Marine Planning Regions

Department of the Environment, Water, Heritage and the Arts (2006): Integrated Marine and Coastal Regionalisation of Australia v4.0 - Provincial Bioregions

ESRI Australia Pty Ltd (Canberra) (2001): ARCWORLD Map of the World 1:20 million

Geoscience Australia (1998): Australia, TOPO-2.5M Topographic Data - Coast and State Borders

Geoscience Australia (2005): Australian Bathymetry and Topography

Geoscience Australia (2006): Australian Maritime Boundaries (AMB) v2.0

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Figure 5.13 Offshore petroleum exploration and production permits in the Region

Australian Bureau of Statistics (1991): Australia, Populated Places

Department of the Environment, Water, Heritage and the Arts (2006): Commonwealth Marine Planning Regions

Department of the Environment, Water, Heritage and the Arts (2006): Integrated Marine and Coastal Regionalisation of Australia v4.0 - Provincial Bioregions

Encom Petroleum Information (2008): GPInfo Petroleum Exploration Database

ESRI Australia Pty Ltd (Canberra) (2001): ARCWORLD Map of the World 1:20 million

Geoscience Australia (1998): Australia, TOPO-2.5M Topographic Data - Coast and State Borders

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Figure 5.14 Sedimentary basins in the Region

Australian Bureau of Statistics (1991): Australia, Populated Places
 Department of the Environment, Water, Heritage and the Arts (2006): Commonwealth Marine Planning Regions
 Department of the Environment, Water, Heritage and the Arts (2006): Integrated Marine and Coastal Regionalisation of Australia v4.0 - Provincial Bioregions
 ESRI Australia Pty Ltd (Canberra) (2001): ARCWORLD Map of the World 1:20 million
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 Geoscience Australia (2006): Australian Maritime Boundaries (AMB) v2.0
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Figure 5.16 Petroleum fields and operations in the North West Shelf (Northwest Shelf Province)

Australian Bureau of Statistics (1991): Australia, Populated Places
 Department of the Environment, Water, Heritage and the Arts (2006): Commonwealth Marine Planning Regions
 Department of the Environment, Water, Heritage and the Arts (2006): Integrated Marine and Coastal Regionalisation of Australia v4.0 - Provincial Bioregions
 Encom Petroleum Information (2008): GPinfo Petroleum Exploration Database
 ESRI Australia Pty Ltd (Canberra) (2001): ARCWORLD Map of the World 1:20 million
 Geoscience Australia (1998): Australia, TOPO-2.5M Topographic Data - Coast and State Borders
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 International Risk Consultants (2007): Facilities, Ports, Moorings Points of Interest – North-west Marine Region
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Figure 5.17 Petroleum fields and operations in the Browse Basin (Northwest Shelf Province, Timor Province and Northwest Shelf Transition)

Australian Bureau of Statistics (1991): Australia, Populated Places
 Department of the Environment, Water, Heritage and the Arts (2006): Commonwealth Marine Planning Regions
 Department of the Environment, Water, Heritage and the Arts (2006): Integrated Marine and Coastal Regionalisation of Australia v4.0 - Provincial Bioregions
 Encom Petroleum Information (2008): GPinfo Petroleum Exploration Database
 ESRI Australia Pty Ltd (Canberra) (2001): ARCWORLD Map of the World 1:20 million
 Geoscience Australia (1998): Australia, TOPO-2.5M Topographic Data - Coast and State Borders
 Geoscience Australia (2004): Australian Geological Provinces
 Geoscience Australia (2005): Australian Bathymetry and Topography
 Geoscience Australia (2006): Australian Maritime Boundaries (AMB) v2.0
 International Risk Consultants (2007): Facilities, Ports, Moorings Points of Interest – North-west Marine Region
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Figure 5.18 Petroleum fields and operations in the Bonaparte Basin

Australian Bureau of Statistics (1991): Australia, Populated Places
 Department of the Environment, Water, Heritage and the Arts (2006): Commonwealth Marine Planning Regions
 Department of the Environment, Water, Heritage and the Arts (2006): Integrated Marine and Coastal Regionalisation of Australia v4.0 - Provincial Bioregions
 Encom Petroleum Information (2008): GPinfo Petroleum Exploration Database
 ESRI Australia Pty Ltd (Canberra) (2001): ARCWORLD Map of the World 1:20 million
 Geoscience Australia (1998): Australia, TOPO-2.5M Topographic Data - Coast and State Borders
 Geoscience Australia (2004): Australian Geological Provinces
 Geoscience Australia (2005): Australian Bathymetry and Topography
 Geoscience Australia (2006): Australian Maritime Boundaries (AMB) v2.0
 International Risk Consultants (2007): Facilities, Ports, Moorings Points of Interest – North-west Marine Region
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Figure 5.19 Submarine telecommunication cables and pipelines in the Region

Australian Bureau of Statistics (1991): Australia, Populated Places

Department of the Environment, Water, Heritage and the Arts (2004): Submarine cables

Department of the Environment, Water, Heritage and the Arts (2006): Commonwealth Marine Planning Regions

Department of the Environment, Water, Heritage and the Arts (2006): Integrated Marine and Coastal Regionalisation of Australia v4.0 - Provincial Bioregions

Encom Petroleum Information (2008): GPinfo Petroleum Exploration Database

ESRI Australia Pty Ltd (Canberra) (2001): ARCWORLD Map of the World 1:20 million

Geoscience Australia (1998): Australia, TOPO-2.5M Topographic Data - Coast and State Borders

Geoscience Australia (2005): Australian Bathymetry and Topography

Geoscience Australia (2006): Australian Maritime Boundaries (AMB) v2.0

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Figure 5.20 Defence bases/training areas within and adjacent to the Region

Australian Bureau of Statistics (1991): Australia, Populated Places

Australian Hydrographic Office (2007): Military Practice and Exercise Areas

Department of the Environment, Water, Heritage and the Arts (2006): Commonwealth Marine Planning Regions

Department of the Environment, Water, Heritage and the Arts (2006): Integrated Marine and Coastal Regionalisation of Australia v4.0 - Provincial Bioregions

ESRI Australia Pty Ltd (Canberra) (2001): ARCWORLD Map of the World 1:20 million

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Dolphins and yacht, Shark Bay World Heritage Area. Photo: Ian Anderson, Department of Environment and Conservation, WA.