Overview of the Australian Fishing and Aquaculture Industry: Present and Future

A report supporting the development of Working Together: The National Fishing and Aquaculture RD&E Strategy

Ridge Partners

March 2010

Australian Government

Fisheries Research and Development Corporation

The Fisheries Research and Development Corporation plans, invests in and manages fisheries research and development throughout Australia. It is a statutory authority within the portfolio of the federal Minister for Agriculture, Fisheries and Forestry, jointly funded by the Australian Government and the fishing industry.

Contents

Figures

1. This Report

Task and Objectives

This report presents the findings from a strategic review and analysis of the business environment for the fishing and aquaculture industry, which was undertaken to support the development of Working Together: the National Fishing and Aquaculture RD&E Strategy. The review covers commercial, recreational and indigenous customary fishing – and the downstream seafood industry.

Objectives

The objectives for the review and analysis were:

1. to assess and analyse the current business and operating environments for the three major sectors of the fishing and aquaculture industry (commercial fishing and aquaculture, recreational fishing, and indigenous customary fishing;
2. to develop scenario forecasts for the future business and operating environments for the fishing and aquaculture industries – including opportunities and threats; and
3. based on the forecasted scenarios, identify the R, D & E strategies to form the basis for a national RD&E plan

Study Team

This report has been compiled by Ridge Partners, a Brisbane based firm, in response to the national RD&E strategy working group's Terms of Reference. The Director of the firm, Ewan Colquhoun lead an experienced team to design the methodology; research, collate and analyse data; and compile this report and related presentations to industry stakeholders. The team included Dr Keith Sainsbury, Dr Julian Pepperell, Sam Gordon, and Chris Robertson. Information used in the report has been drawn from verifiable sources wherever possible, and supplemented by expert consultation and team advice. A first draft of this report was tested with a broad range of stakeholders at a workshop held in Adelaide in November 2009.

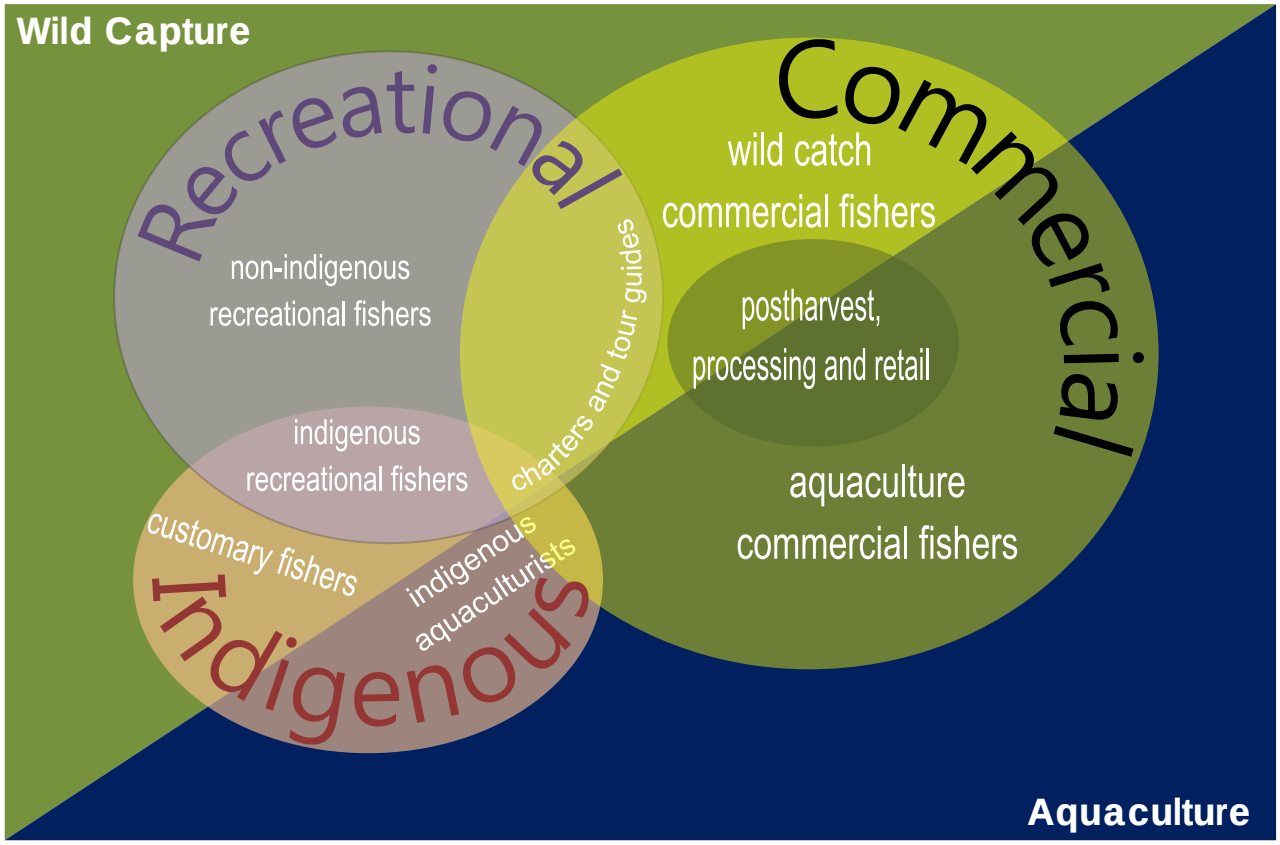
Scope and Terminology

This review briefly considers the global fishing/aquaculture context as a basis for more detailed discussion of the Australian fishing, aquaculture and seafood industry.

The Australian fishing and aquaculture industry is based on three areas of activity – commercial fishing and aquaculture, recreational fishing, and indigenous customary fishing.

Figure 1 illustrates the various activities undertaken within the industry.

Figure 1. Fishing and aquaculture activities



Commercial fishers undertake activities directed to a financial return from the sale of seafood and non edible aquatic products including pearls, sponges, etc. This sector comprises activity in two subsectors:

- wild catch fishers utilising limited entry marine, estuarine and inland fresh and saline waters; and
- aquaculturists utilising marine cage or flow through systems in limited entry marine, estuarine and inland fresh waters; or custom built impoundment based systems on land.

In addition to profit, participants in both subsectors gain a level of personal and professional satisfaction from their participation in the sector. Commercial activity is primarily managed by state and territory governments or the Australian Government, or is undertaken in open ocean waters outside Australia's Fishing Zone. The downstream (from the beach) component of the industry value chain is called the seafood sector.

Recreational fishers undertake activities that create personal enjoyment and recreation from fishing, utilising wild catch marine, estuarine and inland fresh and saline waters. Fish tour and charter operators and fishing guides who provide commercial services to recreational fishers are managed by agencies as part of their recreational fisheries. Fishout activity utilises ponds containing cultured species for recreational fishing.

All Australian recreational fisheries (including game, sports and spear) are managed by state and territory jurisdictions. At present, fisheries management arrangements limit the rights of individual fishers, not the number of fishers active in the sector. Fisher entry (via licensing of fishers or vessels, or via spatial or temporal closures of waters) and fisher take (via bag limits, fish size or other specifications) are the tools used for management of this sector. Recreational catch may be released live, or retained for personal use only (e.g. as food) – sale of recreational catch is illegal in Australia.

Indigenous fishers may undertake commercial or recreational activities, as well as fishing activities based on their tradition or custom. In the context of Australian fisheries, "customary fishing" is an activity unique to Aboriginal and Torres Strait Islander people, but the term does not encompass all fishing undertaken by indigenous Australians. As indigenous people become increasingly active across all fishery activities, fishery management terminology and legislation is being reviewed to incorporate and support management of their rights and sustainability of their fisheries. Indigenous people may participate in the industry as:

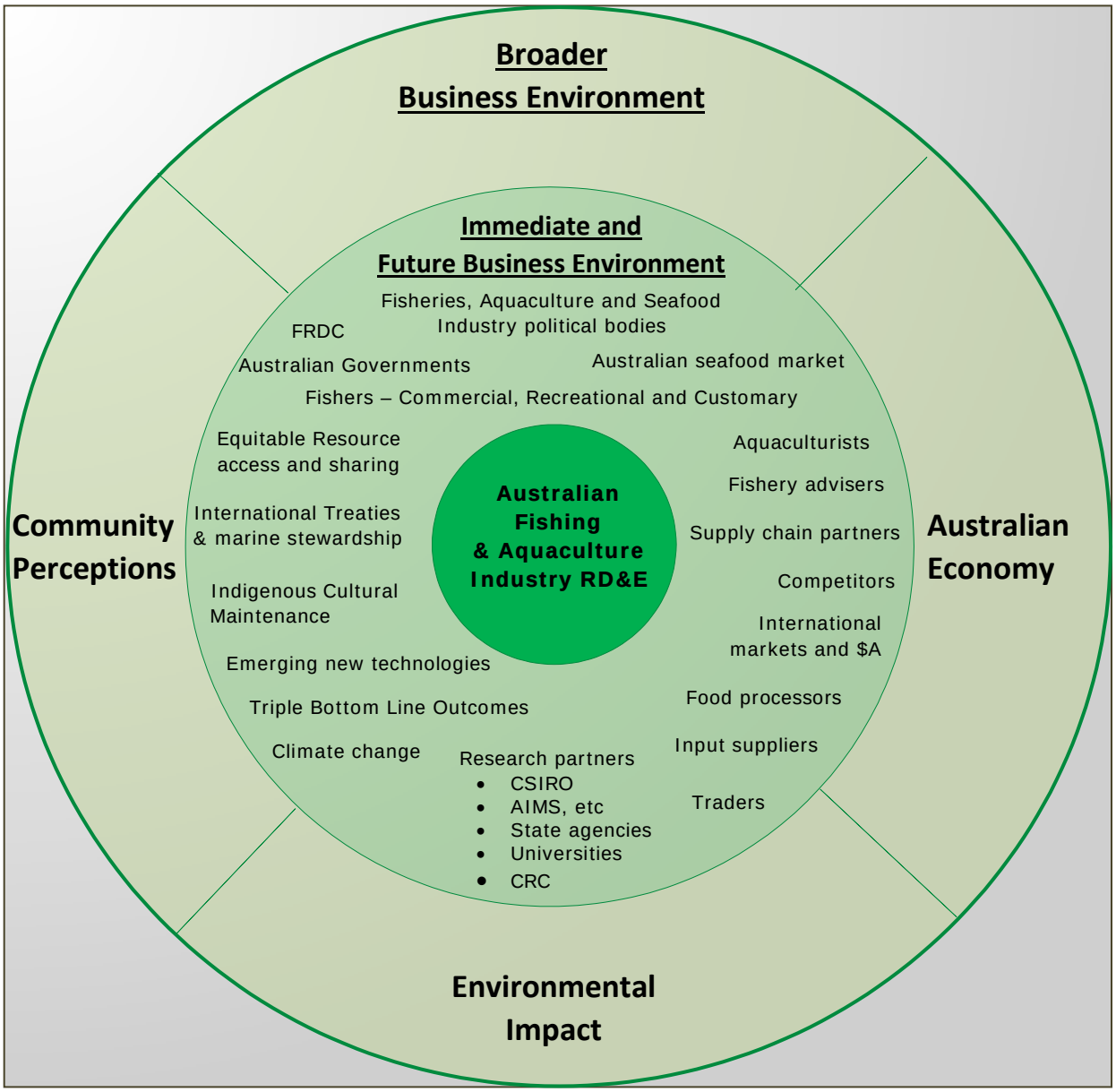
- customary fishers where they observe cultural norms and practice traditional fishing crafts for food and other benefits in support of their indigenous communities and cultural life;
- as commercial fishers for commercial gain in wild catch activities in marine, estuarine, or inland waters,
- as aquaculturists for commercial gain, or for providing food for their community,
- as recreational fishers in pursuit of leisure, or
- as charter operators or fishing tour guides.

A further sector of fisheries activity (not included in Figure 1) can be identified as **illegal, unreported and unregulated** (IUU) catch. While collecting meaningful data on this sector is difficult for obvious reasons, industry advice suggests the take of IUU fishers is as high as 10% of harvest tonnage in some fisheries, with an estimated national take equivalent to 1% of commercial harvest tonnage.

Fishery Business Environment

The central purpose of this paper is to review the various sectors of the fishing and aquaculture industries and consider their development and RD&E investment scenarios in the current and future business environment, 5-10 years ahead. Figure 2 illustrates the business elements influencing the assumptions for future scenarios. Many impacts on fishers and aquaculturists, and their chain partners, arise from non commercial origins (e.g. community perceptions). These are the elements considered in more detail in this Sector Overview report.

Figure 2. Elements of the Fishery Business Environment



2. Issues in a Global Fishery Context

Big Picture

Fishing and Aquaculture are somewhat unique in the context of Australian primary industries in that they are founded on the use and development by individuals of publicly owned natural resources, managed on behalf of Australian communities by governments.

This common property dimension of Fishing and Aquaculture (and the complex relationships and competing interests for the community's aquatic and marine natural assets) is all pervasive and fundamental to the management of these sectors. It is also a significant driver of RD&E priorities and decision making.

Overlaid on this fundamental driver are many international developments, including globalisation of investment, technology, and trade; increased leisure driven by rising disposable incomes in emerging large economies (e.g. China, India, Brazil); emergence of health, convenience and food personality as key aspects of regional consumer cultures; and the increased focus of global communities, agencies and consumers on the sustainability of their natural resources. These drivers are having significant impacts on the fishing and aquaculture industry, and it is imperative that the industry plans to adapt to this complex and rapidly changing world now. Risk and opportunity have no expiry date. The faster globalisation and economic and social connectedness proceed, the faster yesterday's risks morph into new risks and challenges tomorrow.

Australia's fishing and aquaculture industry and the government agencies that manage and support it, must adapt and evolve at a pace to effectively respond to these changes if the industry and the natural resources upon which the industry relies are to remain viable and sustainable.

A futures thinking exercise undertaken by the Australian Government in 2005 (LWA, 2005) revealed some interesting scenarios, many of which inform and remind us about the potential for the Australian fishing and aquaculture industry.

Likely trends

- high rates of development of new technologies, including convergence between previously separate technologies, with increasing power to influence landscape-scale ecological processes, leading to potentially bewildering choices for natural resource planners and managers;
- new ways of trading and exchange;
- international trend towards increased voluntary public reporting and mandatory disclosure in some cases;
- increased prices for oil and gas.

Uncertainties

- whether or not the perceived clash between conservation and economic growth is resolved;
- our ability to move away from institutional arrangements in which issues and jurisdictions are compartmentalised;
- whether government retains the prime role in natural resource management or we see greater roles for non-government organisations, covering a greater diversity of issues and views;
- the ways in which globalisation plays out and its impacts on trade and other alliances between Australia and other countries;
- the impact (potentially great) on global markets by developing countries, as innovators and consumers;
- whether or not hoped-for technological advances eventuate and meet expectations;
- whether Australia can adapt fast enough to stay competitive in an information technology revolution;
- the chance of a politically, economically and socially unstable Asia-Pacific region for several decades, demanding attention and resources from Australian governments.

Potential shocks or surprises

- Australia not keeping pace with the information technology revolution;
- major rapid changes in Asian markets (e.g. China switching its trade focus to eastern Europe);
- the centre of the world economy moves to South Asia;
- introduction of new diseases as a result of increased movements of people and animals;
- major terrorist attack on Australian soil with impacts for decades.

Commercial Fisheries

Production and Use

World supply of fish available for human consumption is determined by capture fisheries production (marine and freshwater) plus aquaculture production, less the share of this total used for other purposes (e.g. animal feeds).

Globally, wild catch (or capture) commercial fisheries reached full exploitation levels in the 1990's at around 95 million tonnes (FAO, 2008) (includes both marine and inland production). However human consumption and non-food uses have driven total demand to over 144 million tonnes in 2008. Aquaculture provides the means to fill this widening global seafood demand shortfall.

Since 1970 aquaculture's contribution to the supply of global seafood has increased from 3.9 percent of total production to 47% (FAO, 2008). Aquaculture now accounts for around 47% of fish available for human consumption and contributes nearly half the global seafood supply of 115 million tonnes, or 17.0 kg per head (live weight equivalent).

Figure 3. Global Fisheries Production and Use - All Uses

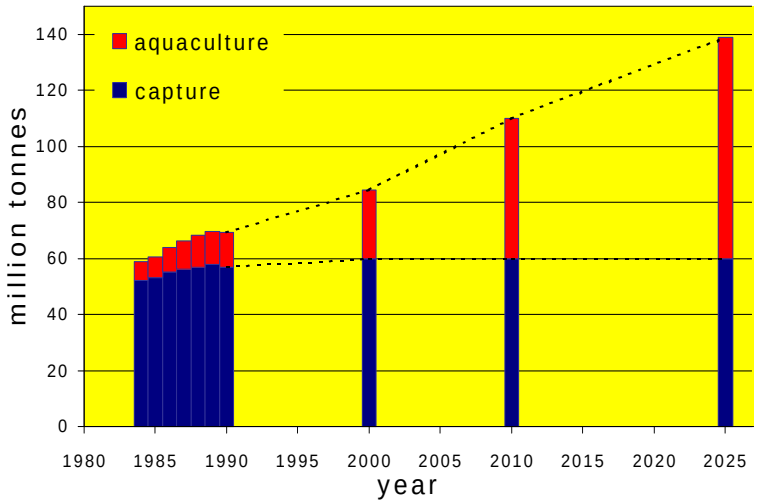
Million Tonnes	2002	2003	2004	2005	2006	2007	2008
PRODUCTION							
INLAND							
Capture	8.7	9.0	8.9	9.7	10.1		
Aquaculture	24.0	25.5	27.8	29.6	31.6		
Total Inland	**32.7**	**34.4**	**36.7**	**39.3**	**41.7**	**n/a**	**n/a**
MARINE							
Capture	84.5	81.5	85.7	84.5	81.9		
Aquaculture	16.4	17.2	18.1	18.9	20.1		
Total marine	**100.9**	**98.7**	**103.8**	**103.4**	**102.0**	**n/a**	**n/a**
TOTAL CAPTURE	93.2	90.5	94.6	94.2	89.6	91.8	91.0
TOTAL AQUACULTURE	40.4	42.7	45.9	48.5	48.4	50.8	53.2
TOTAL WORLD FISHERIES	**133.6**	**133.2**	**140.5**	**142.7**	**138.0**	**142.6**	**144.2**
UTILISATION							
Human Consumption	100.7	103.4	104.5	107.1	110.4	112.3	114.5
Non-food uses	32.9	29.8	36.0	35.6	27.6	30.3	29.7
Population millions	6,300	6,400	6,400	6,500	6,600	n/a	n/a
Per capita seafood supply kg	16.0	16.3	16.2	16.4	16.7	16.8	17.0
Supply from Aquaculture kg					7.3	7.6	7.9

Source FAO. Note: Figures for 2006, 2007 and 2008 are revised estimates from FAO, based on downward revisions by China of its data. See *www.thefishsite.com/.../fish-and-fishery-products-a-global-market-analysis*

Over the last 20 years, growth in aquaculture production has kept pace with global population growth, thereby enabling global per capita growth in seafood consumption. However with global population forecast to peak at ~9.2 billion in 2050, a further 2.4 billion (UN, 2004) people (or 36% increase) will be added in the next 40 years. After this strong growth, the rate of growth in aquaculture (measured in production volume) has started to slow. Average yearly growth for the period 1985-94 was 11.8%; and 7.1 percent in the following decade. As a result, it is likely that seafood consumption per capita will fall in the coming decade. Figure 3 confirms global seafood consumption has increased by 1kg per capita over the last 6 years. Consumption drawn from aquaculture is growing at a relatively rapid rate (~4% p.a.), while consumption sourced from wild catch fisheries is declining at more than 2% p.a.

More detailed analysis by the FAO suggests that aquaculture development globally is lumpy and uneven. It is often external factors (e.g. social, economic or knowledge transfer issues) that result in removal of constraints and obstacles to aquaculture production and enable investors to take up new opportunities. Where aquaculture is new, growth can be rapid, particularly in developed economies. Growth is strongest where technological or management breakthroughs in developed economies coincide with aquaculture species that are expensive, "up-market" and well known. Modern, readily accessible means of communication, transportation and market promotion make it possible to offer the product quickly to a large market. Where initial earnings are high, entrepreneurs are drawn to the sector, and production expands rapidly. Most mature aquaculture industries (e.g. salmon and trout worldwide, eel in Japan, oysters, seabass and seabream in Europe, milkfish in the Philippines, and catfish in the USA) experienced initial phases of very rapid growth.

Figure 4. Forecast Global Seafood Production



Projecting forward, it is suggested that global seafood demand will increase by 37 million tonnes by 2030 (Thyer, 2008). As wild catch yield is unable to grow its current sustainable production, this will mean aquaculture will need to grow 70% from 53 million tonnes today to 90 million tonnes. This 70 % increase will mean that in 2030 aquaculture and wild catch will each contribute around 90 million tonnes to meet consumer demand.

Seafood Consumption

Trends for the larger food markets in North America and European reflect an increase in consumption of seafood products. This rise is driven by a rise in consumption of convenience products, as consumers have less and less time to spare for meal preparation. Frozen products are on a downward trend, whilst the consumption of fresh fish is stable or decreasing.

The rising share of supermarkets in the retail of seafood products also increases availability, leading to increased consumption. Healthy eating driven by pull factors such as omega 3, and consumers' concerns triggered by various food crises (e.g. BSE, dioxin, etc.) also contribute to the positive trend of seafood consumption.

Figure 5 presents trends (FAOSTAT) (FAO, 2007) in seafood consumption (in kg live weight equivalent) for selected countries and regions over the decade to 2003 (the latest international data available from FAO). Significant trends include the growth in Australia and China, and the world market, while consumption in Japan, the world's largest consumers per capita, is declining.

The following discussion focuses on key markets and relevant seafood consumption trends within these markets.

In 2007 the **USA** was the third largest consumer of fish and shellfish behind China and Japan, with imports steadily increasing to 84% of its seafood demand, up from only 63% just a decade ago.

At least half of the seafood imported to the U.S. is farmed. America's aquaculture industry, though vibrant and diverse, currently meets only 5-7% of domestic demand for seafood, most of which is catfish. Marine products such as U.S. farmed oysters, clams, mussels and salmon supplies 1.5% of American seafood demand. In the 5 years ending 2007, American consumers have:

- increased consumption of fresh and frozen seafood from 5.17 to 5.49 kg/head – up 6.1%, and

- decreased consumption of canned seafood from 2.09 to 1.77 kg/head – down 15.2% (NOAA, 2009)

Figure 5. Apparent Seafood Consumption

Kg/capita/yr	1993	1998	Avg 2001-03
Australia	20.0	20.0	22.2
Canada	24.0	24.0	23.8
China	15.0	24.0	25.7
Germany	14.0	15.0	14.3
India	4.0	4.0	4.0
Japan	68.0	64.0	66.9
New Zealand	19.0	26.0	26.5
Norway	44.0	54.0	49.5
USA	21.0	21.0	22.6
UK	20.0	21.0	20.4
WORLD	**13.0**	**16.0**	**16.4**
DEVELOPING COUNTRIES	11.0	13.0	14.5
DEVELOPED COUNTRIES	22.0	24.0	23.7
EAST and SOUTH EAST ASIA	23.0	23.0	27.1
EUROPEAN UNION	23.0	26.0	25.7
EUROPE	31.9	35.7	38.0
NORTH AMERICA	8.2	8.4	8.5
SOUTH AMERICA	8.8	9.0	9.7

Note: Per capita consumption figures are expressed as live weight equivalents. For Australia, the seafood yield is around 50% of live weight.

Japan and the USA are vying for the position of the world's largest single seafood importer (South Australian Food Centre, 2008). Japan is a premium market for many seafood products. As the world's second largest economy, a closer look at Japanese trends (MAFF Japan, May 2009) provides potentially significant insights for the longer term westernization of other emerging East Asian economies. The following observations are drawn from the MAFF Fisheries White Paper released May 2009:

- In 2006, per capita beef consumption in Japan surpassed that of seafood for the first time since government records began in 1949. Per capita seafood consumption is now 20% lower than its peak in 1997.
- Fish consumption has declined for all ages. From 1997 to 2007, fish consumption decreased by more than 20% for the 1-19 year age group and by more than 30% for the 30-49 age group. The reasons cited for disliking fish are : "there are bones"; "fish are difficult to eat"; "eating fish is time-consuming".
- As consumers have increased their inclination for lower food prices and simplicity, they have shifted away from small niche volume products offering variety, seasonality, freshness and whole fish, to mass produced products of limited variety that are available throughout the year, in frozen or fillet format.
- As the time for cooking has declined, people have tended to shift away from fish that are considered difficult to cook. The percentage of those who cannot clean a fish is higher for younger generations. Some people complain that post-cooking cleanup for fish is a bother and that it is difficult to deal with fish food scraps. Parents tend to provide dishes meeting children's preference for meat (beef or pork) rather than fish. These factors may have reduced the experience of parents in preparing fish at home.
- Fine motor skills are required for eating fish because bones have to be removed. Only a half of young people surveyed were able to hold chopsticks in a way that has long been considered functional.

- Fish dominate New Years' dishes, exhibiting a trend for seafood as a festival or special occasion meal (similar to abalone and lobster in China).
- It is feared that the shift away from fish reduces the opportunity for parents to convey Japan's traditional eating habits to their children. The frequency of children's contact with the sea and fish has declined. Opportunities have decreased for children to know the good taste of very fresh fish, how to clean a fish, and to have a relationship with fish and fishermen. Over the long run, MAFF concludes it is feared that children's shift away from fish will affect the fishing industry's pursuit of sustainable development.
- The report confirms that more than 80% of mothers are "willing to increase the opportunities for children to eat fish." But it is important to diffuse knowledge about dishes, eating habits, and cooking methods to support their motivation. The report recommends that fish-handling methods, and semi-finished and finished fish dishes should be provided, cooking information be given through face-to-face sales, and new fish dishes should be proposed.

One element of Japanese seafood cuisine has become a worldwide food style. Where sushi was considered extremely exotic and foreign only a few years ago, sushi bars are common and sushi is part of regular food global consumption (including in Australia), especially in cities of the developed world. Growth in Japanese restaurants has also been rapid in growing economies, such as Russia, China and India. Numerous media reports have focused on the increasing pressure sushi consumption is having on fish stocks, particularly Atlantic Bluefin Tuna. Media reports have highlighted that increasing scarcity and high prices of Bluefin Tuna are linked to sushi consumption.

Taken as a whole, the **European Union** is the largest importer of seafood, more than double the size of USA or Japan. Total seafood imports into the EU are growing strongly, with a small increase in total volume, but a substantial increase in value. Domestic production of seafood is under pressure through over-fishing and reduction in catch quotas. Major markets include Spain, France, Italy, Germany, UK, Belgium, Denmark, Sweden, Netherlands and Portugal.

Global Economic Crises

Twenty-four months after the decline toward a global financial crises, the trends in seafood consumption in global markets are becoming clearer. Generally the crisis is having a strong impact on the global seafood sector.

In general terms for some products, as income rises, demand for the particular good or service rises even faster than income. These goods are said to be income elastic. Many "luxury" goods are income elastic; as we get wealthier, we tend to buy more expensive clothing, and go on more overseas holidays. In most OECD economies seafood is considered by consumers to be more than a staple food product, if not a luxury. The impact of an economic downturn on seafood markets is therfore magnified.

A number of trends (Rabobank, 2009) and factors are at play in major northern hemishpere markets as the economic crises unfolds. Firstly on the demand side:

- Consumers are choosing "back to basics" unprocessed products such as natural fillets or whole fish, rather than value added options or ready meals.
- Products with a high exposure to food service (prawns, fresh tuna, sushi) are far more impacted than products distributed at the retail level. As seafood has higher exposure to food service globally (in US and UK food service has more than 50% of the seafood market in value terms) than other foods it suffers a greater impact from an economic crisis. There has been little impact on retail wet markets.
- Consumers perceive that any change to "centre of the plate" products (mussels, salmon fillets, hake) will mean drastic lifestyle changes and this change should be resisted. However changes to products consumed as snacks (prawn cocktail, smoked salmon, surimi) are far more discretionary and will be assigned to their fate by an economic crisis.
- Consumers are choosing to save money by reducing their consumption of premium end products. Therefore products with relatively low per kilogram prices (e.g. canned tuna, herring) are less impacted by an economic crisis than large prawns, lobster, fresh tuna, abalone. In the Australian market the mesages are mixed. For example, the 2008-09 year has been a good year for the domestic prawn industry (based on larger wild catch and

farmed species) with increased production and prices. Wholesalers are reporting that the market for imported vannamei prawns has fallen in recent years, citing the continued poor media surrounding imported prawns and vannamei prawns in particular.

- Latest data suggests that frozen seafood categories are outperforming fresh chilled categories. This suggests consumers are substituting between categories. The reasons for this may be that more high-end products are sold through specialist chilled markets than commodity frozen markets; and discount frozen seafood has recently emerged as a separate category and is now being promoted in its own right. Outright substitution of chilled products with frozen alternatives based on price alone is not evident.
- Seafoods products that consumers consider an essential part of their culture or cuisine are less impacted by an economic crisis. For example fish (cod) and chips in the UK, and mussels in Belgium, are proving far more resilient in their markets than new and exotic prawns or sushi are in European or US markets. Tropical prawns are expected to contract between 30-40% in value in the US market during 2009.
- Typically, branded seafood products are higher end products than private label products, and branded product players tend to be more innovative and better tuned to changes in consumer sentiments. In an economic crisis one would expect the cheaper private label sales to grow at the expense of branded products, but the inconsistency of private and branded labels across advanced seafood markets (canned, fresh, chilled, frozen) means there is no consistent and clear evidence to support this expectation.
- Evidence suggests substitution between species is rare within the seafood category, and almost non existent between seafood and other protein sources (e.g. poulty, pork). Consumers are determined to maintain their lifetyles in the face of the economic crisis and to keep to a pattern of main meals across a week. Cost savings are far more likely to be found through a choice of in-home meals inplace of take aways, rather than switching from seafood to cheaper poultry.
- FAO records confirm a clear link between the slowing of seafood production and recession periods. This relationship is not evident for other protein sectors such as poultry and beef. High exposure of the seafood sector to food service means a greater impact on seafood from a recession. As the US and Japan account for around 85% of global seafood imports, the more severe recessions in these two markets has forced global seafood export prices lower. Offseting these losses in the last year is the relative fall in fuel costs (a major input cost to wild fishing), and the more competitive shipping and freight rates available due to a fall in all gloabl trade across all industries.

There are also significant supply side impacts which reveal the relative competitiveness of the wild catch and aquaculture sectors. In a clear change of fortunes, recent global economic development has placed wild catch seafood at a distinct cost advantage to aquaculture for two reasons:

- The cost of fuel (25-75% of the costs of wild catch fishing) has fallen. Aquatic feed, comprising 30-60% of the input costs to aquaculture, has also fallen in price – around 10-20%. However the feed price decline has been relatively smaller than the fuel price decline resulting in a relatively positive position for wild catch over aquaculture.
- Globally, aquaculture companies are being impacted significantly more by the economic downturn than wild catch fishing companies. Aquaculturists with long production cycles are especially hard hit. The unit cost of working capital for both sectors is similar, but aquaculture financing must cover infrastructure as well as the growout of production through to sales. Wild catch financing is typically based on long term debt facilities for vessels and equipment only, and does not include the value of sales.

A snapshot (FAO Globefish, 2009)of current global seafood markets confirms the ongoing recovery from the global economic crisis, and other issues are resurfacing.

Shrimp markets are showing *t*entative signs of a recovery. In Japan, home consumption increased while US market demand continues to be moderate. The EU market is still in a downturn, but also here some price improvements have materialized in recent weeks.

The ***Tuna*** industry is in transition - after increasing for several months, most tuna prices softened suddenly at the end of August. Further price declines are expected, which will assist canneries buy stock and rebuild supply.

Groundfish and ***cephalopod*** supply was very good in the course of 2009, with prices trending downward. This trend is likely to continue in 2010.

Tilapia is a product with a strong growth rate, especially across Asia. This species does well during economic crises, due to a high price/value ratio.

Pangasius exports are booming. Viet Nam exported 334 000 tonnes of catfish in the first eight months of 2009, worth an estimated USD 737 million, the top foreign currency earner among seafood exports.

Bass and ***Bream*** prices have fallen in the last quarter contrary to expectations. This is largely due to the most exposed companies in Greece harvesting early to rebuild cash flow.

Salmon production in Norway cannot be geared up rapidly enough to compensate for the Chilean shortfall, resulting in higher prices this year. In recent months however, the market has become more unsettled as rapid growth in the salmon biomass in Norway is pushing many producers to the maximum limits set by their production licenses. As a result, increasing supplies are now coming to market and prices are falling.

Fishmeal production by the five major producers declined in 2009, continuing a trend started some years ago. Chile is the only country reporting any increase in production, while all others reported lower outputs.

Fish oil production declined in the first half of 2009. Fish oil prices rose in the second quarter of the year. Further price hikes are likely in coming months.

Trade

FAO (Globefish, 2008) estimates world fish imports exceeded USD 100 billion in 2008, for the first time in history. The value of fish exports is estimated to be slightly lower. About half of world fish exports originate in developing countries, while 80% of world imports go to the developed countries. Net exports from developing countries reached USD 25.4 billion in 2008, thus emphasizing that fishery products are an important source of foreign exchange earnings for developing countries. Japan and the USA are the top fish importers in 2008. The EU accounts for more than 40% of world fish imports in value terms, however intra-EU trade is included in these figures.

Figure 6. World Fish Trade

	EXPORTS			IMPORTS		
US$ Billion	**2006**	**2007**	**2008**	**2006**	**2007**	**2008**
Australia	0.9	0.9	0.9	0.9	1.1	1.1
Canada	3.7	3.7	3.8	1.8	2.0	2.0
Chile	3.6	3.7	3.9	0.2	0.2	0.2
China	10.8	10.9	12.2	6.7	7.4	8.4
European Union	21.6	24.2	25.5	37.4	41.8	43.2
Japan	1.4	1.7	1.6	14.0	13.2	14.5
Norway	5.5	6.2	7.4	0.8	1.1	1.3
Thailand	5.2	5.7	6.5	1.5	1.7	2.4
USA	4.1	4.4	4.5	13.3	13.6	14.4
Vietnam	3.4	3.8	4.0	0.3	0.4	0.4
WORLD	**85.9**	**92.8**	**99.5**	**89.9**	**98.0**	**104.7**
DEVELOPING COUNTRIES	42.6	45.1	49.5	18.6	21.3	23.9
DEVELOPED COUNTRIES	43.3	47.6	50.0	71.3	76.7	80.9
ASIA	29.0	30.9	34.0	28.5	29.5	32.6
AFRICA	4.1	4.5	4.8	2.0	2.4	2.8
NORTH AMERICA	8.2	8.4	8.5	15.1	15.6	16.2
SOUTH AMERICA	8.8	9.0	9.7	1.0	1.4	1.7
EUROPE	31.9	35.7	38.0	41.3	46.7	49.0

Commercial Outlook

The FAO forecasts (FAO, 2007) that the species consumed in 2030 will be more or less the same ones as eaten today, as important stocks of fish in the world are already fully exploited. Some marine species may be produced by aquaculture (e.g. cod or other demersal species), but growth will be more a result of shifts in the production systems, than an introduction of new species. There are already limitations to the potential yield of deep-sea fisheries.

Growth in seafood and marine product demand in China is of particular relevance to aquaculturists worldwide, and to Australian industry. The following summary draws from the FAO Study. (FAO, 2008)

Figure 7. Global Fisheries Outlook – Key Regions

	Demand Growth	Possibilities for Aquaculture	Constraints
China	• It is likely that, by 2015, annual fish consumption in China could be 4.5–5.5 mill. tonnes higher than in 2005 • Rapid economic growth coupled with a slow population increase means 60% of the seafood demand increase will come from projected growth in household disposable income • Seafood consumption is relatively high at 26 kg (world average is ~14kg if China is excluded). As urbanisation continues seafood demand may moderate as more affluent consumers turn away from what they perceive as low-quality products towards high-quality items e.g. beef and grain. This would lead to lower growth in volume terms. • China produces more fish than it consumes – future increases in national demand could be met by redirecting some exports to the domestic market	• In recent years, aquaculture production in China has grown in volume terms by 5–7%p.a. (~2MT), significantly more than the projected annual increase in the volume of fish demanded. • China has the largest aquaculture sector in the world in terms of both the volume of aquatic animals produced and the number of species cultivated. This increases the likelihood that the sector will continue to be able to supply the local market with almost all that it will want. • Some of the exotic species now in demand, such as Atlantic salmon, are not produced commercially by China's aquaculture or capture fisheries.	• Microeconomic constraints are rising (sites, inputs, feed, services) as other industries compete • Limited freshwater culture sites. Limited chance to change this with current technologies. • China may relocate its aquaculture grow-out facilities abroad (e.g. Sub-Saharan Africa, Latin America). The added costs of imports would be offset by lower costs for sites etc. • Pollution is a major constraint. Growing waste impacts from other industries. Consumers reject products, intensive inshore cage technologies. RDE focus on deepwater cultures is underway. • Significant feed inputs are imported (soybean, fishmeal, fish oil) and their price on world market is likely to rise. • A stronger Yuan against the US$ may reduce import costs but will ultimately reduce market competitiveness.
South East Asia	• Consumption is high in absolute terms (~18MT pa). By 2015, it could increase by another 3MT. • Fish consumption is high. Growth in disposable incomes is unlikely to boost consumption. Most of the increase in demand will come from population growth. • Capture fisheries supply bulk of consumption and are near sustainable yields. The region has an annual exportable surplus of ~1.5-2.0MT. (incl. aquaculture) • It is likely exports will fall as they are redirected to domestic needs.	• In volume terms, aquaculture has grown at annual rates of 6.1 - 7.6% p.a. for two decades. • Aquaculture expansion and productivity increases may meet the annual growth in demand of 0.25–0.3MT p.a. required in the domestic markets. However there will be some significant challenges to overcome to achieve this outcome.	• Success of aquaculture is increasing competition for sites and inputs, and stresses on wild resources (e.g. brood stocks for catfish, and lobster). • Foreign producers will promote their own products in their markets and reject imported aquaculture products • Technology development is too slow to solve new problems in hatcheries and feeds. It is likely that governments will increase regulation, and in so doing draw public resources away from where they are most needed (e.g. human resources). Slower growth is likely in mid - long term.
Europe, North America & Japan	• Seafood consumption is above global average of 17kg/capita. (Japan 60 kg); North America (24 kg); Europe (21 kg). With slow population growth and depressed economies there is likely to be decline in Japanese consumption, growth in North America and a very slow increase in Europe. • Overfishing and deficient economic returns for fishing vessels may lead to a decline in effort and falls in wild capture production levels. Economic growth in Asia may cause some of the fish now exported to the industrialized world to be sold there instead. Prices may rise.	• In North America & Japan aquaculture supply is minimal. In Europe it provides about 20% • Expansion of domestic aquaculture to cover for shortfalls in capture fisheries would face severe competition from aquaculturists in Asia and Latin America. • Aquaculturists in Europe, North America and Japan could make inroads in high-priced markets in Asia and Latin America. It is likely that • Thus, marketing, sales promotion and continued cost-cutting will be essential if aquaculturists in the developed world are to remain competitive.	• Markets for aquaculture products produced in the industrialized world will not expand rapidly at present price levels. • However, it is not unusual for agriculture commodities to pass through production cycles where the volumes produced first expand only to contract later. A frequent cause of such cycles is the time lag that occurs between producers' decisions to modify output and the subsequent effects on supply once produce is harvested. • Generally, however, the long-run tendency for aquaculture products going through such production cycles, and the consequent rise and fall in volumes and prices, is one of increasing volumes and falling prices. Moreover, as production grows, the cycles flatten out.

Sunken Billions

A recent World Bank Report (World Bank, 2008) has identified the poor economic contribution of global commercial capture fisheries, and the declining social capacity of many related communities. The Bank's detailed analysis claims that some 75% of the world's marine fish stocks have been "underperforming assets" for over 30 years. The evidence cited includes loss of habitats, increased marine pollution, rising sea temperatures and the increasing acidity of the oceans, illegal fishing and unreported catches, and subsidies that continue to support unsustainable fishing practices.

The 25% of fisheries which remain under-exploited tend to comprise lower-value species, or the fisheries for such stocks are the least profitable.

By 2004, the lost economic value to the global economy is estimated conservatively at US$50 billion per year, a cumulative global loss of potential economic benefits in the order of US$2 trillion over the 30 years. The losses represent the difference between the potential and actual net economic benefits from global marine fisheries.

The report claims society could capture a substantial part of this $50 billion annual economic loss by improved governance of marine fisheries. Comprehensive reforms could be a basis for economic growth and the creation of alternative livelihoods in many countries. At the same time, a nation's natural capital in the form of fish stocks could be greatly increased and negative impacts of the fisheries on the marine environment reduced.

The estimated loss excludes consideration of any losses to recreational fisheries and to marine tourism, losses attributable to illegal fishing or downstream processing, distribution and consumption. It also excludes the value of biodiversity losses and any compromise to the ocean carbon cycle. This suggests that the losses to the global economy from unsustainable exploitation of living marine resources substantially exceed $50 billion per year.

The Bank finds that the current marine catch could be achieved with approximately half of the current global fishing effort. There is massive overcapacity in the global fleet. Excess fleets competing for limited fish resources result in stagnant productivity and economic inefficiency. This exacerbates the economic conditions depressing real income levels for fishers as costs per unit of harvest increase. Rising and volatile fuel costs have not helped. Over the last decade real landed fish prices have stagnated, compounding the industry's economic malaise.

The study estimates the value of the marine capture seafood production at the point of harvest is around 20% of the $400 billion global food fish market- i.e. $80 billion. A full 80% of chain value is created downstream of the beach. The market strength of processors and retailers and the growth of aquaculture, which now accounts for around 47% of seafood production, have contributed to downward pressure on producer prices.

Recreational Fisheries

In 2008 the global participation rate for recreational fishing was estimated to be around 10%, with the related recreational harvest to be about 12% of the total catch for all fish species (Arlinghaus & Cooke, 2008).

The primary motivation for recreational fishers in advanced economies is the enjoyment of the fishing experience in a relaxed natural environment. However recreational fishers may retain their catch for personal consumption (but not commercial sale). The definition of "recreational fisher" includes a wide spectrum of users all of whom are wholly or partially motivated by the pursuit of leisure.

There is a perception in many communities in the advanced economies that recreational fishing is a benign activity that makes limited positive contribution to national economic and social wellbeing. However as increased global consumer wealth drives changes in leisure demographics, the literature (Cowx, 2002) (Cooke & Cowx, 2004 Sept) suggests that both of these perceptions are increasingly erroneous.

High effort - low catchability are fundamental indicators to the recreational fishing sector. The increasing sophistication and use of technologies (e.g. fish finders) is lowering the effort and increasing the catchability. This places greater pressure on fishery resources.

Evidence of a stable or falling fisher participation rate as the primary indicator of sectoral activity may also mask the real impacts on the resource base and the economy (both positive and adverse). Where per capita participation has remained stable or fallen, such as in North America,

increase in population has resulted in higher levels of participation. Globally, recreational fishing is now highly developed and pursued by large numbers of people, primarily for leisure, but also for income generation and to supplement food supply.

There is limited global data available to inform our regional or global understanding of recreational fishery production and use. However looking across advanced recreational fishing economies where relevant data is collected, we can summarise the scale and scope of global recreational fishing, in Figure 8 (Cooke & Cowx, 2006).

Figure 8. Scale and Scope of Global Recreational Fishing

Location	Recreational Fishing Statistics
Europe	• Amongst 22 European countries there are an estimated 21.3 million anglers, with an estimated expenditure on recreational fishing in 10 of the countries in Western Europe where data were available, in excess of $US 10 billion (Cowx, 1998)
USA	• In 1996, 18% of the US population 16 years of age and older (i.e., 35 million persons) spent 514 million angler-days in fresh waters, expending $US 38.0 billion (US Fish and Wildlife Service, 1997). • In 2001, anglers in US marine waters of the Atlantic, Gulf, and Pacific coasts made an estimated 84.3 million fishing trips and captured more than 440 million fish of which 187 million were estimated to have been retained (US Dep't of Commerce, 2002). • Only 12% of the entire population have never participated in recreational angling (US Dep't of Commerce, 2002).
Canada	• 3.6 million anglers spent 47.9 million days and caught over 232.8 million fishes while spending $US 6.7 billion of which $US 4.7billion was wholly attributed to the sport in 2000. Of these fishes some 84.6 million were retained (Dep't of Fisheries and Oceans, 2003)
Australia	• In 2002 an estimated 3.4 million anglers contributed to 20.6 million angler days and caught in excess of 70 million finfish, while spending in excess of $US 1.3 billion (DAFF, 2003)
Global	• In 1995 it was estimated that total recreational catch worldwide is of the order of 2 million tonnes, and represents an important source of animal protein in many developing countries (Coates, 1995). • In 2004 it was estimated (using extrapolations from North American fisheries statistics) that total annual recreational catch worldwide may be in the order of 47 billion fish per year of which roughly 2/3rds are released (Cooke and Cowx, 2004) • It was estimated that freshwater recreational fishing effort represents roughly half of the food fishing effort from a global perspective relative to all fishing effort (e.g., marine recreational and commercial fishing effort.(Kapetsky, 2001).

Cooke and Cowx conclude that efforts to conserve and manage fisheries must recognise that issues and threats from commercial and recreational fishing are similar and therefore require management strategies and solutions that are similar and effective.

As a comparison, in 2006 (NOAA, 2008), the U.S. **commercial** fishing industry (comprising harvesters, seafood processors and traders, wholesalers and retailers) generated US$103 billion in sales, US$44 billion in income and supported 1.5 million jobs, while the U.S. **recreational** fishing industry generated US$82 billion in sales, US$24 billion in income, and supported 534,000 jobs. In 2007 there were approximately 12 million recreational anglers in the US. Of the 468 million fish caught by marine anglers in that year, 58% were released alive.

NOAA (US National Ocean and Atmospheric Administration) and its regional fishery management councils, interstate fisheries commissions, state agencies, and other partners are working together to revamp saltwater angler surveys and create a national angler registry. Under a new Marine Recreational Information Program it aims to improve the collection, analysis, and application of fishing data, provide a more informed basis for sustainable fishery management, and give anglers better representation in the decision-making process.

Resource sharing issues between users are significant current issues for stakeholders. NOAA is currently developing its policy in this area, under the heading of "catch shares".

It is clear that recreational fishers have significant impacts on the stocks of many aquatic species (especially fin fish). The sustainable management of global and Australian fisheries will not be either achievable, or credible, unless assessments of biological sustainability incorporate detailed effort and mortality data from both commercial and recreational users.

Artisanal and Subsistence Fishers

Eighty-six percent of the world's fishers (all types) and fish farmers live in Asia, with China having the greatest numbers (8.1 million fishers and 4.5 million fish farmers). In 2006, other countries with high populations of fishers and fish farmers were India, Indonesia, the Philippines and Viet Nam.

Many small-scale fisheries are typically of traditional or artisanal (small scale commercial or subsistence fishing practices) nature. In a traditional fishery the fishing activities have been passed on from generation to generation and fishing is carried out for livelihood and food security purposes. Subsistence fishers catch fish for food on the family or community table and also engage in trade or barter. However, the term subsistence implies that the fishers are not engaged in the money economy.

The social and cultural roles, and economic contributions of artisanal and subsistence fishing are increasingly relevant to the sustainability of regional ecosystems, and to the acceptability (to western consumers) of marine products traded from these ecosystems. Internationally there is a growing body of literature (Venn & Quiggin, 2007) attempting to assess the method and worth of valuations of indigenous cultural heritage (particularly use values) for resource evaluation. Traditional economic approaches have significant shortcomings in ascribing robust assessment methodologies and appropriate values to establish economic and non social benefits.

Ocean Health

As a small but advanced player in the global fishing industry, Australia actively seeks out and imports many of its management approaches, sciences, technologies and policy initiatives from large intensive fisheries serving seafood markets in the northern hemisphere, including Europe, the USA, Canada and Japan. In this context the following sections discuss some significant contemporary issues relevant to planning and investment in Australian fisheries RD&E.

EU Fishing Policy

The EU's Common Fisheries Policy (CFP) was announced in 2002 to establish a basis for radical change in the European fisheries sector. The major problems identified then still exist today, and include (EU Green Paper, 2009):

- Plummeting fish stocks and overfishing in 88% of fisheries. Over a third of fisheries are still outside safe biological limits and may not be recoverable to maximum sustainable yields MSY
- Fleet overcapacity. This is the fundamental problem at the heart of low economic performance, weak enforcement and overexploited resources.
- Heavy subsidies by many European Union member countries,
- Low economic resilience across fishers and their downstream partners. Most EU fishing fleets are making very low profits, or a loss, causing an added incentive to overfish.
- Decline in the volume of fish caught by European fishermen. Catches have fallen so much that Europe now imports two-thirds (and rising) of its fish consumption.

The CFP reforms since 2002 have achieved two positive outcomes: they have given fishery stakeholders more influence over policy-making through co-management, and many fisheries are now managed through comprehensive long term plans (not just annually as before).

In 2009, the EU determined that its failure to make greater progress was due to 5 structural failures of policy:

- a deep-rooted problem of fleet overcapacity;
- imprecise policy objectives resulting in insufficient guidance for decisions and implementation;
- a decision-making system that encourages a short-term focus;
- a framework that does not give sufficient responsibility to the industry; and a
- lack of political will to ensure compliance and poor compliance by the industry.

The Commission's current round of industry consultation and discussion intends to drive further analysis and shared planning for the next round of reform in European fisheries

Vision for European Fisheries by 2020

Fish is a growing market again and has re-established itself as a regular fixture in the diet of the more than half a billion European consumers. The continuous decline of catches by the European fleet came to an end around 2015. Fish caught or produced in Europe is valued and recognised by consumers as high-quality produce.

Rampant overfishing, with a large impact on coastal economies, has become a thing of the past. Nearly all of Europe's fish stocks have been restored to their maximum sustainable yields, for many a significant increase on 2010 levels. Fishermen earn more from these larger fish populations composed of mature and bigger fish. Young people from coastal communities once again consider fishing as an attractive and stable means to make a living.

Europe's fishing industry has become far more financially robust. The industrial segment of the fleet is efficient and independent from public financial support. It operates with environmentally friendly boats and its size is commensurate with the fish it is authorised to catch. At the other end of the spectrum, small-scale fisheries continue to produce high quality fresh fish consumed locally and marketed under labels of quality and origin that give higher value to fishermen. The ever increasing proportion of Europeans living along the continent's coasts represents a growing demand for high-quality, locally produced food. Their work has also become much more integrated with other economic sectors which are key to coastal communities. Throughout the sector, the production and marketing chain offers full transparency to authorities and consumers on the origin of raw materials "from net to plate." Europe's aquaculture industry is also an important provider of fish to European consumers: it remains at the forefront of technological development and continues to export know-how and technology outside Europe.

The EU Common Fisheries Policy has become streamlined and is now considerably cheaper and simpler to manage. Decision-making is now undertaken with the closer involvement of fishers. Fishing operators are given incentives to behave responsibly but they are also expected to demonstrate that they comply with the basic principles of the CFP. Stakeholders fully participate in decisions and debates on policy implementation. Fisheries control has become far more effective with a focus on shared investment and good maritime governance.

Paraphrased from Green Paper-Reform of the Common Fisheries Policy 2009

Codes of Conduct

In 1996 a voluntary Code of Conduct for Responsible Fishing was developed by the United Nations. A recent review published in Nature, (Not Honouring the Code, Feb 2009) across the 53 countries landing 96 percent of the global marine catch reveals "dismayingly poor compliance". Australia, ranked fourth, is one of only six countries (with in descending order Norway, USA, Canada, Iceland, Namibia) to achieve overall compliance scores at or above 60 percent. On a brighter note however, the paper concludes attitudes have changed since the 1990s and there is now widespread consensus on the negative ecological impacts of overfishing, and the need to minimise the impacts of overfishing and IUU fishing on the marine ecosystem.

Stewardship

Concern among advanced nations regarding the health of global oceans and fisheries has been rising since the early 1990s. As these concerns have gathered momentum, a number of private organisations and NGOs (Non Government Organisations) have established themselves as arbiters of sustainable fisheries. Sustainability assessment methodologies used by these groups are wide ranging, varying in quality with respect to regional variations, maintenance of the data in response to new information, interpretation, and use and presentation of output.

FAO Members have established Guidelines for Eco-labeling of Capture Marine Fisheries, and new certification guidelines for aquaculture, as well as ongoing work on inland capture fisheries. (FAO Guidelines)

A number of NGOs have formed or mustered resources to raise awareness about marine stewardship, to achieve various political outcomes, or to create and promote related services for sale (Greenpeace.org). As part of the "chain of custody" approach to ensuring producers' environmental commitment to consumers, certification of production or supply chains is a common approach to offering a range of services. There are many global and regional organisations in this category, but three relevant to Australia include:

- **Friend of the Sea (FOTS)** aims to encourage and motivate seafood companies to lower their impact on the environment, and on exploited or endangered stocks. This global organisation was established in 2006 and developed the only certification scheme in the world that certifies both farmed and wild caught seafood companies as ecologically sound. Friend of the Sea Certification is the only one in the market which follows the FAO - Guidelines for the Ecolabelling of Fish and Fishery Products from Marine Capture Fisheries. The firm has an advisory board composed of five environmental and seafood experts from Europe, the USA and Canada. FOTS standards are developed and reviewed by the Technical Board (26 members) with representatives from industry, environmental groups and scientific community. An Australian mussel aquaculture firm (Spring Bay Seafoods, Tasmania (Spring Bay Seafoods, 2009)) was the recipient of the FOTS Aquaculture 2009 Award.
- **Marine Stewardship Council (MSC)** is the world's leading certification and ecolabelling program for sustainable seafood. The Council certifies wild capture fisheries as sustainable, environmentally responsible and well managed, based on scientific methodology and independent assessment. Certified fisheries may carry an MSC eco-label through to their end consumer. WAL-MART, the biggest US retailer, announced that it will source all its wild harvest and frozen seafood from MSC certified sustainable suppliers within five years (FRDC R&D News, 2008). Australian examples of the 33 fisheries MSC certified (MSC, 2000) include the Western Rocklobster fishery (since 2000), the Australia mackerel icefish fishery at Heard and McDonald Islands (2006), and the Lakes and Coorong fishery (2008).
- There are also many examples of fishery specific programs. In 2004 the Australian Southern Rocklobster fishery established a separate Clean Green Program certified across South Australian, Victorian and Tasmanian waters. The program (Southern Rocklobster Ltd, 2004) incorporating 400 fishers and 250 vessels (50% of the fishery), is a world first rocklobster supply chain strategy. It certifies for environmental management, food safety and quality, work place safety and animal welfare. (Southern Rocklobster Ltd, 2004)

US Leadership

This stewardship approach has been recently taken up by the US Government, although with a far more comprehensive array of issues than that evident elsewhere. On 12th June 2009, President Obama initiated an interagency task force (US Interagency Ocean Policy Task Force, Sept 2009) to develop a policy and implementation framework to improve stewardship of the USA's oceans, coasts and lakes. The cross agency task force consulted Federal, State, tribal, and regional representatives, scientists, legal and policy experts, and the public. Several key themes emerged, including:

- Adoption of ecosystem-based management as a guiding principle, acknowledging regional differences, and practicing adaptive management;
- Embracing science-based decision-making and investing in ecosystem-based science, research, and ocean observations, including comprehensive research on the linkages among ecosystem health, human health, economic opportunity, national and homeland security, social justice, and environmental change, including climate change;
- Improved coordination and collaboration across Federal, State, tribal, and local governments, and regional governance structures, and for improved transparency and public participation, while avoiding new layers of bureaucracy and unnecessary costs;
- Improving both formal and informal education about the ocean, our coasts, and the Great Lakes;
- Ensuring that policies are adequately funded; and
- Joining the 1982 United Nations Convention on the Law of the Sea (the Law of the Sea Convention).

The responses to the Task Force suggested that any new policy needed to adopt a number of improvements to arrangements established in 2004. These improvements include:

- The need for a strong, clear, overarching policy mandate and the setting of national ocean priorities;
- The need for high-level direction and policy guidance from a clearly designated and identifiable authority;

- The need for more consistent and sustained senior-level participation and attention on ocean-related issues from all member agencies and departments;
- The advantages of stronger linkages between management and science;
- The need for an improved, clear structure for ongoing and active engagement with State, tribal, and local authorities, and regional governance structures to address relevant issues; and
- The need for improved coordination with other national US Government agency policy committees

Rebuilding Fisheries

While efforts are underway to restore global marine ecosystems and rebuild fisheries, a recent comprehensive study in Science Journal (Rebuilding Global Fisheries, Jul 2009) warns that 63% of assessed fishery stocks worldwide still require rebuilding, and even lower exploitation rates are required to reverse collapse. Certification of sustainable fisheries is becoming more common, based on selected economic incentives that align management practices with resource conservation.

The study concludes that incentives must be sensitive to local conditions, and a combination of traditional approaches (catch quotas, community management) coupled with strategically placed fishing closures, ocean zoning and economic incentives should be considered. At the regional level, measures to repair fisheries results in loss of jobs, at least in the short term. In turn this may lead to strong resistance from fisheries-dependent communities through the political process.

At a global scale, the movement of fishing effort from the industrialised countries to the developing world has been accelerating since the 1960s. This displacement of effort to jurisdictions with weaker laws and less enforcement capacity often results in overuse and degradation of fishery resources in developing countries.

Human Wellbeing

Consumer Credence

Credence attributes are food attributes that cannot be readily observed by consumers but that may add value to the product: for example through increased healthiness, environmental sustainability or ethical production.

Product differentiation is a crucial element in premium markets. Credence attributes are increasingly being recognised as a component of differentiation. Consumers are paying more attention to the food they eat, the value they get from it, and what it does for them and for the world around them. Food attributes that offer value to the consumer through good health, environmental stewardship, and ethical treatment of people and animals are becoming more mainstream (Cuthbertson & Marks, 2008). Figure 9 illustrates these attributes.

Essentially, credence attributes work because they embody a value to the consumer that goes beyond satisfying hunger, allowing consumers to "vote" as shoppers at a time when they are feeling increasingly divorced from the food production system.

Seafood is unique among foods, being drawn traditionally from "raw and pure" nature. This realisation combined with increasing awareness of scientific findings is seeing it regarded as an important food. The concept of wellness or wellbeing applied here to seafood consumers applies

Developments in Credence Attributes

A 2007 Victorian Government Department of Primary Industries report, ***Beyond Credence? Emerging consumer trends in international markets,*** included this summary of current developments relating to credence attributes:

- "Health and wellness foods" will have a high to very high impact in the medium term, both through increased consumer demand and through public interest in company's responsibility towards promoting good health.
- Environmentally sustainable supply chains are growing in value and scope. This is driven by consumers' increasing environmental awareness and the changing environment where the operations of the food industry are coming under increased scrutiny.
- Ethical food production is also on the agenda for some consumers; where they see a problem so that they will buy a solution. This relates strongly to 'fair trade' and animal welfare issues.
- At the heart of these trends is the evolution of corporate social responsibility from a "fringe" activity to a core part of many large companies' strategies.
- Food safety was found to be a critical factor to control, rather than a trend, given that breaches or perceived breaches in food safety could have disastrous effects for companies.
- The extent to which producers can make substantiated and true claims about the attributes of their products is a key condition for the growth of the credence market.

equally to recreational fishers, who are "consumers" of recreation.

Companies with a desire to be seen as having high levels of corporate social responsibility are paying attention to this new consumer behaviour and progressively fine tuning the way food supply chains operate and serve. This is particularly apparent in relation to the healthiness of food, the sustainability of food production, in processing and transportation, and in the ethical treatment of supply chain participants.

The price of consumer aspirations of wellbeing is to put further pressure on marine catch and increase demand for aquacultured fish.

As part of the study above, market interview work undertaken across international markets (UK, Japan, USA, Australia, China, Canada, South Korea, Norway, and Vietnam) reveals a number of key findings, summarised in the figure. Consumers still believe taste and convenience are central to value in food, but the trend is for food convenience, and health/wellbeing to converge. Pre-cut salads, par-cooked vegetables and grains, and an explosion in convenient dairy products all signify this trend. With advanced economies typically exhibiting low population growth and an ageing demographic (e.g. Japan), the momentum for the convergence of convenience, health, longevity and lifestyle can be readily understood.

Figure 9. Consumer Trends for Food Credence

Certification and Food Safety

In 2007, delegates to the World Seafood Conference (Valdimarsson, 2007) discussed international seafood safety and quality requirements, and how they have developed towards risk-based HACCP systems, with industry largely responsible for maintaining the systems under rules set by governments. There is a clear trend for the private sector (large retailers and their supply chains) to more strongly commit to environmental and social certification, and animal welfare in response to perceived consumer wants. In competitive retail markets this provides a valuable marketing edge to first movers. Many large retailers have now committed themselves to selling only eco-labeled fishery products. The FAO claims the pull of this trend, driven by private retail compliance systems, has become so strong, that it is not so much a question anymore of whether the industry will comply, but how.

Retailers and the corporate sector justify private standards and certification schemes by claiming governments have left a vacuum in responding to the new demands of consumers. Drawing on FAO comments, Figure 10 summarises these competing objectives.

Figure 10. Competing Seafood Compliance Objectives

	Objectives of Private Sector	Objectives of Government Sector
Marketing	Market advantage, profits, shareholder expectations, labels, safety, organic, environmental	Market rules, tariffs, antitrust, technical barriers to trade commitments, trade and environment, Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Convention on Biological Diversity (CBD)
Processing	Efficient processing, value addition – profits, "own checks", private standards, corporate social responsibility, social and environmental reporting	Safety rules, sanitary and phytosanitary framework, competent authorities, minimum criteria and standards, working conditions, worker safety
Capture Fisheries	Food production, efficiency, profits, maximum benefits within framework set by government	Sustainable use of resources, (TAC, IQs, ITQs), common good, equitable distribution of benefits, provision of food, provision of work and income, rural development

The FAO claims there is now ample evidence that the emergence of a wide range of certification schemes and accreditation bodies has resulted in higher costs for producers and confusion among producers, retailers and consumers alike.

Retailers are undecided on whether voluntary ecolabelling should be a market responsibility, or regulated as a precompetitive issue by governments. After 10 years of work, FAO now has guidelines for ecolabelling but the very difficult task of establishing the minimum substantive requirements and criteria for such schemes has not been addressed.

A US-based study (IFIC Survey Sep 2007 FRDC) considered the impact of the media on US consumption of food. The study found a sagging consumer perception of the safety of food systems. While the overall confidence of consumers in the safety of the food system remained high at 69%, the number of "very confident" consumers decreased from 21% to 15% (2006 to 2007). Disease and contamination were the primary concern for 75% of consumers and country of origin concerns rose from 6% to 20% in the same period. Industry advice suggests the negative media concerns overseas are primarily based around contamination with pathogens and/or chemical residues (e.g. paralytic shellfish poisoning, or mercury in large pelagic fish), while concerns in Australia relate more to perceptions of polluted culture waters and antibiotics in Asian fish imports.

Human Health

Research worldwide is uncovering seafood's effect on human growth, health and development. The FAO's CALIPSO study (FAO Calipso, 2006) concluded:

> " ...the study results confirm the validity of the recommendations formulated by various national scientific bodies: that the general population should consume fish at least twice a week, including some oily fish, and that pregnant or breast feeding women should consume predator fish not more than once a week".

The Australian National Dietary Guidelines (National Health and Medical Research Council, May 2005), and US Health Department (US Dept of Health and Human Services, 2005) both recommend consumers eat two meals per week of fish or other seafood. Advice from the respective seafood industry authorities, Seafood Services Australia (SSA), and US Commerce Department's National Oceanic and Atmospheric Administration (NOAA) summarises the impacts of seafood on human health as follows:

- Seafood is a practical, cost-effective way of significantly improving the health of the average Australian.
- NOAA recommend eating a variety of fish and other seafood at least twice a week, and, ideally, four times a week or more.
- NOAA recommends portions of 200 to 250 grams rather than the standard portion of 150 grams, to achieve optimum nutrition. SSA recommends at least four meals per week of 200 to 250-gram portions of fish or other seafood. This is achievable, considering there are 21 meal opportunities every week. Eating fish or other seafood twice a week should be the minimum consumption level simply to avoid deficiencies in essential nutrients such as Omega-3 fat and iodine.
- Seafood is a high-quality protein source and relatively low in fat. Its protein comes at the cost of fewer calories than most other meats, and so is beneficial in weight-reduction diets in particular, something very relevant now that obesity levels are causing such concern to health authorities in Australia.
- Also, seafood is a prime source of essential nutrients, particularly Omega-3 oils, iodine and selenium, and is also rich in zinc, calcium and Vitamin B12.
- Research suggests that many Australians, particularly children, are deficient in iodine, and, in the case of zinc, the NHMRC itself has described it as 'borderline for adequacy in the community'. Seafood is an excellent source for both: all seafood in the case of iodine and oysters in particular for zinc.
- NHMRC has formally recommended specific intakes of the essential Omega-3 fatty acids (oils), which make up the largest component in fish oil. The levels required to avoid deficiencies in Omega-3s can be achieved by eating two or three meals of 200 to 250 grams each of most types of seafood each week.
- NHMRC's typical recommendation was to replace what it called 'nutrient-poor, energy-dense foods and drinks' -- in other words, foods low in nutrients but high in calories -- with vegetables, fruit, wholegrain cereals and lean protein like seafood.
- To optimise the disease-fighting benefits of Omega-3 oils, the NHMRC recommended average daily intakes of 610mg for men and 430mg for women, which are three to four times the minimum daily intakes recommended. That may seem like a lot to Australians at present but it is only half the average Omega-3 intake of the Japanese, and their high seafood consumption and consequent Omega-3 levels is attributed as the major reason for their comparatively low levels of heart problems.
- It means eating varieties of fish with higher-than-average oil content -- fish like swordfish, the mackerels, Australian sardines, Australian herrings, mullet, tailor and Atlantic salmon -- and probably eating seafood four times or more a week. It can be included for lunch, even breakfast, as well as making up the centrepiece of evening meals. One simple thing to do, and this deserves to be emphasised, is to eat a wide variety of seafood and to eat it often.
- The SSA's advisor, Dr Somerset has been studying how Australian fish and other seafood fit into the context of the new NRVs. Specifically, he has prepared calculations for a range of popular fish and other seafood that estimate the amounts of each required to meet the nutrient reference values (NRVs) for a range of nutrients. It is intended as a guide upon which evidence-based communication about the health benefits of fish and other seafood can be derived. It is not intended to be a promotional vehicle in itself. "This analysis confirms that the NRVs for long-chain Omega-3 oils can be met by the consumption of many forms of seafood. Further, many seafood species can also be considered as rich sources of selenium, for example, and the NRVs for zinc and copper can be met by regular consumption of shellfish, like oysters, crabs, etcetera. "However, there are still many gaps in our knowledge of the

composition of seafood and this should be taken into account when referring to individual seafood species in relation to NRVs." he said.

SSA's advice had provided a number of conclusions:

- Fish and other seafood are clearly a viable source of dietary long chain Omega-3 oils,
- Australian consumers can meet the NRVs for long chain Omega-3 oils entirely from the consumption of certain species of fish and other seafood without the necessity of consuming either Omega-3 supplements or foods artificially fortified with Omega-3 oils,
- Feasible levels of consumption of fish and other seafood can meet the NRVs for certain other nutrients, such as selenium, zinc, copper, iodine and Vitamin B12,
- There are substantial gaps in species-specific information on the composition of fish and,
- Other seafood, especially in critical nutrients such as zinc, selenium, iodine and copper; and fish and other seafood are a major source of protein in the Australian diet.

SSA recommended that the seafood industry:

- Advocate the inclusion of identification of specific fish species in the next Australian National Nutrition Survey (which is currently under development by the Federal Government),
- Develop species-specific compositional information on fish and other seafood, especially for key nutrients such as zinc, selenium, iodine and copper,
- Consider a focus on fish and other seafood as an important iodine source in view of decreased consumption of iodised salt and progressively decreasing iodine content in dairy foods, and
- Recommend consumers eat a wide variety of fish and other seafood species.

The U.S. guidelines noted:

- By eating the right kinds of seafood, pregnant and nursing women pass to their baby important nutrients that aid in brain development and may lessen the effects of dyslexia, autism, hyperactivity and attention deficit disorder, according to scientists presenting at the conference.
- Studies also have presented a link between these nutrients and increased intelligence in infants and young children. Species that are rich in these nutrients – omega-3 fatty acids, iodine, iron and choline – include wild and farmed salmon, shrimp, pollock, cod, canned light tuna and catfish.
- Women will not put their baby at risk if they avoid eating shark, swordfish, tilefish, king mackerel, tuna steaks and whale meat until after they have delivered and stopped breast feeding, scientists said. Exposure to mercury found in those species during the sensitive stages of fetal brain development may cause neurological damage. As an extra precaution, women who plan to become pregnant should avoid those species for six months before conception. These are conservative guidelines, with a 10-fold safety margin built in for precaution.
- Scientists reiterated that there is no evidence of health risk to the rest of the population, including children and the elderly, from eating seafood. To the contrary, studies have shown seafood consumption to help people live longer, healthier lives. Seafood cuts the risk for heart disease, cancer, Alzheimer's, stroke, diabetes, and inflammatory diseases such as rheumatoid arthritis.

Technologies

There are many areas of innovation and research being explored, and or developed, in the global fishing, aquaculture and seafood industries and related value chains. The profit motivator means the private commercial fishing sector is a major investor in its own productivity and sustainability. However, public sector agencies, NGOs and philanthropists are also major investors in new technologies that support the environmental and social performance of all fisheries. Many technologies developed in other industries also have ready application to the fishing, aquaculture and seafood sectors (e.g. cool chain and logistics management software).

The primary research areas and technologies of interest to the Australian industry are:

- Biosecurity, pest and disease mitigation, and aquatic animal health management,

- Spatial and temporal management of target species for sustainability, yield and quality,
- Climate change impacts on fisheries and aquaculture,
- Cage and offshore marine ranching and enabling community endorsement for site access,
- Breeding programs for aquaculture,
- Nutrition and feeds for aquaculture,
- Systems, technologies and practices to improve pre-harvest productivity and viability,
- Seafood impacts on human health,
- Human capacity development to enable sustainable environmental and market outcomes,
- Systems, technologies and practices to improve postharvest productivity and viability through improving consumer access to seafood; meeting consumer demands for safe, high-quality, nutritious seafood products; and increased profitability throughout the value chain,
- Community benefits from and interactions with fisheries, aquaculture and aquatic resources.

Cage Aquaculture

As oceans cover 71% of the earth's surface the opportunities for aquatic cage culture to provide fish for the world's growing population are enormous. To date, commercial cage culture has been mainly restricted to the higher-value compound-feed-fed finfish marine species (salmon, Japanese amberjack, seabream, seabass, cobia, rainbow trout), and increasing volumes of freshwater fish species (carps, tilapia, catfish). (FAO, 2007).

There are around 80 fish species presently cultured in cages. Atlantic Salmon makes up 50% of all caged culture production: 90% is from the top 8 species; and 10 % from another 70 species.

Figure 11. Caged Aquaculture Production

Production 2005 tonnes	Marine and brackish water	Fresh water	Atlantic Salmon marine	Total Caged Aquaculture	% share of global cage production
China	287,301	704,254	-	991,555	29%
Norway	652,306	-	582,043	652,306	19%
Chile	588,060	-	374,387	588,060	17%
Japan	268,921	3,900	-	272,821	8%
UK	131,481	-	129,823	131,481	4%
Vietnam	-	126,000	-	126,000	4%
Canada	98,441	-	83,653	98,441	3%
Turkey	68,176	10,751	-	78,927	2%
Greece	76,212	-	6	76,212	2%
Indonesia	-	67,672	-	67,672	2%
Philippines	-	61,043	-	61,043	2%
Korea	31,895	-	-	31,895	1%
Denmark	31,192	-	18,980	31,192	1%
Australia	30,057	-	16,033	30,000	1%
Thailand	22,410	7,000	-	29,410	1%
Malaysia	22,000	6,204	-	28,204	1%
Ireland	14,000	-	13,764	14,000	0.4%
USA	15,000	-	9,401	15,000	0.4%
Iceland	15,000	-	6,488	15,000	0.4%
Russia	-	14,036	204	14,036	0.4%
Laos	-	9,900	-	9,900	0.3%

Over the last few years the global salmon aquaculture industry has reduced its focus on developing cage technologies, believing that there was rising community resistance to its wider scaled-up use. But as industry development has progressed (e.g. a collapse in the Chilean industry, intractable aquatic animal health issues, rising energy costs), the industry is now reconsidering cage

technologies. The primary risk for open ocean cage systems remains that complete loss of infrastructure in the event of severe weather.

A seminar supported by the United Nations explored the key issues (FAO, 2007) and challenges related to the use of an open net cage-based culture system and the consequent real and/or perceived impacts of such farming or ranching systems upon the surrounding aquatic and terrestrial environment and ecosystem. Risk factors identified include:

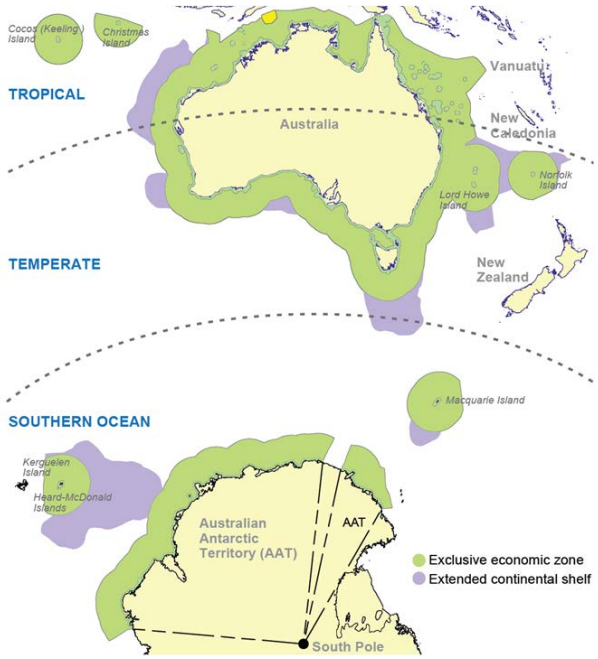
- nutrient loss from uneaten feed,
- faecal wastes and impacts upon water quality and surrounding aquatic environment and ecosystem health,
- risk and translocation of aquatic disease,
- dependence on feed inputs, including fishmeal, fish oil, and low-value "trash fish" species,
- dependence of some cage-farming systems upon the capture of wild caught seed,
- risk of fish escapes from cages and consequent potential impacts on wild fish populations,
- potential impacts of cage farming activities (negative and/or positive) upon other species, including predatory birds and mammals attracted to the fish within the cages,
- community concerns regarding the use of shared public inland and coastal water bodies for rearing fish within cage-based farming systems
- need for establishment and implementation of adequate government controls concerning the development of the sector, including planning and environmental monitoring, and implementation of good/better on-farm management practices,
- public concerns regarding the long term environmental and ecological sustainability of the intensive farming systems.

3. Australian Fisheries

Context

Australia is a maritime nation; over 90% of the population of 22 million lives within 120 km of the coast, and citizens have sovereign rights over the world's third largest fishing zone (13.6 million square kilometres). Marine, estuarine and terrestrial ecosystems provide habitat for a diverse range of species – about 4,500 finfish species, and perhaps tens of thousands of invertebrate species.

Figure 12. Australian Fishing Zone



Australian marine and terrestrial waters are nutrient poor by global standards, due to the dominance of the two southern polar flowing currents of warm tropical waters. Consequently our marine fisheries rank 60th in global tonnage terms (0.2% of tonnage landed), but are relatively high in value (2% of landed value). The low production capabilities of these marine fisheries offer little opportunity to increase tonnage However the extensive length of our coastline (25,760 klms, rank 7th) creates great diversity in habitat, and species, providing potential for selected aquaculture. This is particularly the case for molluscs and crustaceans, where Australian is established as a significant producer of wild catch species, including rocklobster, pearl oysters, abalone and prawns. Fish habitat on remote sovereign Australian islands (Macquarie, McDonald Heard, Norfolk, Cocos and Christmas) are variously impacted by these oceanic circulation patterns. Waters in north eastern Australia are dominated by the world's largest coral reef systems. Inland waters are diverse, ranging from temperate highland lakes in Tasmania to highly seasonal flood-event rivers in Tropical Australia.

Stakeholders

ABARE has identified that fishery users operate in excess of 15,000 commercial licences under regimes managed by all states and territories and the Commonwealth.

Fishing and aquaculture activity utilises 12 major methods of capture across the commercial wild catch, aquaculture, recreational, and indigenous customary sectors. These include finfish trawling/Danish seining, prawn and scallop trawl, scallop dredging, purse seining, net hauling, meshing, line fishing, trapping, potting, hand gathering, mixed methods and exploratory methods. Fishing methods are designed to target either single or multiple species. (FRDC Board, 2009).

Fishing and aquaculture activities provide direct employment for over 10,000 people directly and an estimated 90,000-110,000 additional people in directly in transport, storage, wholesaling and retailing (FRDC, 2005).

Efficient and sustainable fishery access, use and management is a complex activity. It follows that investing and managing fishery related research, development and extension should be no less a challenge. Figure 13 identifies the complex structure of the Australian fishing and seafood industries across all uses. The figure illustrates the interface between the fishers, their respective access arrangements to the marine and terrestrial resource, and the role of governments. Importantly the concept also captures the nature of specific social, cultural and business responsibilities and relationships stakeholders have with their local and regional communities, value adders and seafood consumers. The lifeblood of human innovation and new capital investment which is the basis for

research, development and extension will be most effective where it makes use of these relationships and structural linkages.

A review of any complex industry needs a sound and agreed starting point – a template to ground its facts and guide and inform more comprehensive analysis of its motivations and activities. Figure 13 builds on the discussion of Figure 1 to enable more detailed review of the Australian fishing and aquaculture industries, their stakeholders and business environment, and the advocates, implementers and beneficiaries of shared investments in RD&E.

The following brief summary relates to stakeholders and linkages illustrated in Figure 13.

Communities are groups of local and regional Australians who collectively own the national marine and terrestrial resource assets. They exercise authority over access and use of fishery resources through elected governments and jurisdictional resource managers. Communities typically have a very low awareness of the fishery resource, often only participating as seafood or aquatic product consumers, and their judgments are often partially or ill-informed by partisan opinions. Non Government Organisations (NGOs) often try to fill this lack of awareness through advocacy and issues management.

Consumers of seafood and unique aquatic products drive fishing and aquaculture, value adding supply chains and markets for Australian and imported products. They determine prices which prioritise the worth of product attributes they believe best meet their needs for convenience, nutrition, health, lifestyle outcomes, etc.

Fishers catch fish from the ocean, estuary, lake, dam or pond resource - as finfish, molluscs, or crustaceans- using lines, nets, spears, hands, etc. Entry to and beneficial use of the marine (wild catch and aquaculture) or terrestrial (fresh or saline water, or aquaculture) resource is limited (e.g. Total Allowable Catch, bag and size limits, spatial zoning) by Governments. Fishery Managers act within jurisdictional legislation established on behalf of communities to manage fishery stocks and resource health, and with allied agencies to monitor, conserve and optimise ecosystems. Commonwealth Fishery managers and related agencies manage multilateral relations that impact on fishery biosecurity, trade etc.

Fishing is an "extractive" activity as it takes from or reduces the immediate biomass of the resource; ecotourism is a non-extractive, passive activity.

Commercial fishers and aquaculturists are motivated by financial return and harvest or culture fish for landing, sale or export as fresh or processed seafood or aquatic products (e.g. pearls) to consumers. The commercial ***wild catch fishing sector***, and the ***aquaculture sector***, together with the downstream ***seafood sector***, supply edible and inedible aquatic products to consumers, in Australia and overseas. Recreational fishers seek both lifestyle and well-being outcomes - the enjoyment of the fishing experience, in a natural environment, for sport or food for personal consumption. An increasing percentage of the recreational catch is released alive thereby reducing fish mortality in the resource. Sale of recreational catch is illegal. Recreational fishing also incorporates charter fishing and tour guide services, and significantly contributes to media content (magazines, television programs, DVDs etc) related to active outdoor pursuits. Recreational fishers and their direct and indirect suppliers are referred to as the ***recreational fishing sector***. Customary fishers are indigenous people of Australia who fish for food and or for community or cultural reasons.

Figure 13. Australian Fishery Stakeholders, Structures and Linkages

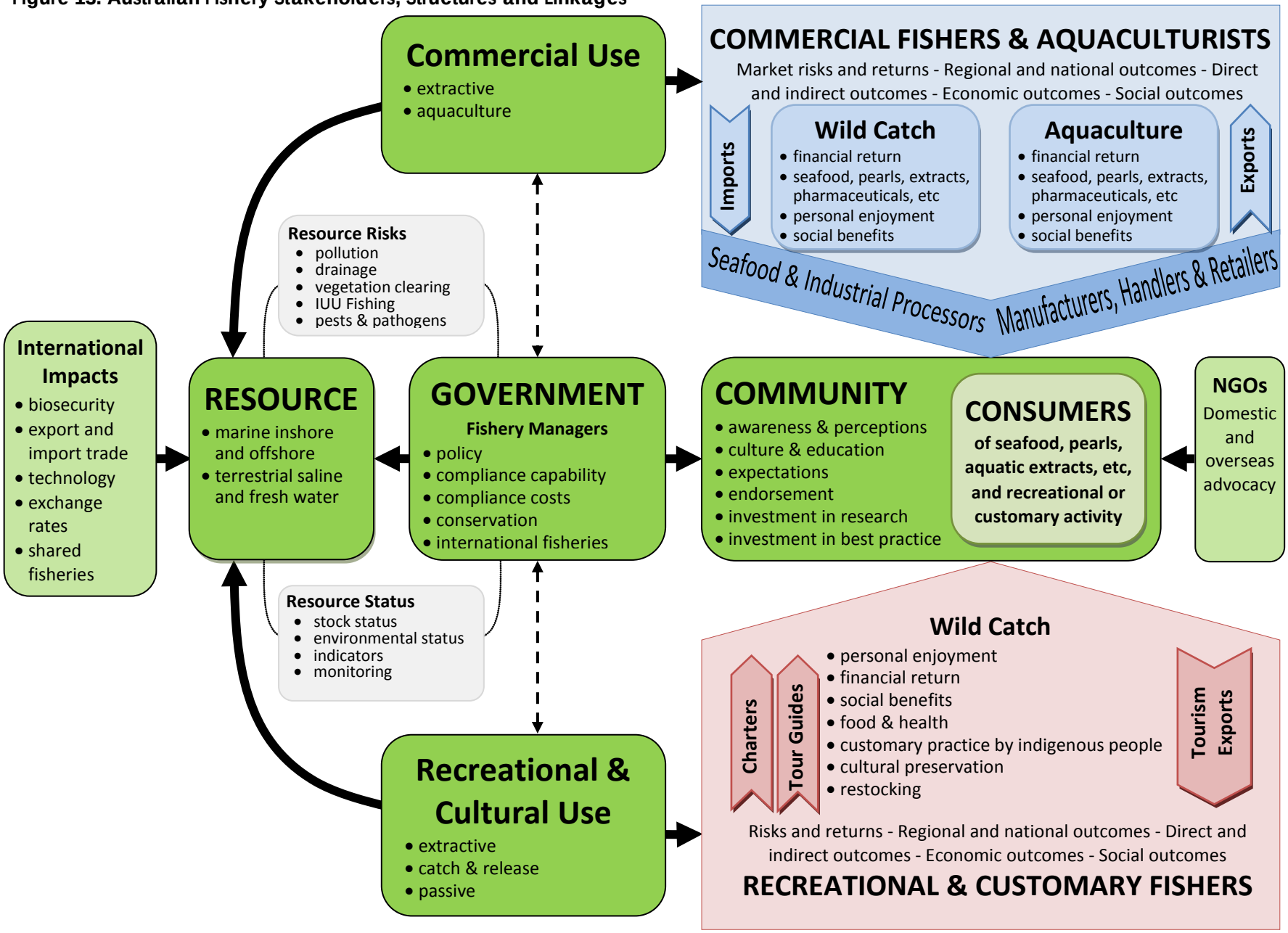


Figure 14. Australian Fishery Jurisdictions, Access, Species, Employment, and Use

Use	Jurisdiction	Access Arrangements	Key Species	Employed	Harvest t.
1. Commercial wildcatch	NSW	9 fisheries - 1,986 licences	prawns, sea mullet, rock lobster	1,106	14,565
	Vic	24 fisheries - 803 licences	abalone, rock lobster	514	6,390
	QLD	21 fisheries - 2,761 licences	prawns, coral trout, crabs	1,460	23,405
	WA	44 fisheries - 126 licences; 458 boats	rock lobster, prawns, scallops	1,152	28,288
	SA	13 fisheries - 761 licences	rock lobster, prawns, abalone	1,003	40,804
	Tas	11 fisheries - 934 licences	abalone, rock lobster, scallops	643	6,784
	NT	14 fisheries - 270 licences	snapper, crabs, barramundi	222	5,937
	C'wlth	23 fisheries - 371 vessels, 1,890 permits, 152 Boat SFRs	prawns, tuna, sharks	7	[1]52,227
	Total	**159 fisheries**		**6,108**	**178,399**
2. Aquaculture	NSW	609 licences	oysters, silver perch, yabbies	709	5,229
	Vic	167 licences	trout, abalone, mussels, Murray cod	280	1,927
	QLD	695 development approvals	prawns, barramundi	551	5,674
	WA	na	pearls, mussels, barramundi	325	1,013
	SA	1,185 licences	southern bluefin tuna, oysters, abalone, yellow tail kingfish, mulloway	766	20,984
	Tas	225 licenses	salmonids, abalone, oysters	935	27,676
	NT	18 licences, 45 endorsements	prawns, barramundi, pearls	62	na
	C'wlth	nil	nil	nil	nil
	Total			**3,628**	**62,503**
3. Recreational	NSW	All fishers licensed. Size/bag/gear limits apply + closures. Charters licensed + records.	flathead, bream, whiting, tailor	na	15,190
	Vic	All fishers to hold an all-state-waters license – some exemptions. Size/catch limits apply + closures.	flathead, KG-whiting, A-salmon	na	11,812
	QLD	License not required. Charters licensed + records. Size/bag/gear limits apply + closures.	whiting, bream, mullet, tailor	na	24,514
	WA	Licenses for abalone, rock lobster, marron, net fishing, freshwater angling. Size/bag/gear limits apply + area/ seasonal closures. Aquatic tour/ charters licensed.	Aust. herring, whiting, tailor, bream	na	11,485
	SA	License not required. Charters licensed + records. Size/bag/gear limits + closures. RL pot licenses.	Aust. herring, KG whiting, garfish	na	8,123
	Tas	All fishers license for inland freshwater+ abalone, rock lobster and scallops. Gear limits + closures. Bag/size/possession limits + area restrictions in abalone, rock lobster, shellfish, scalefish.	flathead, A-salmon, rock lobster, trout	na	2,446
	NT	License only to enter aboriginal lands/waters. Fishing guides licensed+ logbooks. Possession limits.	Sea perch, snapper, mullet	na	1,885
	other			na	24
	Total				**75,481**
4. Customary	NSW	Subject to changes undertaken by state and territory jurisdictions	na	na	na
	Vic		na	na	na
	QLD		na	na	na
	WA		na	na	na
	SA		na	na	na
	Tas		na	na	na
	NT		na	na	na
	C'wlth		na	na	na
	Total		na	na	na
TOTAL					

Source: ABARE Fish Stats 2008, NRIFS p79, State Agency and DEWHA websites. na = advice or data not currently available.

[1] Includes 5,221 tonnes of southern bluefin tuna catch, used as input stock to aquaculture.

Industry Location

Fishing and aquaculture activities occur throughout the Australian Fishing Zone. While the more cost effective fishing is usually near ports and / or urban centres, the catch for effort metrics of maximum economic yield and the desire for enhanced recreational experiences mean looking further afield. Open ocean marine activities are largely concentrated at or near favourable bathymetry adjacent to the edge of the Australian continental shelf or islands. For recreational and customary fishers, estuaries and coral or rocky reefs offer attractive returns for effort, where access is not restricted by marine exclusion zones. Both marine and land based aquaculture sites must firstly meet stringent environmental impact assessments, before the tradeoffs between site and water access, production costs, and logistic and market costs are firmed up.

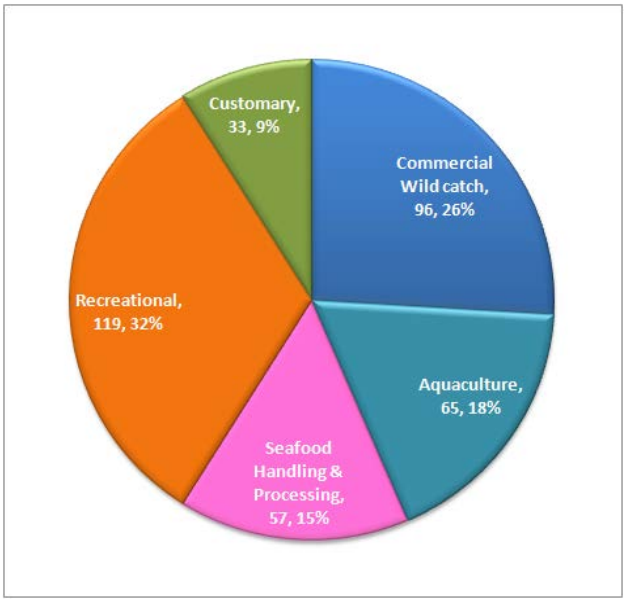
These and other drivers have been at work for decades framing the fishing and aquaculture map of Australia. Based on advice from state and territory agencies, and industry, the spatial scale and scope of the fishing and seafood industries is summarised as follows:

Figure 15. Major Fishing and Seafood Industry Centres

	QLD	NSW	Vic	Tas	SA	WA	NT	ACT	Total
1. Major Marine Commercial Wildcatch Centre	12	7	3	12	3	9	15	0	61
2. Minor Marine Commercial Wildcatch Centre	13	3	5	5	5	10	8	0	49
3. Freshwater Commercial Wildcatch Centre	0	0	0	1	0	0	4	0	5
4. Marine Aquaculture Centre	13	8	4	12	14	5	6	0	62
5. Freshwater Aquaculture Centre	4	0	0	0	3	2	3	0	12
6. Seafood Handing & Processing Centre	9	6	5	13	9	9	1	0	52
7. Seafood Market	3	1	1	1	2	2	1	0	11
8. Major Marine Recreational Centre	10	10	3	2	8	10	17	0	60
9. Minor Marine Recreational Centre	7	5	5	15	6	9	10	1	58
10. Freshwater Recreational Centre	21	1	0	1	2	4	1	0	30
11. Customary Fishing Centre	6	0	2	17	0	2	10	0	37
12. R,D&E Centre	5	5	2	2	3	1	1	0	19

Source: Ridge Partners analysis based on advice from State and Territory agencies, and industry. Note that the distinction between "Major" and "Minor" centres is subjective and based on advice by agency or industry contributors. The basis for their decision is relative importance (based on a triple bottom line) of each centre to that jurisdiction. As result there will be minor misalignment between jurisdictions. More detailed analysis in future should use a quantitative basis (eg catch tonnes) to guide these decisions.

Figure 16. Centres by Sector



A "centre" is a location (port, town, river, water body, locale) where fishing or seafood activity, including retail sales, are undertaken. There are round 170 individual centres identified by industry at October 2009. The classification of centres as major and minor is determined by the relevant constituency, based on a range of relevant local and regional criteria, not just tonnage of catch or number of fishers. Care needs to be taken therefore in comparing data across jurisdictions. For example, almost the whole coastline of the NT is used by customary and or indigenous fishers for a range of activities. However only the major community locations, rivers or townships are recorded here.

Figure 16 identifies the number of industry centres by sector and the percentage share of each. As many centres serve multiple sectors the sum of centres is greater than the 170 specific locations identified.

This data is translated through geocoding into spatial data for the centres mapped on the following pages. Additional data drawn from other sources (ABARE, BRSD, FRDC) is added to these maps.

The location of Australian fishery and seafood activity is increasingly about the efficiency of demand chains for seafood and leisure. But the social and cultural history of the industry aids our understanding of what we are managing and how we might optimise tomorrow's chains. Importantly, understanding the regional and local communities across the industry is a prerequisite to achieving better outcomes of the collective investment in R,D&E.

Australians have been using the aquatic environment for millennia. Many 21st Century Australian communities comprise indigenous people whose cultures arose from use of the aquatic environment. Many others are the children of immigrants over the last two centuries who proudly bring to their new home their established fishing and seafood cultures from Europe, Asia and the Pacific.

Australians are increasingly realising the economic and social benefits of the fishing industry, especially to regional populations. In the relatively short history of modern fisheries, the community's motivation for access to fishing has progressed from the search for food, to include the economic gain from sale of seafood and aquatic products, and more recently to embrace the opportunity for hunting and recreation as rising living standards have created increased leisure time.

Fishing is a significant industry in many coastal communities, providing direct jobs in harvest and processing, and indirect jobs in service (e.g. insurance) and input (e.g. vessel maintenance) sectors. Data collated for South Australian commercial wild capture fisheries confirms that over the last 11 years to 2007-08 (Econsearch, 2009):

- The average aggregate value of direct (fishing + processing, transport, retail, food services and capital expenditure) and indirect (effects in other sectors of the economy (trade, manufacturing, etc) outputs from the states wild commercial fisheries has been 2.3 times the value of direct outputs from fishing. The annual multiplier has ranged from 2.0 to 2.7 times. Output is a measure of the gross revenue of goods and services produced by commercial organisations plus gross expenditure by government agencies.
- For every direct job created in the State economy, fishing and seafood industry (fishing plus processing, transport, retail, food services and capital expenditure), an additional 0.81 full time jobs (on average) is created indirectly in other sectors of the economy. The annual multiplier ranges from 1.7 to 2.0.

Unfortunately, there is no other comparable data available for other wild catch fisheries.

In a coast-dwelling and sparsely populated nation, commercial wild-catch fishing activity is a major resource in many small communities. Such activity often involves several generations of family members; it fosters a unique blend of self-reliance and teamwork; it provides a core for related activities; and it engenders strong levels of "ownership" of the industry by the local community.

The extensive spatial scope of the industry evident on the maps below is matched by the diversity of people and interests in communities supporting the industry. Commercial fishing activities carry high cultural values that add to the richness and robustness of communities. People in the industry who support wild-catch and aquaculture activities — such as transporters, wholesalers, retailers (including restaurant operators), and suppliers of commercial and recreational gear — also add to the social fabric of Australian life (AFMA, 2005).

There are currently approximately 159 commercial wild catch marine or estuarine fisheries in Australia, managed variously by Commonwealth, state and territory jurisdictions. In addition there are recreational and customary wild catch fisheries, and aquaculture fisheries, which are variously defined and identified in agency literature. The marine resources are assets owned by all Australians, so the rights to access and harvest aquatic species from these resources are increasingly of interest to the broader community. Research, development and extension are critical strategic and tactical tools (and weapons) available to fishery stakeholders intending to sustain their resources, create economic wealth, and deliver social and cultural benefits to regional and local communities. Shared national research will provide the knowledge and insights to develop the regional science and local tools to manage these changes, as cost effectively as possible for all Australians.

Figure 17. Map of Commercial and Recreational Fishing by Jurisdiction

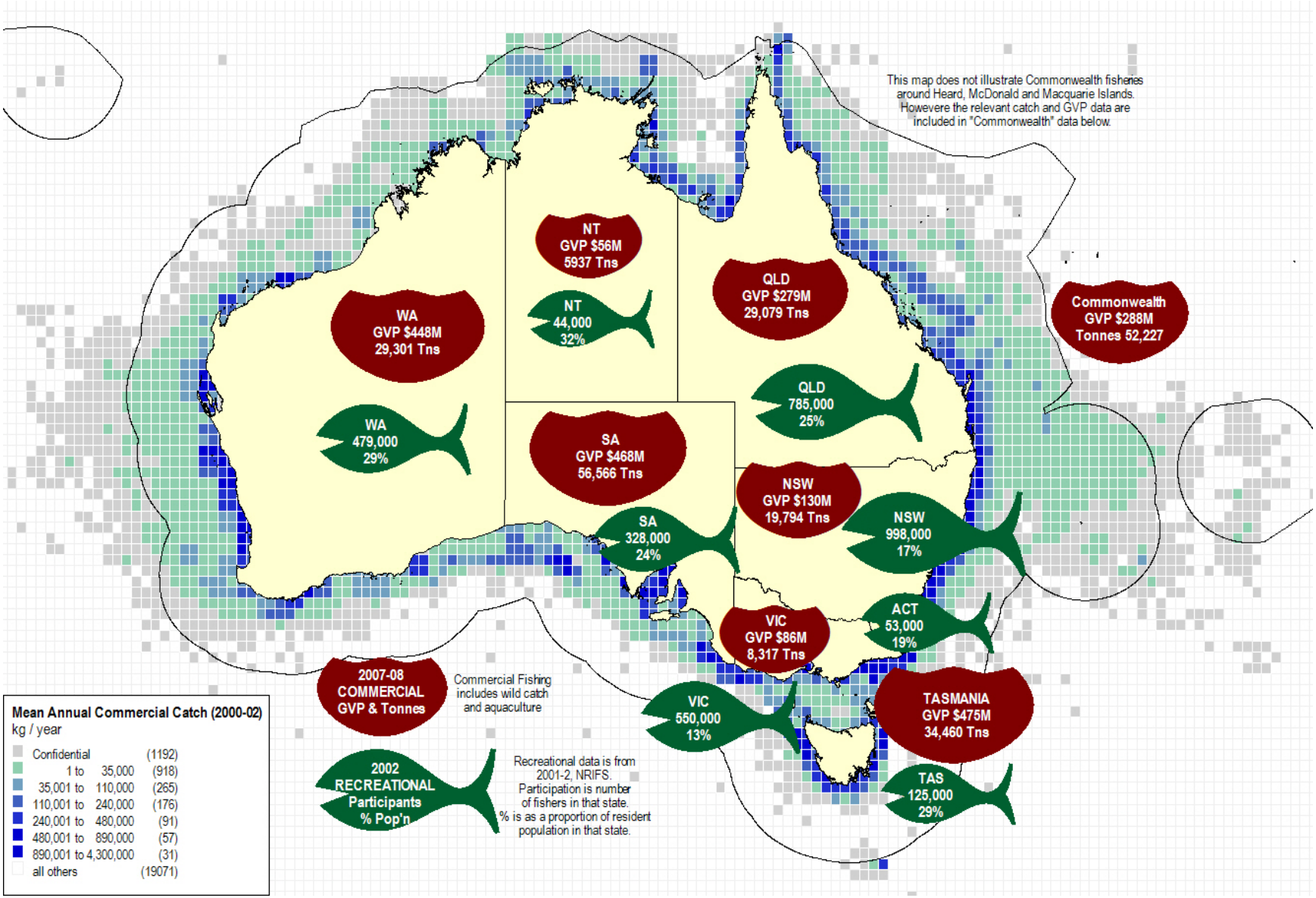


Figure 18. Map of Recreational Fishing

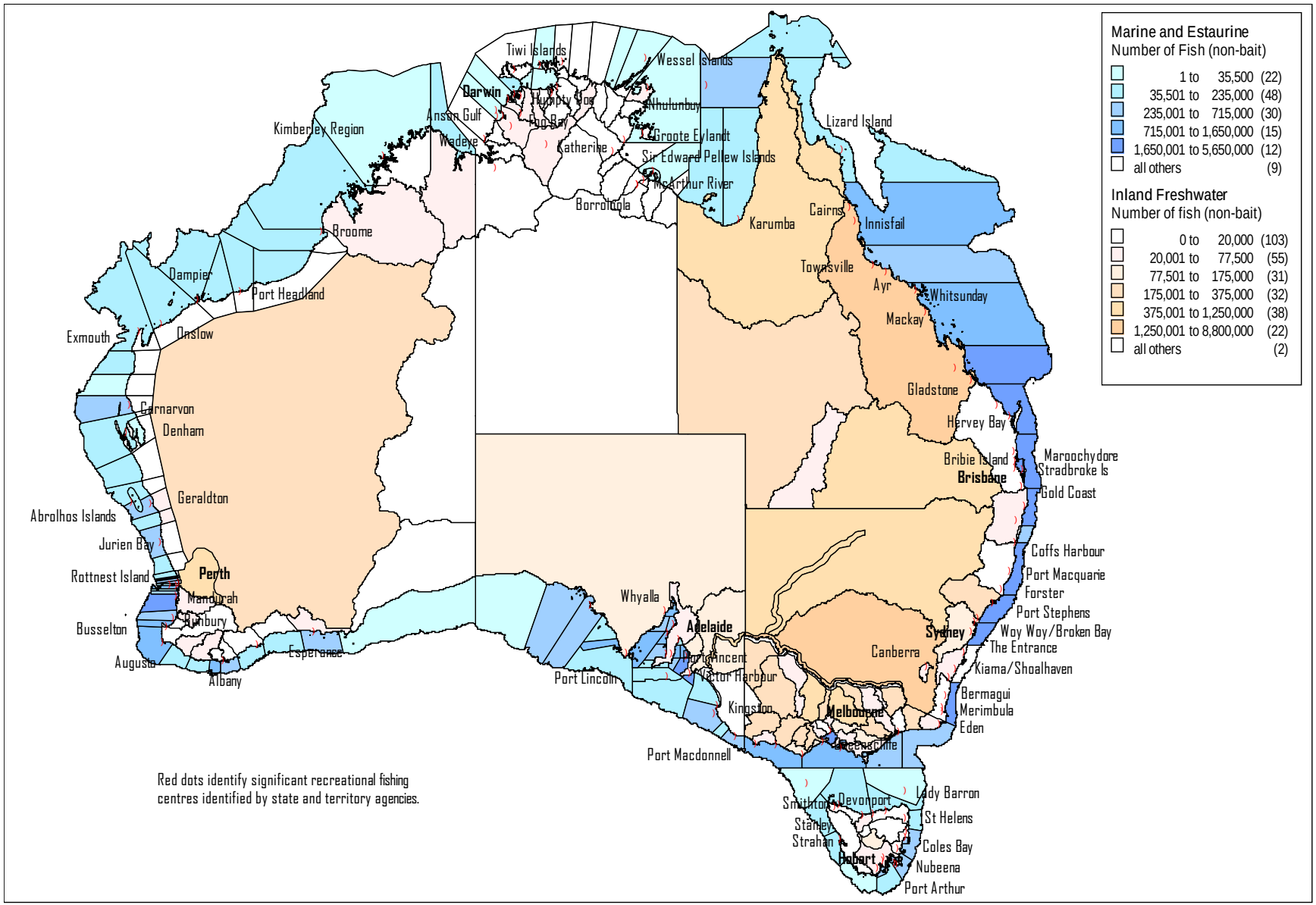
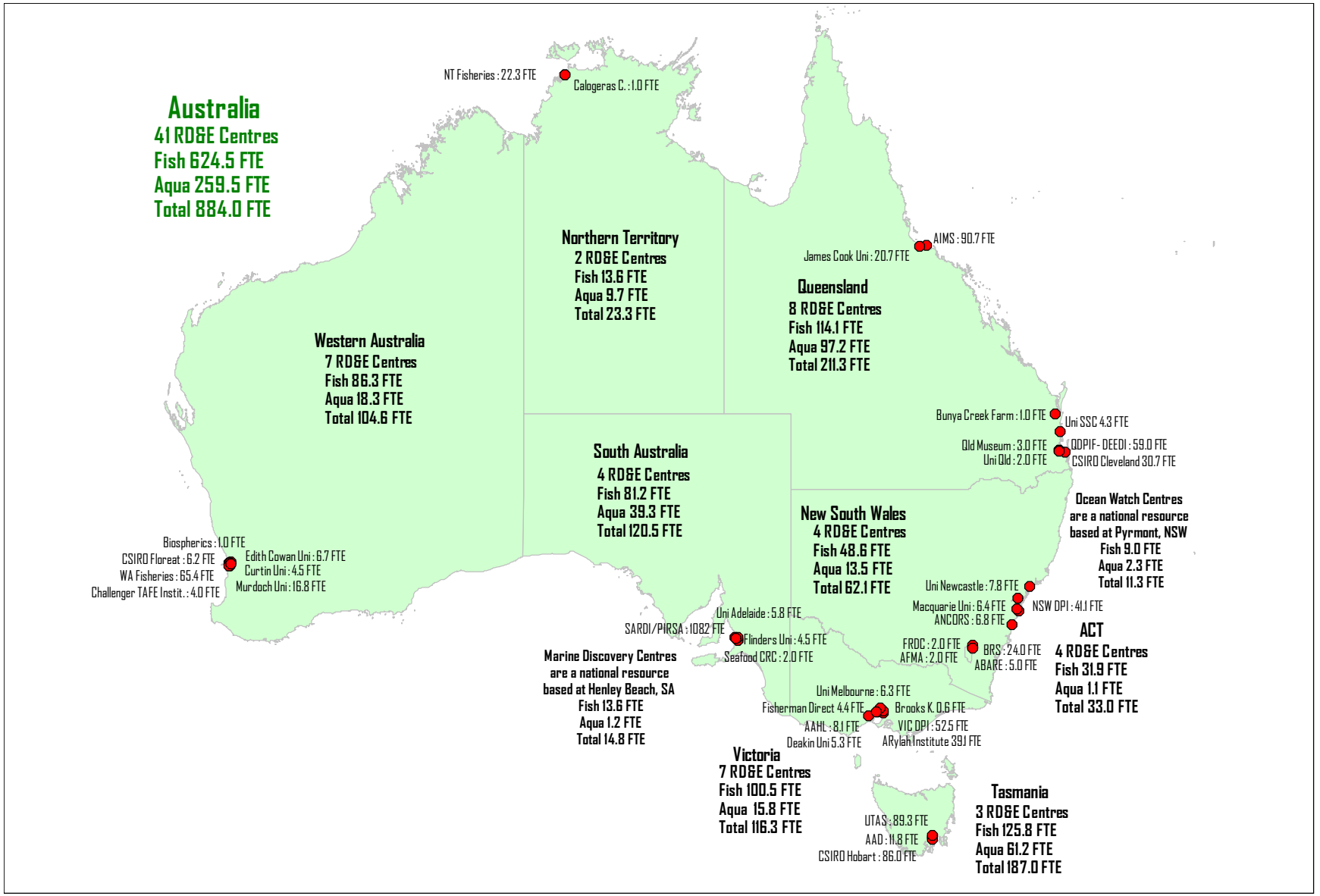


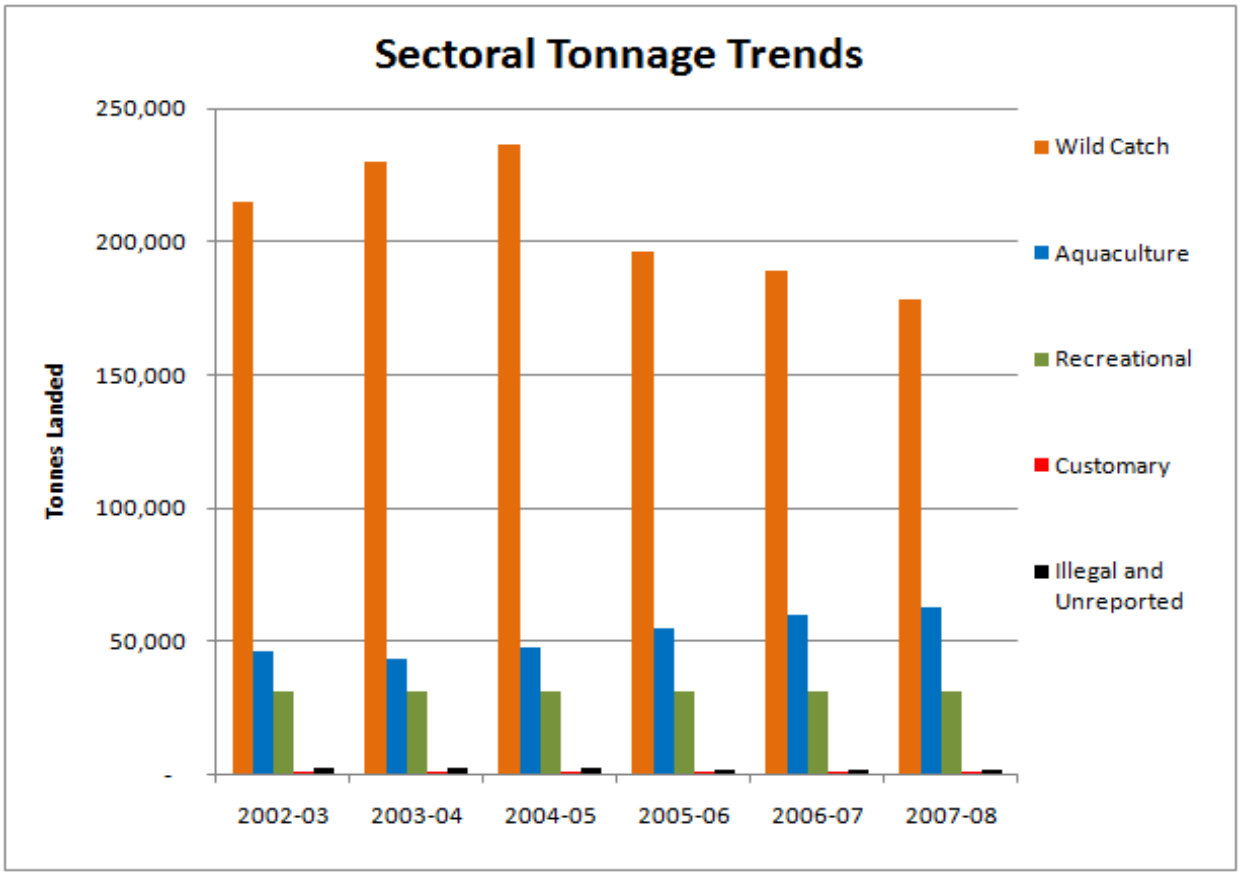
Figure 19. Map of R, D and E Centres and Capacities

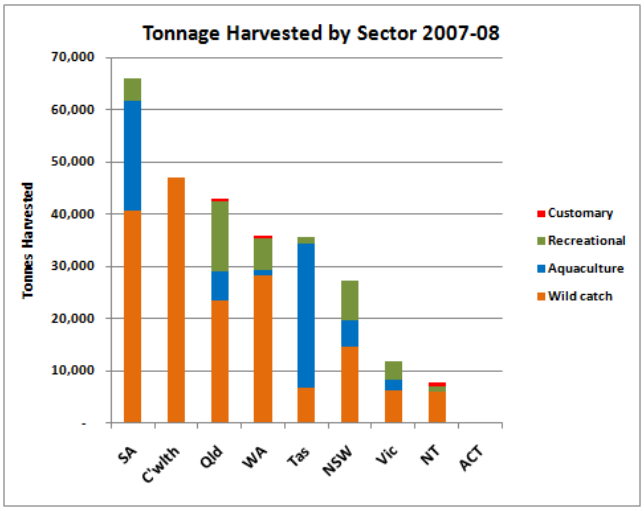


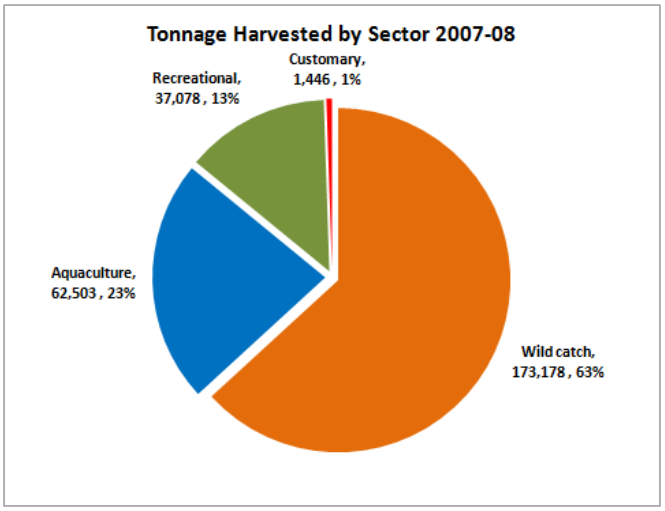
Relative Size of Fisheries Sector

The following charts, comprising Figure 20, illustrate relative catch mortality (tonnes harvested) by each industry sector (FRDC 2006/071.20, 2009). The data comprise actual tonnages drawn from ABARE Fish Stats 2009 for wild catch and aquaculture sectors, and Ridge Partners research team estimates of current mortality in the other sectors. The relative tonnages are: Wild Catch 173,178 tonnes (after 5,222 tonne adjustment for SB Tuna), Aquaculture 62,503 tonnes, Recreational 37,078 tonnes, and Customary 1,446 tonnes. The IUU(Illegal, Unrecorded and Unregulated) harvest is estimated to be 1,784 tonnes. Most fishery catch results in fish mortality. This is the central motivation of commercial, customary and illegal fishers. However in the recreational sector an increasing percentage of the overall catch is caught and released.

Figure 20. Sectoral Sizes by Tonnes Harvested

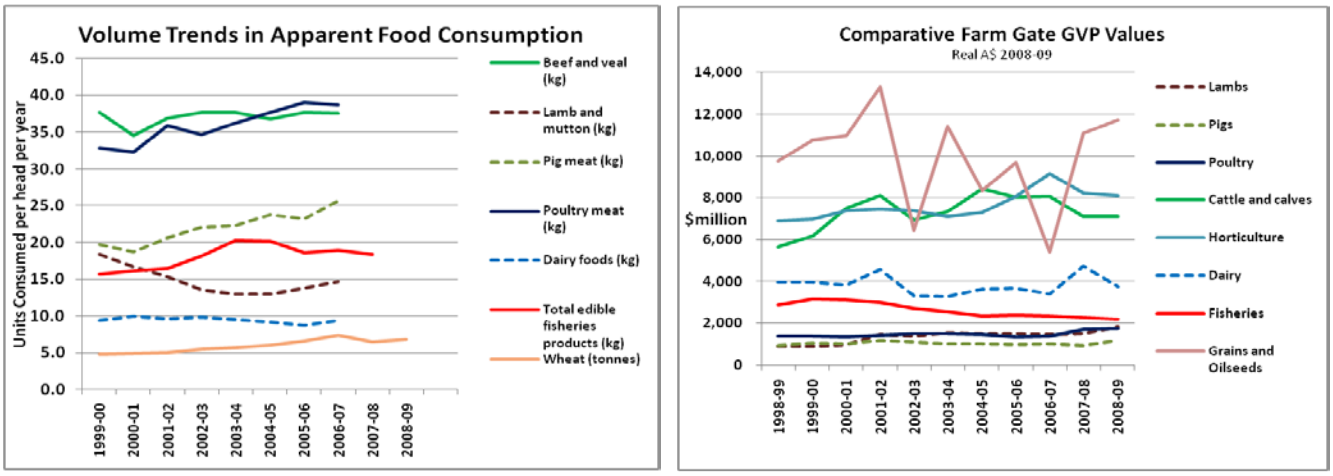






The commercial sector, incorporating wild catch fishing and aquaculture, is Australia's fifth largest food producing primary industry, ranked by farm gate/portside values. Data collated by ABARE confirms the recent decline in apparent per capita consumption of all edible seafood products. Following strong growth up to 2004, apparent seafood consumption has plateaued and fallen in the last 5 years. While these data are a little inflated as the weights are in whole weight terms (not processed food weight), the trend remains the same. This decreasing consumption trend in the last five years is not evident in other commodities.

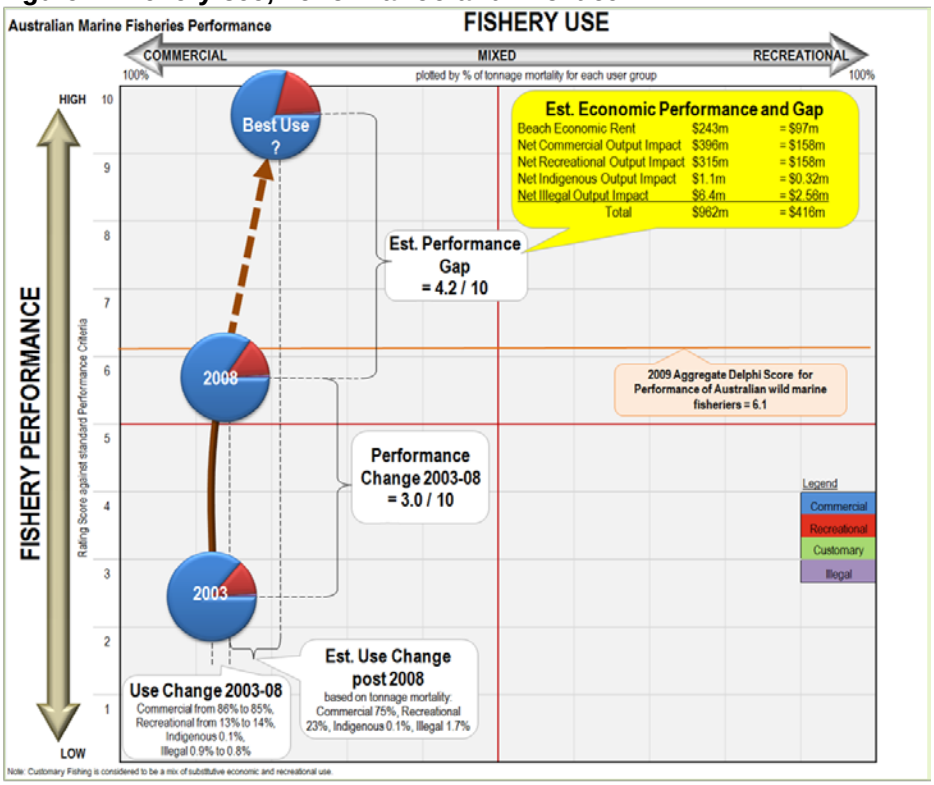
Figure 21. Comparative Food Consumption and Value Trends



The Gross Value of Production figures for eight Australian primary industries, including fisheries also confirm the decline in the long term real value of the commercial fishing industry. The trend in this decline has been occurring since the 1999-2000 year.

Performance and Use

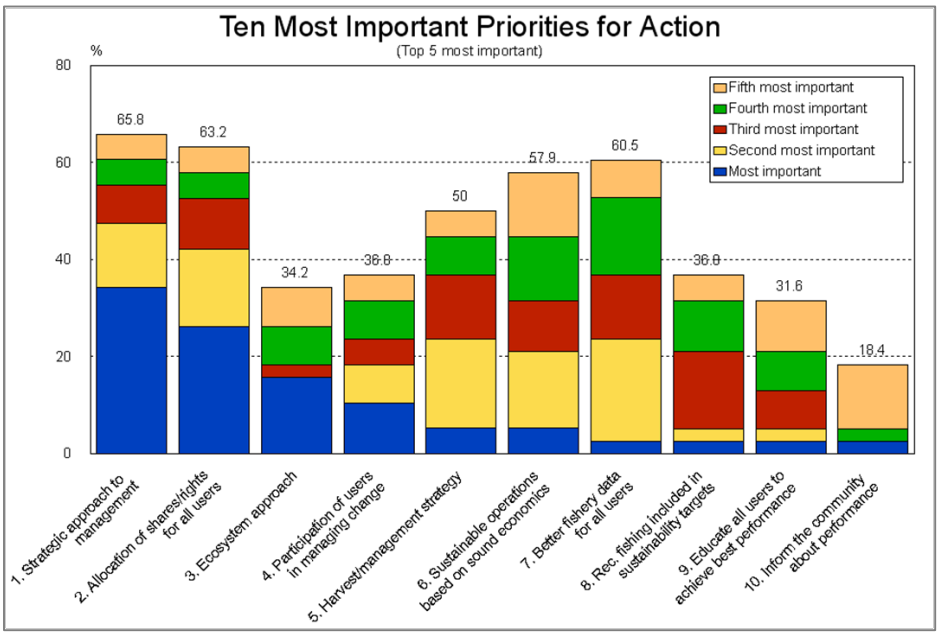
Figure 22 Fishery Use, Performance and Priorities



In 2008-09 the FRDC assessed the performance and use of Australian marine fisheries (FRDC 2006/071.20, 2009). Building on the concepts identified in the *Sunken Billions Report* the Work Group sought advice from a balanced stakeholder sample of more than fifty Australian and international stakeholders and experts regarding the use and performance of Australian fisheries. Quantitative estimates of the value of the underperformance gap (i.e. current performance versus best use and management) were prepared to inform responses. Experts believe, in 2008 Australian marine fisheries achieved a

performance score of 5.8/10 across 44 performance criteria. They estimate the comparable performance in 2003 was 2.8/10.

The study also found that the forgone value of direct and indirect economic benefits (i.e. the gap) from all fishery uses (commercial, recreational, indigenous, illegal) was in the order of $350 - $450 million per year – around $1 million per day.

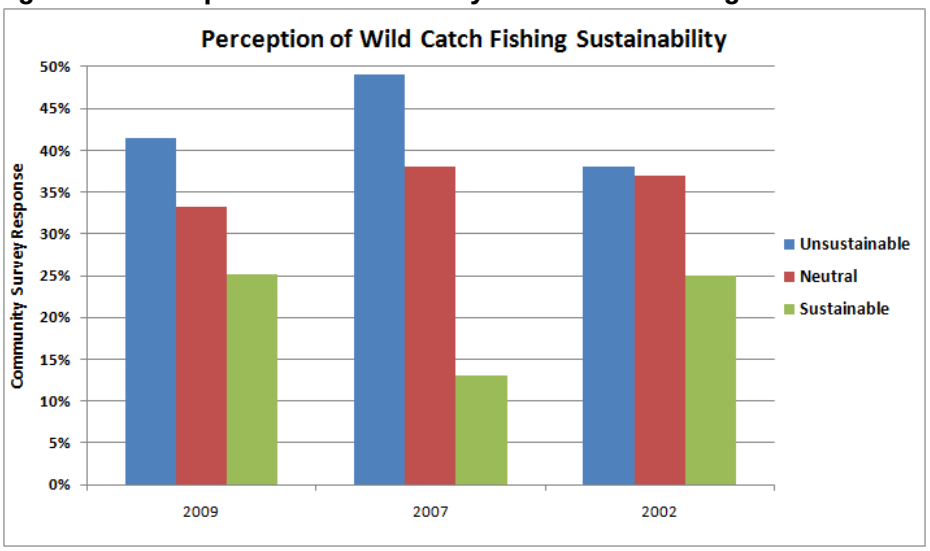


Experts also provided advice to the study regarding priority actions for closing the performance gap (i.e. to move toward a score of 10/10). Experts also made the critical point that the lost $1 million/day can be recovered by stakeholders without catching one more fish. Better performance comes from stronger strategy and collaboration. The key actions confirm the focus should be as much about how fishery users and stakeholders behave and work together, as it is on what they do individually.

Public Perceptions of Fishing

Research conducted for FRDC in 2007 found that just 13% of the public believe that **wild catch fishing** is sustainable in its current form. Apart from being a very low absolute figure, the number is only half the number of people who believed wild fisheries were sustainable in 2002.

Figure 23. Perceptions of sustainability of wildcatch fishing



However parallel research released in late 2009 (FRDC Perceptions Survey, 2009) suggests the Australian community has changed its view and now has an improving perception of the sustainability of wild catch fisheries. While of full third of responses are still neutral or undecided on the matter, the change has occurred as the marginal responses have move from unsustainable to sustainable. Females (43%) are slightly more likely than males (40%) to believe that wild catch fisheries are not sustainable.

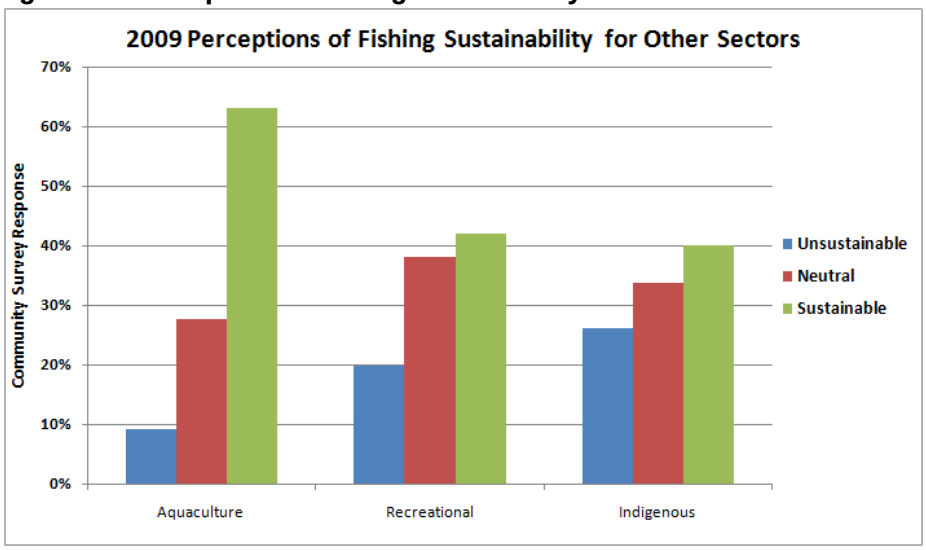
While the data suggest improving outcomes for wild fishers, there are still challenges and threats ahead. Comment from recreational fishery experts suggests the perceived non-sustainability of fisheries may be magnified by the highly urbanized structure of recreational fishing, in particular. As a

large percentage of recreational fishers in Australia live in the larger urban centres of Sydney and Melbourne, their local recreational fishing waters are most heavily fished and therefore low yielding. Their experience of the recreational activity and consequently their expectations of future fishing experiences are lowered as a direct result. Regardless of the real state of the fishery, the public perception that all fisheries are unsustainable is therefore reinforced by the perception of recreational fishers in highly urbanized centres.

A further impact to consider is the extent to which overseas immigration impacts the recreational fishing participation rate. While immigration data is available, there is minimal information to track recreational fishery participation. Industry experts suggest increased immigration from countries with well established fishing and seafood cultures (e.g. Vietnam, other SE Asia) have immediate and direct upward impact on the number of active recreational fishers especially around large urban centres, but with little impact on the national recreational fishery participation rate.

Research (FRDC Perceptions Survey, 2009) has also been undertaken to assess community perceptions regarding **aquaculture, recreational fishing and Indigenous customary fishing**.

Figure 24. Perceptions of Fishing Sustainability for Other Sectors



The 2009 survey results (shown here) suggest the community believes aquaculture is sustainable, certainly much more so than other wild catch recreational and indigenous customary fishing activities.

Studies (DAFF BRS, 2005) undertaken in communities in SA (Eyre Peninsula) and Victoria (Port Phillip Bay) have found:

- regarding community benefits, community respondents recognised aquaculture's socioeconomic benefits, such as its contribution to local economies in rural and remote regions. Support was strongest among older age groups and those who had more direct contact with the industry production sites. Most respondents placed high value on the environment, particularly coastal and marine settings. The environmental contribution to the community was rated higher than the need for industry's economic contribution.
- a majority agreed that aquaculture generally provides a good or at least equally acceptable alternative to wild-caught seafood, there was some uncertainty — which rose considerably when respondents were asked more detailed questions. Responses identified higher environmental concern among female respondents, those involved in groups with coastal management interests, and younger and well educated respondents.
- with regard to trust for the aquaculture industry: trust varied across industry sectors. But respondents more likely to trust the aquaculture industry included those who had been to aquaculture farms and knew someone in the industry, and/or were longstanding residents. Those least trusting of industry were those with higher levels of education, involvement in coastal groups or interest in recreational fishing.
- regarding risks, generally, more respondents had concerns about environmental risks from sea-cage sectors (eg kingfish, tuna) than from the shellfish sectors (eg mussels, abalone, oysters). Overall, there were high levels of uncertainty about aquaculture's future impacts.
- regarding trust of government agencies, interviewees from both regions made judgments on the perceived impartiality of decision makers, their accessibility, and how responsive they were to different interests and environmental problems related to aquaculture. Respondents also

had varied trust in the national, state and local governments' aquaculture-related decisions and procedures. Respondents less likely to trust governments' aquaculture decisions were females, those involved with coastal groups, and people who attended aquaculture public meetings.

- community awareness of aquculture practices was greatest in well established "fishing communities".
- interviewees wanted to see improved relations between governments, the aquaculture industry and communities through greater governmental transparency and coordination, firm regulations, clear and accessible information, and more inclusive dialogue with communities.

Access, Property Rights and Co-management

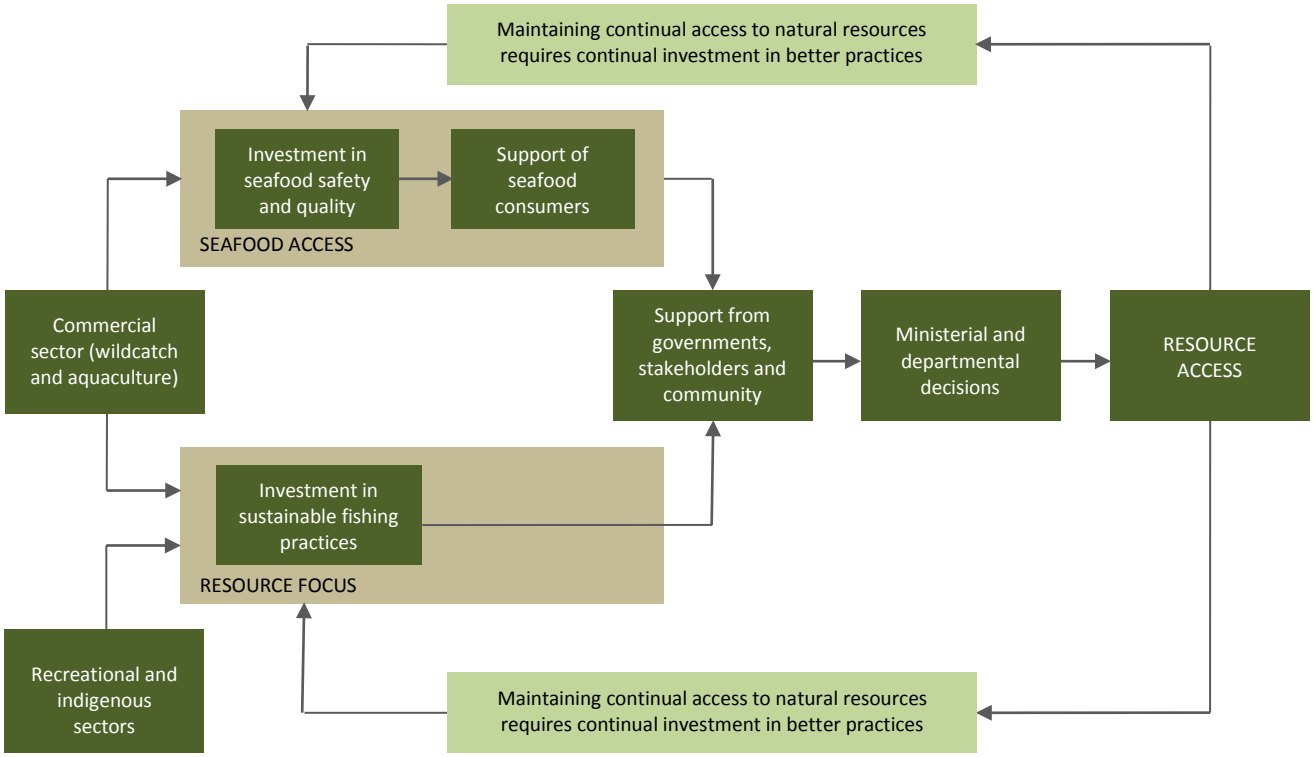
As public stakeholders and regional communities worry about the sustainability of their national wild fishery assets (marine, estuarine, and terrestrial), they demand greater awareness of and share in the management of wild fishery issues. Fishers - commercial, recreational and customary - face greater challenges to their traditional rights of resource access and use.

Seafood consumers see the fishing and aquaculture industries through the lens of their local supermarket, fish retailer or food service provider. There is now increasing point of sale labelling and information to enable consumers to differentiate local and imported products, fresh and frozen products, and wild catch and aquaculture sourced products. Consumers, and the broader community through the media, now have a richer understanding of the source and resource attributes of available seafood. Chain of custody programs and various NGOs now actively seek to endorse product integrity or position public opinion regarding fishing sustainability and resource use and performance, to suit their various ends. Amid all these local and global media messages it is not surprising that the broader public will find it difficult to draw its collective frame of reference regarding the rights of fishers and aquaculturists to access and use the resource. The critical point is that communities ultimately determine the rights of fishers and aquaculturists to access the resource. A public that increasingly believes (correctly or incorrectly) wild catch fisheries globally are unsustainable is unlikely to support the allocation of increased rights of access to, or shared management, of wild resources or new aquaculture projects.

This is occurring at a time when new technologies make fishing far more efficient for all users, communities demand and can afford greater access to the natural environment for both passive and active leisure (e.g. marine parks), governments respond to NGOs pushing for greater surety regarding sustainability, and every month efficient aquaculture puts a new more competitive price and cost base into the global seafood markets also supplied by wild fishers.

When governments provide sectors of the industry with access to publicly owned resources, and to some form of security in such access, the governments need to be confident that their decisions have the support of the general community and seafood consumers. (FRDC, 2005, p. 31). The extent of support by consumers and the community depends on the values they place on seafood, the industry, and on fisheries resources. The fishing industry must always understand the terms of its arrangement with the community and governments, the status of its resource use and performance, and take every opportunity to clearly state its views and communicate its environmental performance. The more the industry sectors harmonise and inform their voice, the more likely it will be that governments (on community's behalf) will grant them appropriate access rights. These factors are illustrated in Figure 25.

Figure 25. Factors Involved in Access to Fisheries Resources



The traditional arrangements governing rights to access and use of wild fisheries are not sustainable themselves, regardless of the health of the fishery resource. These fishers will lose their social license to operate unless they establish a better way to work collaboratively with their communities and consumers to determine, monitor and work towards overt sustainability and other goals. Appropriate mechanisms to ensure shared fishery access, rights and use are at the heart of this process on for the ongoing private investment in fishing. Fishers, aquaculturists, Fishery and other NRM Managers, and stakeholders increasingly recognise the need for a cultural change, away from an untrusting, often conflicted "them versus us" centralised approach to one of partnership based on joint responsibility for decision making and implementation in fisheries management. The FRDC (FRDC 2006/068, 2008) has defined co-management as "an arrangement where responsibilities and obligations for sustainable fisheries management are negotiated, shared and delegated between government, industry, other user groups and other stakeholders". Drawing on international and local experience, a number of preconditions were identified in the FRDC study that need to be satisfied for co-management to be implemented on a mutually satisfactory basis. These include:

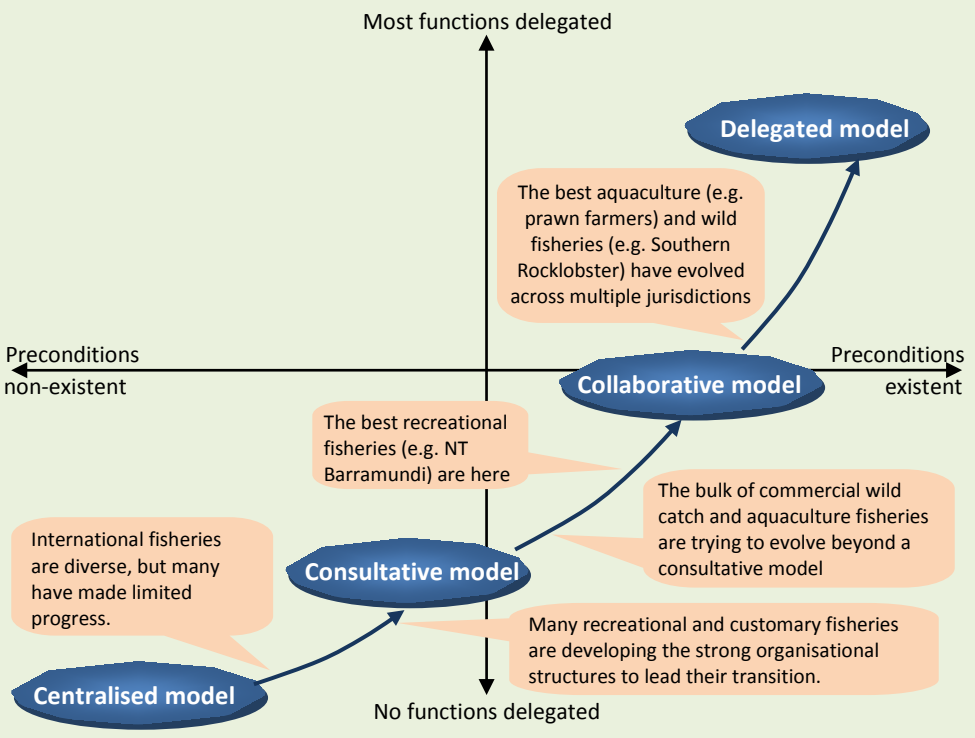
- a willingness by governments to share responsibility,
- fisher groups wanting to move to co-management,
- identified "champion/s" to negotiate with governments and build ownership,
- well resourced, effective fisher organisations that communicate with all stakeholders,
- a legislative basis to delegate powers,
- the ability to legally bind undertakings through an MOU or contract between the parties,
- an ability for the fishers' organisation to legally enforce agreements through the law, and
- availability of conflict resolution mechanisms.

The progress of sectors along the co-management pathway is presented in the following figure. Paraphrasing further from the study, most fisheries commence under a **centralised** "command and control" framework in which government takes full responsibility for almost all management decisions, with little or no consultation with fishers and other stakeholders. The progression towards co-management starts with the establishment of a **consultative** model in which management decisions

are discussed and debated. However, the majority of management decisions are still made by the government or management agency. The consultative arrangement may mature into a **collaborative** model, in which decision making is negotiated and shared between government and fishers, fisher organisations and other stakeholders with some decisions, such as fishing times or area closures, assigned to fishers or fisher organisations. Under a **delegated** model, agreed, negotiated management decisions are made by governments, fishers, fisher organisations and other stakeholders within a broad framework and agreed functions are undertaken, or services delivered, by a fisher organisation under a formal agreement.

Operating in this way within a broad regulatory framework is achievable when all pre-conditions for delegation to a fisher organisation have been met to the satisfaction of all parties.

Figure 26. Co-management Pathway



Co-management is one pathway offering increased collaboration between fishery users and managers, increased management flexibility, reduced stakeholder conflict, potentially lower costs, more transparent costs and planning, reduced political intervention, potentially improved public perceptions, and greater innovation and development of human capacity.

So, where are Australian wild fisheries on this transitional journey? The diagram suggests the current status of sectors, based on expert industry comments. Note these propositions are based on expert industry advice, not on quantifiable data. There is general agreement among experts that the granting of more specific access rights to fishery users will result in a general move of users up the curve toward a delegated model.

Ecologically Sustainable Development

Biological diversity and interconnectedness of ecosystems is increasingly important to the Australian community. This manifests as a desire to understand the ability of the aquatic environment to sustain fishing yields, aquatic operations, and provide other multiple use benefits to communities. As a result, Governments and fishery managers have identified ecologically sustainable development (ESD) as one of the greatest challenges for Australia's governments, industries, businesses and the community. An effective level of progress towards ESD requires a strong economy and a vigorous, profitable commercial sector (wild catch, aquaculture, charter and fishing support services). Businesses that are struggling for economic survival have limited ability to implement continual improvement of their environmental performance.

The Australian Government has published R&D priorities to guide the prosperity of rural and aquatic industries. In the case of the fishing, aquaculture, and seafood industries these 7 objectives are to be implemented jointly by the FRDC, AFMA and relevant Commonwealth and State agencies.

1. Sustainable natural resource management
2. Improving competitiveness through a whole-of-industry approach

3. Maintaining and improving confidence in the integrity of Australian products
4. Improved trade and market access
5. Use of frontier technologies
6. Protecting Australia from invasive diseases and pests
7. Creating an innovative culture

Habitat

Changes in the broader environment impact directly on the sustainability of regional ecosystems and habitats for aquatic species. Habitat integrity is a primary driver for the productivity of fisheries, the health of the catch and the safety of the seafood chain.

Marine, estuarine and freshwater catchments provide the requisite range of sustainable fishery habitats to service commercial, recreational and customary resource users. However the inappropriate management of proximate activities and industries will adversely impact fishery habitats. These activities include land clearing, land use resulting in nutrient and fertiliser run-off, catchment management and water allocation, wetland management and destruction of mangrove breeding habitats, and point source industrial pollution.

Biosecurity

Pest organisms and pathogens represent an increasing threat to Australian fisheries and ecosystems. These organisms cause disease or compete with native species for food and habitat, or by predation. Borne by international trade in live aquatic animals (e.g. aquarium fish), bait fish, aquaculture feeds, foodstuffs, and global logistic (e.g. ballast waters in ships) and human travel, this risk will continue to rise in concert with globalisation.

Inland Saline Aquaculture

Rising saline groundwater is the biggest environmental problem in Australia with the risk that over 2.5 million ha of land currently affected will become unproductive. It is estimated that within the next 30 – 40 years, the affected area will grow more than fourfold.

Australian researchers have been investigating the potential for using inland saline groundwater for aquaculture for several years. Results (FRDC 2004/241, 2008) suggest minor adjustments to water chemistry could facilitate sustainable large scale inland saline aquaculture (ISA) ventures for selected species.

Large scale infrastructure and remediation projects to construct saline groundwater interception and evaporation schemes are underway. If commercially viable aquaculture can be developed in association with these schemes, it may mitigate the costs of establishment and maintenance of both the schemes and aquaculture. In other parts of Australia, e.g., WA and QLD, saline groundwater or saline lakes also offer the potential for aquaculture. Provided effluent can be managed and salty water does not leak into freshwater drainage systems, these resources may offer exciting opportunities for commercial aquaculture.

There have also been significant investments in ISA in Victoria, South Australia, Western Australia and Queensland. These states have current active research programs in this area but there is no formal collaboration and limited communication between the different groups.

Credible industry modeling (Kearny, Foran, Poldy, & Lowe, 2003) suggests that ISA could make a valuable contribution to bridge the supply-demand gap for seafood in Australia over the next 50 years. The Aquaculture Industry Action Agenda (a 1999 plan to triple the value of aquaculture production to $2.5 billion by 2010 and create 29,000 new jobs) has picked up this opportunity as a core strategy.

The relatively inexpensive price of land in inland Australia is attractive to ISA investors. Provided appropriate technology to culture marine or salt tolerant freshwater species using saline groundwater can be adapted or developed, ISA could become a significant new rural industry. Increasing rural economic activities through aquaculture will stimulate regional economic development and employment. The research studies cite several examples of large-scale "commercial" aquaculture of marine or estuarine species in inland areas overseas. In Arizona and Thailand new prawn farming ventures dependent on saline groundwater are emerging.

Species of interest to ISA include marine finfish and crustaceans. A key requirement for development of ISA is the expansion of existing facilities to allow them to be used as demonstration centres. The aim is to develop a growout protocol for commercially viable aquaculture in the region and to transfer the technology to the industry and government bodies involved with new salinity control schemes.

The NAC recommends a national network be developed between the various State Departments and supporting agencies (ACIAR, AFFA, and the National Aquaculture Action Agenda Implementation Committee). The fragmented nature of inland saline research has also made it difficult for those interested in the field to easily access the collective information available.

Input Costs

Increases in, and the volatility of, costs of all inputs to fishing have a direct and significant impact on the profitability of all fishers, but commercial fishers and charter boats in particular. Fuel, skilled labour, finance charges, and bait are the major inputs to fishing activity. Fuel costs comprise the largest component of cash costs for fishers, representing up to 40% of total running costs for trawl fishers, and around 17% for long liners. By comparison, fuel comprises only around 9% of production costs in the grains industry (Australia's largest primary food production sector).

Climate Change

A changing climate poses both challenges and opportunities for Australia's communities and food industries, including wild fisheries and aquaculture sectors. Industry's investment in RD&E needs to consider and bring forward strategies to enhance each sector's adaptive capacity, mitigate against, and take advantage of further climate change.

The Climate Change Research Strategy for Primary Industries (CCRSPI) has noted a rise of 10-17cms in sea levels for Australian sites in the last century. The agency forecasts (CCRSPI, 2009) a further rise in marine water level by 18-59 cms by 2100 and a range of other marine impacts, including general ocean warming around Australia, changes in ocean chemistry and circulation patterns are projected. Substantial warming has occurred in the three oceans surrounding Australia. (E.g. the ocean temperature around Maria Island, Tasmania, has warmed by approximately 1.5°C since the 1950s). By 2030, the ocean temperature is projected to warm by 1–2°C around Australia with the greatest warming off south-eastern Australia (2°C). By 2070, the ocean temperature is projected to warm by 2–3°C around Australia with the greatest warming off south-eastern Australia (3°C). Warming ocean temperatures, in particular on the east coast, are expected to threaten coral reefs with more frequent bleaching events, causing fish species to migrate towards cooler water at the poles and threaten kelp forests. Ocean acidity is projected to increase as levels of carbon dioxide in oceans increase; reducing the availability of calcium carbonate, which is required by many creatures with calcium carbonate shells. The East Australia Current is likely to strengthen, resulting in warmer waters extending further southward. Estuaries are likely to be affected by rising sea levels and changes in flows of freshwater from rivers, impacting on fish breeding cycles. Changes in agricultural land use patterns can also impact on fisheries stock through run-off and loss of sea grass habitat.

The National Climate Change Adaptation Framework that was endorsed by the Council of Australian Governments in 2007 recognises that Australian commercial, indigenous and recreational fisheries will be affected by climate change through increasing ocean temperatures, changes to ocean currents, wind and nutrients, changed rainfall patterns, and ocean acidification.

The FRDC's 2009 Annual Operational Plan (FRDC AOP, 2009-10) provides an update on the approach to climate change research. Climate change poses both challenges and opportunities for Australia's wild fisheries and aquaculture sectors. FRDC has been participating in the development of an effective strategic framework to enhance each sector's adaptive capacity, mitigate against, and take advantage of further climate change. This builds on the vast bank of research undertaken over the past decade looking at climate variability and its impact on the fishing industry. FRDC will participate with others RDCs in the collaborative research initiative Climate Change Research Strategy for Primary Industries (CCRSPI), to examine and respond to (positive and negative) impacts of climate change on primary industries. Projects include: understanding the biophysical implications of climate change, understanding the social and economic implications of change for the sectors and related

communities, understanding market risks and opportunities ahead, understanding the needs of stakeholders, facilitating the development of adaptive capacity within sectors Climate change is impacting on the fishing industry on a number of levels and the industry will need to reduce production costs, such as fuel, through gear, engine and vessel configuration changes.

Many indirect and as yet unforeseen impacts will change where and how we fish in the future. Evidence recorded in the literature to date includes invasions of sea urchins native to NSW coast causing loss of kelp forests in off eastern Tasmania (N. Bax), and major distributional or range changes for 34 fish species south of Bass strait. (P. Last).

Under the Commonwealth Government's current CPRS planning, it is intended that terrestrial farmers will eventually be required to purchase permits to account for the direct emissions on-farm, such as the methane from livestock or the nitrous oxide emissions from fertilizer use. It is not yet clear how these new regulations will impact terrestrial or marine aquaculture or wild catch fishing. But regardless of outcomes around those policy decisions, fishers and aquaculturists will be subject to the direct impacts of carbon costs via higher costs on fuels and other inputs.

Evidence from Australian waters is sparse (mainly due to a lack of historical long-term data collection). However it is inevitable that there will be flow-on impacts and implications for human societies and economies, particularly those in regional Australia highly dependent on the marine environment and its resources.

The CSIRO has identified six key questions that need to be addressed by future modelling and monitoring programs:

1. How will the distribution and abundance of marine species and communities alter with climate change? Changes have already been observed in some regions, for example in the south-east.
2. Which species are candidate indicators for climate change impacts? Species that provide structural integrity of habitat, such as corals and kelp, or species that have key ecological roles, such as phytoplankton that drive food chains, would be effective sentinals of climate change impacts.
3. Within large marine domains, where are sensitive areas or hotspots of change? Preliminary analysis from the CSIRO suggests that there is regional variability in sensitivity or vulnerability to climate change impacts, with the Tasman Sea in the south-east and the east coast identified as examples of hot-spots of change.
4. How will ocean productivity alter with climate change? International studies indicate that productivity of marine systems will be affected by climate change, and the CSIRO report provides evidence that Australia's already low productivity is likely to decrease further.
5. How would reduction in non-climate related stressors increase ecosystem resilience to climate change? The CSIRO recommends that a reduction in non-climate stressors such as extractive or polluting activities is likely to build ecosystem and species resilience to the impacts of climate change.
6. To what extent will marine climate change impacts affect socially and economically important uses of Australian marine ecosystems? The CSIRO finds that climate change effects are likely to affect social and economic uses of the marine environment, with Australia's fisheries and tourism industries likely to be most affected.

Regional Fishery Impacts

It is difficult to gauge the real impacts of climate change without a closer look at a regional level. There are few detailed studies that look at the impacts of climate change in regional Australia for fisheries, or communities invested in these sectors.

A recent report (CSIRO, 2008) has considered the regional impacts of climate change specifically for regional fisheries and aquaculture industries. In Northern Fisheries rainfall is projected to slightly decrease in some parts, and slightly increase in others. The frequency of severe cyclones may increase. Sea level rises will impact on low-profile shores, such as mangroves (essential habitat for prawns and estuarine fish) increasing the extent of mangroves in some areas and decreasing it in others. As a result, catches of prawns, Barramundi and Mud Crabs related to summer rainfall may be

adversely affected. Moves by fisheries agencies to manage in an ecosystem context will improve adaptability of this fishery to climate change.

In South-east Demersal Fisheries there are correlations between changing ocean temperatures and growth rates, meaning enhanced growth for some species. Changes in persistent zonal winds may bring positive and negative impacts for different species recruitment. A number of stocks in the region are over-exploited; the additional impact of climate change is of concern to future sustainability. Increased temperatures at the southern end of species' ranges leaves little room for further southward migration, thus fishers will likely be affected.

For Western Fisheries the west coast is an oligotrophic region (with low nutrient levels) dominated by invertebrate fisheries. The Leeuwin Current is a major driver for fishery recruitment in the region. There is more work to be done to enable better predictions about changes to the Leeuwin Current and impacts on fisheries. In Pelagic Fisheries temperature is implicated as the main driver in climate impacts in the pelagic realm. Evidence in Australia and elsewhere has shown these species respond to interannual climate variability. For example, on the east coast, the abundance of several tuna species is linked to the expansion and contraction cycle of the East Australian Current.

Climate changes in the East Australian Current region are likely to impact pelagic species. For example, a climate-related decline in one mid-level species (Jack Mackerel) and its cool water prey (krill) has been documented. Also, squids may grow faster, mature earlier, and require more food resources, and tropical tunas will likely be found further south along the east coast of Australia. Pelagic species are typically mobile and wide-ranging; thus, species' ranges and distribution are most likely to be impacted by climate change. This may mean relocation will be likely for some fishing operations.

In Sub-Antarctic Fisheries the Southern Ocean is projected to be under-saturated with regard to calcium carbonate through its entire water column by the end of the century. Sea ice is expected to decline and become more seasonal. Changes to krill biomass and other plankton species associated with reduced sea ice and lowered pH may have severe consequences for exploited fish species and other predators. Increased water temperature may impact metabolic rates for some fished species and lead to changes in distribution for others.

Regarding Aquaculture, projected sea level rises increase the risk of low-lying coastal inundation. A general decrease in rainfall is projected, while the intensities of severe storms and cyclones are expected to increase. Changing rainfall patterns will alter salinity, nutrients and suspended sediment levels of coastal waters, with implications for coastal aquaculture. Viable regions for aquaculture will shift, depending on species.

Increases in temperature may reduce production efficiency of key cool water farmed species, such as Atlantic Salmon, and increase incidences of diseases. The Tasmanian Atlantic Salmon industry contributes a large portion of Australian fisheries' production value, so the threat of warming temperatures is of great concern, but impacts may be mitigated by moving cages offshore. Industry has capacity to adapt through selective breeding of broodstock, and switching to species more suited for future conditions. Selective breeding and the design of farming systems to deal with higher water levels and storms, should also be a priority for the well established industries such as oysters

A further study (MTSRF, 2009) looked at impacts across all regional industries in central Queensland adjacent the Great Barrier Reef, and found that businesses have a limited interest in, and/or awareness of, climate change. This is the case even though around 75% of species valuable to fisheries production are directly dependant on estuarine environments for at least one stage of their life cycle, and, should that stage be interrupted, fishery stock impacts can be significant.

Little or no action has been taken to address potential impacts by these businesses as business operators do not necessarily consider the importance of underpinning economic, social and infrastructure prerequisites for their business to operate. Instead, operators tend to focus only on immediate factors likely to achieve the results for their businesses. By comparison, local governments in the region are actively interested in climate change adaptation, but lack a detailed knowledge of their risks and exposure. As result, there is no clear pathway forward to address climate change implications for these regional businesses. The study concluded that business owners believe they have the capacity to respond to changed conditions (e.g. put off staff, change business practices,

etc) once they have some sense of what those conditions are likely to be. Looking forward, half of the interviewed business operators could see opportunities resulting from climate change, even though plans to take up these opportunities were generally not highly developed. Operators were considered to be optimistic about their capacity to respond to the challenges of climate change.

Indigenous Customary Fishing Impacts

Current climate change knowledge suggests that northern Australian may become wetter, with significant changes to river flows. The aquatic species food webs (ecosystem interrelationships across species from algae through fish to top predators such as crocodiles) resident in these catchments may be subject to significant change as a result of changes in seasonality and flows. Typically these catchments have short and extreme periods of high flow, followed by long periods of minimal or no flow, on an annual basis. Indigenous communities are the major fishing stakeholders subject to change in food drawn from these webs.

While little is known about the impacts of climate change and stream flows on these webs, significant work (TRaCK, 2009) is underway to gather the data and assess the impacts on fisheries, and coastal and inland communities. A focus for some of the research is the understanding of species that may be adaptable to aquaculture for indigenous communities.

Figure 27. Expected Impact of Climate Change

This figure presents the impact on Australian marine life in terms of the four potential biological responses to climate impacts. These ratings are based on the expected response to predicted changes in sea surface temperature, salinity, wind, pH, mixed layer depth, and sea level, as described in the specific sections. (CSIRO Marine and Atmospheric Research, Sept 2006)

Groups	Distribution/ abundance	Phenology	Physiology/ morphology/ behaviour	Impacts on biological communities	Example Impact
Phytoplankton	High	High	Medium	High	Temperate phytoplankton province will shrink considerably
Zooplankton	High	High	Medium	High	Acidification will dissolve planktonic molluscs
Seagrasses	Medium	Low	High	Medium	Increased dissolved CO2 may increase productivity
Mangroves	Medium	Low	Medium	High	Sea level rise will destroy mangrove habitat
Kelp	High	Medium	High	High	Ranges will shift southwards as SST warms
Rocky Reefs	High	Medium	High	Low	Species ranges will shift southwards as temperatures warm
Coral Reefs	High	Medium	High	High	Acidification and warming will cause calcification problems and coral bleaching
Cold water corals	High	Low	Low	High	Ocean acidification will dissolve reefs
Soft bottom fauna	Medium	Medium	Medium	Medium	Modified plankton communities or productivity will reduce benthic secondary production
Benthic and demersal fish	High	Medium	Medium	High	Southward movement of species on both east and west coasts
Pelagic fishes	Medium	Low	Medium	Low	Pelagic tunas will move south with warming
Turtles	High	Medium	High	Low	Warming will skew turtle sex ratios
Seabirds	Medium	Medium	Low	Low	Shift in timing of peak breeding season as temperatures warm
Total number of high impact habitats or species groups	**8**	**2**	**5**	**7**	

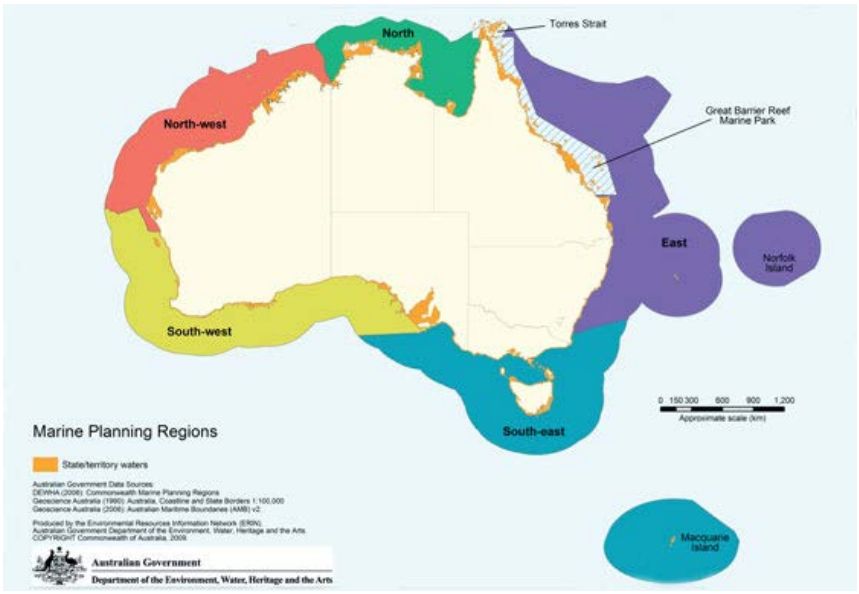
Regions / Bioregions

Context

Australia's marine bioregional planning program (DEWHA, 2009) is designed to provide a clearer focus on conservation and sustainable management of Australia's marine environment. It is a process that is underpinned by the principles of ecologically sustainable development and it takes an ecosystem approach in managing Australia's marine biodiversity and environment. Bioregional planning focuses primarily on Commonwealth waters, and therefore has limited relevance to state or territory fisheries.

Bioregions have been devised based on ecological similarities, species distribution and oceanographic and seafloor characteristics. They reflect our understanding of the ecology of a marine region, and underpins related planning processes.

Figure 28. Marine Bioregions

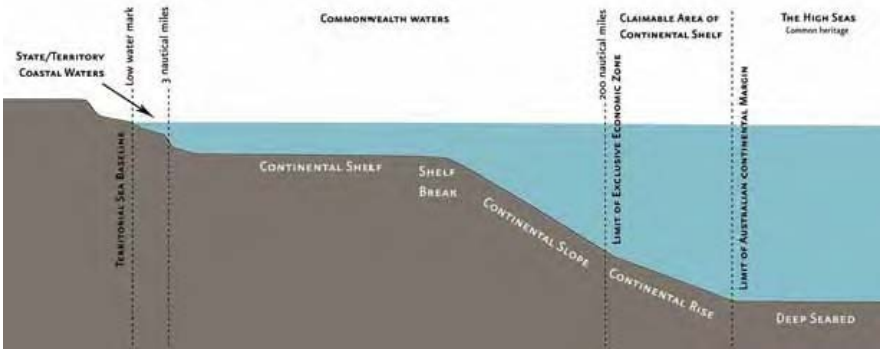


There are two major parts to the marine bioregional planning process: regional assessment, and implementation of Australia's National Representative System of Marine Protected Areas.

The figure illustrates the five bioregions established by the Australian Government.

Bioregionalisation starts with the unique attributes of a specific ecosystem. From a fisheries and aquaculture industry planning viewpoint "**bioregions**" may also provide the spatial template for logical fishery and aquaculture "**regions**" of unique target species. This approach would enable access, harvest, and management to be fine-tuned for that marine region to suit the capacity of the particular ecosystem, species ranges and related fishery uses. Improved efficiencies and lower unit costs could logically be expected by all users. It is logical to assume then that the rationalisation of and planning for RD&E investments for all stakeholders may also be improved on the back of these efficiencies.

Figure 29. Australia's Maritime Zones



One limitation of bioregions is that they are "on average", and cannot completely represent the range of any target species (e.g. pelagic species such as tuna and billfish). The bioregions each have a core zone (where the ecological properties are almost always found) and a boundary zone (where the ecological properties are reasonably often present). Some species and processes operate at space

scales smaller than the bioregions and some at larger, but the bioregions are sensible for many target species. However with uncertain climate changes ahead, this focus on regional ecosystem impacts would seem to be a good approach to better inform outcomes for all fishery users.

There are no facts about the future – there is no pilot bioregion outcome or data to identify the constraints and benefits, or quantify potential efficiencies or costs. This bioregional approach is not yet fully developed from either a fisheries or aquaculture industry perspective, and the implications for these stakeholders are untested.

Jurisdictional Responsibility

Jurisdictional responsibilities for marine resources are complicated by the complexity of marine species targeted by fisheries and aquaculture industry, their spatial and temporal ranges, and the lack of harmony and alignment of existing agreements between jurisdictions.

The Offshore Constitutional Settlement (OCS) between the Commonwealth and each State/Territory sets out the basis for management responsibilities for marine species in the Australian Fishing Zone (AFZ), however the arrangements for each unilateral agreement with the Commonwealth are not uniform. The agreement with some jurisdictions allocates the responsibility by species, while in other cases it allocates responsibility by fishing gear type.

Bioregions are bounded inshore by the outer limit of State waters (~ 3 nautical miles from shore) and offshore by the outer limit of the Australian Exclusive Economic Zone. Given that the location of a fishery is determined by the presence of the target stock rather than by the location of political boundaries, many fisheries cross the borders of several jurisdictions. Under the terms of the OCS the governments of Australia (excluding NSW) have agreed to a sharing of fisheries management responsibilities which has resulted in State and Territory governments managing fisheries that are partly within Commonwealth waters.

Regulation

Under the Australian Constitution, state and territory governments have primary responsibility for management of land and waters within a state or territory, and management of waters out to the three nautical mile limit. The Australian Government has the responsibility for management of marine waters between the three and two hundred nautical mile limits.

All states and territories have fisheries or aquaculture legislation that regulates aquaculture production. In New South Wales, Victoria, Queensland and Western Australia, aquaculture is regulated under general fisheries legislation covering commercial and recreational fishing, and aquaculture. Tasmania has two pieces of legislation relating to marine and inland fisheries respectively. Separate legislation provides for marine aquaculture leases in Victoria (Land Act 1958), Tasmania (Marine Farming Planning Act 1995), and in Queensland (Land Act 1994) there is a system of "approved areas" under the Fisheries Act. South Australia has a single dedicated Aquaculture Act (2001, as amended in 2003 and 2005), while Western Australia has dedicated legislation for pearling (Pearling Act 1990).

Recfish Australia has confirmed (pers. comm.) that there is no compulsion under the EPBC Act to report recreational catches. However most states report on recreational fisheries as part of their Annual Reporting Process and some states choose to include recreational fishing performance measures in the fishery assessments that are submitted to the Commonwealth's lead environment agency (DEWHA).

Aquaculture production may also be subject to Commonwealth legislation, such as the Environment Protection and Biodiversity Conservation Act (1999) and the Great Barrier Reef Marine Park Act (1975) (the latter affects Queensland only). Other Commonwealth legislation that may be relevant includes the Native Title Act (1993) that may affect the use of public land and waters. Commonwealth quarantine legislation can affect aquaculture operators' access to new species, broodstock and feed.

Figure 30. Summary of Legislation

		RESOURCE USERS	
		NON-INDIGENOUS PEOPLE	INDIGENOUS PEOPLE
UPSTREAM SECTORS	**CUSTOMARY WILDCATCH**	• N/A	• AFMA/Torres Strait, NSW and Victoria have specific strategies and also in FRAB subprogram – emphasis on Human Capacity
	RECREATIONAL	• Commonwealth, QLD, NSW, Vic, Tas, SA, WA, NT, - specific inclusion in legislation and strategies • AFMA Charter and investment Strategy Plan	• No specific legislation or programs
	AQUACULTURE	**All jurisdiction** have specific arrangements for aquaculture. However: • Across jurisdictions there is poor design, alignment and variable security of tenure - add costs to businesses • Multiple objectives that overlap and conflict • Lack of guidance re relative weights of issues • Slow progress in marine planning except for SA & Tas • Multiple agencies in approvals and monitoring • Limited /no audits of and reporting by key agencies • Progress re translocation protocols varies significantly	• Specific legislation established and strategy plans developed by NT, QLD, NSW, Vic, Tas, WA • SA – in legislation but no formal strategy • AFMA – in legislation and Torres Straits Program • CommFRAB – projects by appointment • ACIAR projects • SW Bioregion Strategies
	COMMERCIAL WILDCATCH	• Relevant legislation defined in all jurisdictions	• QLD – FRAB strategy subprogram • NSW - FRAB strategy subprogram

Recent advice from the Commonwealth (Natural Resource Ministerial Council, Nov 2009)confirms "Council noted the need to develop a regulatory framework for aquaculture development in Commonwealth waters that could allow state and Northern Territory governments to manage and regulate aquaculture in Commonwealth waters. Over the next year, the Australian Government will work with the state and territory governments to develop a preferred option for regulation of aquaculture in Commonwealth waters that offers national consistency, promotes best-practice operations and streamlines approval processes".

Aquaculture

State and territory governments have primary responsibility for the regulatory framework for aquaculture. Their responsibilities cover marine and coastal management, environmental management, land use planning, land tenure, native title, and quarantine and translocation (Productivity Commission, 2004). However, as the Productivity Commission noted, "aquaculture production is subject to an unnecessarily complex array of legislation and agencies," across State / Territory and Local Governments.

Relevant Australian Government legislation includes the *Environment Protection and Biodiversity Conservation Act 1999*, the *Native Title Act 1993*, and the *Quarantine Act 1908*. The Australian Government's Great Barrier Reef Marine Park Authority also has responsibility for regulation of aquaculture in or adjacent to the marine park.

The Commission's further comments can be summarised as follows:

Figure 31. Regulatory Assessment of Aquaculture

Regulatory Area	Commission Comments
Industry competitiveness	o Regulatory arrangements that are poorly designed or implemented add costs to producers and consumers and adversely affect investor behaviour and competitiveness
Legislative objectives and Agency Functions	o State aquaculture legislation often has multiple objectives , that may overlap or conflict o There is often a lack of guidance as to the relative weights of parallel objectives
Marine resource planning and aquaculture	o Jurisdictions have used different planning processes to allocate marine resources for aquaculture and provide for management of the marine environment o Except for TAS and SA, there has been slow progress with marine aquaculture planning
Land use planning and aquaculture	o A number of jurisdictions (e.g. Vic, SA, WA) do not provide planning guidance to local councils on how to address land based aquaculture in planning schemes, or how development approval should be assessed
Lease of public waters and/or land for aquaculture	o Marine based - the use of marine aquaculture leases varies significantly across jurisdictions. The limited use of marine aquaculture leases in VIC, QLD, and WA has implications for the growth of marine aquaculture. Inadequate security of tenure may constrain financing for aquaculture projects. o Land based – some jurisdictions lack defined processes for leasing adjacent lands and public foreshores, across which aquaculture pipelines must traverse.
Approvals, monitoring and reporting	o Misguided or in efficient approval requirements can create barriers to entry into the industry or expansion of existing operations. o In most jurisdictions around five state agencies as well as local government are involved with processing and approving aquaculture projects. This can lead to excessive costs an uncertainty for investors. Complex aquaculture projects may take more than 4 years to approve. o Some environmental and compliance monitoring arrangements may be too prescriptive, and in some jurisdictions enforcement appears not to be adequate resourced. o There appears to be limited reporting by and auditing of, the main state agencies responsible for environmental regulatory arrangements for aquaculture.
Quarantine and translocation	o Progress on developing consistent translocation protocols varies significantly across jurisdictions. Inconsistencies may breach WTO rules, as well as generate higher costs for aquaculture producers.

The Productivity Commission concludes "there is a need for further research across industries to assess if the level of regulation and control is consistent with the level of environmental risk posed by each industry"… and "there would seem to be scope to simplify approval processes by reducing the number of individual aquaculture and environmental approvals required". A uniform national Resource Impact Statement process for aquaculture is recommended as a preferred approach to overcome the current regulatory conflicts, gaps and overlaps.

In line with emerging thinking on co-management of fisheries, the Commission also noted the opportunity to assess the cost effectiveness of innovative approaches to regulation, including:

- regulatory instruments - (such as demerit schemes, environmental assurance bonds, and offsets) to improve the efficiency and effectiveness of existing regulation;
- market-based approaches - (such as tradeable permits for pollution discharges, and auctions for lease allocations) to achieve desired regulatory outcomes in least cost ways by allowing individuals to make their own benefit-cost tradeoffs;
- voluntary approaches - (such as environmental management systems, codes of practice, environmental labelling and cooperative agreements) may contribute to the capacity of the aquaculture industry to manage environmental impacts; and
- education and information approaches - particularly where sound environmental management does not occur because resource users are not well informed or lack the necessary skills.

Industry Demographics

The FRDC has recently established a social sciences RD&E program. The program will address the limited understanding around the social aspects of the fishing and aquaculture industry, including fisheries management, change management, community perceptions, R&D adoption and industry communities' ability to adapt.

There is limited data currently available to track the age and other social attributes of fishers and their communities. In 2008 (ABARE FishStats 2008) there were 13,000 people directly employed in wild catch, 30% up from 2006-07, but below 2001 peak of 19,000. Census 2006 suggests direct employment of: finfish trawl 278; line fishing 86; prawn fishing 648; rock lobster fishing 1154; other fishing 3941. The FRDC (2005 Plan) estimates direct and indirect employment in wildcatch of 60,000 people. Employment is quite volatile subject to viability. Regional employment in coastal ports and centres is a significant component of the fishing industry. The trend of employment is for declining wildcatch employment and increasing aquaculture employment.

Of interest is the series of surveys (2005, 2006, 2008) of representative stakeholders the agency has undertaken across all sectors to assess various matters related to RD&E design, delivery and performance. The most recent survey (FRDC Ipsos, 2008) profile suggests the age of active fisheries and aquaculture stakeholders:

- Younger than 40 years, has declining from 25% to 21%
- From 41-50 years, has declined from 38% to 31%, and
- Older than 51 years, has increased from 35% to 48%.

Current FRAB and Organisational Investment Priorities

An analysis of the existing investment plans and strategies (by line item) across all Commonwealth, State and Territories provides some insight into the strategic priorities of the various Fishery Research Advisory Bodies (FRABs) and related planning organisations across the user base and value chain.

Unfortunately the value of the analysis is discounted due to the lack of hard financial data identifying the funds invested for each strategy line item. That data would greatly enhance our understanding of priorities, but it is very hard to assess. Discussion with a couple of agencies indicates that the line items represent a wish list of potential investment target areas, with many line items ultimately receiving no financial investment.

This analysis has been undertaken by Ridge Partners based on a desk research process only, and is not informed by more detailed consultation with relevant stakeholders. Caution should be exercised in interpretation of the analyses. The following tables, grouped here collectively as Figure 32, summarise the analyses of the 847 line items of RD&E investment across the 8 FRABS and 7 planning bodies.

Community Outcomes

These raw numbers suggest that by far the greatest investment is currently being directed to achieve and enhance capacity in the area of fishery sustainability.

Figure 32. Current FRAB and Organisational Investment Priorities

	COUNT	FRAB Comm/AFMA	FRAB NSW	FRAB Vic	FRAB Qld	FRAB Tas	FRAB SA	FRAB WA	FRAB NT	AIMS	Indigenous NSW	Indigenous Vic. Aqua	Marine Nation	NAC	Recfish	SSA	TOTAL	
Community Outcomes	Sustainability	14	195	124	19	11	8	6	65	12	0	0	3	0	13	0	**470**	55%
	Healthy food	0	23	5	3	2	2	0	4	0	0	0	0	0	0	24	**63**	7%
	Economic	3	48	37	8	3	6	5	12	0	4	0	1	0	3	2	**132**	16%
	Social	1	8	4	3	1	0	3	2	0	8	0	0	0	9	0	**39**	5%
	Human capacity	1	10	34	8	4	9	13	18	0	14	6	1	5	17	3	**143**	17%
		19	284	204	41	21	25	27	101	12	26	6	5	5	42	29	**847**	

Around 55% of investment priorities fall into the sustainability category while Human capacity (17%) followed by Economic (16%) and Healthy Food (7%) and Social (5%) make up the balance. Industry comments suggest that the promulgation of the EPBC Act has significantly boosted the industry focus on sustainability of fisheries. This clearly raises the near term investment priority toward the long term capacity of the industry and its resource, in line with community expectations. But it would also be logical to expect that industry stakeholders,

over the longer term, would rebalance their investment focus back towards achieving outcomes that create wealth, efficiency and social benefits once resource sustainability was locked in. With 55% of strategies still in the sustainability area, it seems this rebalancing is yet to occur.

FRAB/Organisation

It is interesting to also note that some FRAB jurisdictions have very detailed planning documents (NSW FRAB with 284 strategies) while others in a similar planning role have very few (SA FRAB has 25 strategies, Tasmania with 21 strategies). There is also considerable variation in emphasis across the planning bodies. For example NSW has allocated about 69% of its focus to sustainability, while WA has only 22%.

This analysis is indicative only and suggests local issues are at play in setting these priorities. It is logical for planning bodies that have a specific role in chain or sectoral development to allocate all their strategies to a dominant outcome - for example Australian Institute of Marine Science would logically be very strongly focused on sustainability, and Seafood Services Australia would focus on post harvest and human health and nutrition.

Fishery Use

Analysis of the Investment Strategies by fishery use confirms, as expected, that multi-user strategies are dominant, and the commercial wild catch and aquaculture sectors are the largest sectoral investment targets.

	COUNT	All Fishers	Commercial	Recreational	Customary	Indigenous	IUU	Resource Share	TOTAL
Community Outcomes	Sustainability	387	46	34	0	0	2	1	**470**
	Healthy food	37	26	0	0	0	0	0	**63**
	Economic	56	54	6	0	8	4	4	**132**
	Social	8	4	16	2	9	0	0	**39**
	Human capacity	74	9	23	17	9	9	2	**143**
		562	139	79	19	26	15	7	**847**
		66%	16%	9%	2%	3%	2%	1%	

The balance between customary (2%) and indigenous (3%) gives some confidence that strategies to assist indigenous people with commercial/aquaculture or recreational skills are quite commonplace.

Perhaps one indicator that may concern stakeholders is the relatively high percentage (66%) of strategies that are not user-specific. These would appear to be generic strategies, including for public good, but the apparently low level of accountability to a specific class of fishery user may be a shortcoming.

Fishing Method

Analysis of the strategies by fishery method confirms the relative investment (by line items only) in wild catch (commercial, recreational and customary) and aquaculture.

	COUNT	All Methods	Wildcatch	Aquaculture	TOTAL
Community Outcomes	Sustainability	77	364	29	**470**
	Healthy food	36	0	27	**63**
	Economic	50	20	62	**132**
	Social	14	19	6	**39**
	Human capacity	80	40	23	**143**
		257	443	147	**847**
		30%	52%	17%	

This analysis appears to reveal few insights of worth, with one exception. There is not one strategy across all wild catch plans that deals with improving the healthy food outcomes, whereas aquaculture identifies 27 strategies. Perhaps part of the answer is that wild catch sector deals with this issue under sustainability (i.e., biosecurity, fish health) rather than as downstream seafood. Aquaculture planners appear to be far more focused on RD &E that drives economic gain from sales of seafood, than do wild catch planners.

Analysis of the Strategies by project focus confirms the relative importance of various project areas. Grouped broadly in colours by planning issues, the data suggests that *biology + nutrition* (25%) and *management + planning + RDE* (21%) are bigger issues, than *technologies + production systems* (3%), for example.

	COUNT	Stocks	Biology	Fish health	Feed	Ecosystem	Habitat	Climate	MPA	Management	Plan	RDE	Postharvest	Markets	Bycatch	Awareness	Leadership	Training	Cost	Risk	Return	Technology	Systems	TOTAL
Community Outcomes	Sustainability	81	43	38	0	37	74	20	9	87	6	3	0	1	25	3	0	1	10	17	4	6	5	470
	Healthy food	0	0	24	0	0	0	0	0	0	0	1	21	14	0	1	0	2	0	0	0	0	0	63
	Economic	8	8	0	2	0	0	0	0	14	2	1	12	14	1	2	0	2	25	13	16	6	6	132
	Social	0	0	0	0	0	0	0	1	11	1	0	1	0	0	11	0	3	2	5	4	0	0	39
	Human capacity	3	4	1	0	0	1	1	1	25	9	14	3	2	0	35	10	21	2	4	7	0	0	143
		92	55	63	2	37	75	21	11	137	18	19	37	31	26	52	10	29	39	39	31	12	11	847
		11%	6%	7%	0%	4%	9%	2%	1%	16%	2%	2%	4%	4%	3%	6%	1%	3%	5%	5%	4%	1%	1%	
		25%				**13%**		**4%**		**21%**			**8%**		**3%**	**11%**			**13%**			**3%**		

But looking more closely at second tier implications, the data suggest that the efforts to improve "human capacity" are quite strong. Specifically the investment in *awareness + leadership + training* (66 strategies) *and management + planning + RDE* (48 strategies) are evident. It is pleasing to see that the priority allocated to economic strategies *(returns + costs + risks)* is not just purely economic- resource and social aspects in support of our economic investment are also evident.

RD&E Users

Drawing from Figure 13, the table below identifies direct and indirect stakeholders in fisheries and downstream seafood activities, and their respective key motivations for investing in RD&E.

Figure 33. Stakeholders and RD&E Users

Direct Stakeholders	Key RD&E Interest and Drivers	Related Indirect Stakeholders
1. Consumers of seafood	• Seafood supply and quality • Health and welfare • Lifestyle opportunities	Nutritionists, chefs, Health authorities, Fair trading agencies
2. Consumers of non-edible aquatic products	• Product supply an quality • Product utility and integrity • Lifestyle opportunities	Fair trading agencies
3. Australian Communities	• Resource sustainability • Fresh Australian seafood • Local employment • Fishing industry viability	Non Government Organisations (Pew Trusts, WWF, Traffic Int'l, etc), Marine park managers
4. Commercial wild catch fishers – CFA, SEFA, State Organisations, etc	• Profitability and ROI • Resource sustainability • Business risk management	Bait suppliers, tackle and equipment suppliers, ship yards, port services firms, transporters, processors, cold stores, energy suppliers, packaging suppliers, banks, financiers
5. Aquaculturists – NAC, APFA, etc	• Profitability and ROI • Resource sustainability • Business risk management	Equipment suppliers, water quality experts, feed suppliers and experts, transporters, processors, cold stores, energy suppliers, packaging suppliers, banks and financiers
6. Recreational fishers: RecFish, etc., license holders, and non-affiliates	• Personal enjoyment • Resource sustainability • Activity risk management	Bait suppliers, tackle and equipment suppliers, ship yards, energy suppliers, packaging suppliers, banks and financiers, guides, media
7. Customary fishers	• Food for community • Customary practice • Cultural preservation • Resource sustainability	Indigenous communities and support groups and agencies
8. Fishing industry employees	• Remuneration and security • Interesting work • Skills and career opportunity	Labour hire companies and recruitment gents, training organisations
9. Fishery managers	• Legislative compliance • Resource sustainability • Fishery performance • Efficient investment of resources • Community engagement	Australian/State/Territory Government agencies
10. Seafood and aquatic product processors	• Profitability and ROI • Product safety and integrity • Chain risk management	Equipment and technology suppliers; inputers, fabricators and service providers; waste managers; compliance inspectors and managers; banks and financiers
11. Merchants & wholesalers	• Profitability and ROI • Product safety and integrity • Chain risk management	Freighters, handling and logistics suppliers, cold stores, waste managers, packaging suppliers, banks and financiers,
12. Supermarket retailers	• Profitability and ROI • Chain risk management • Market competitiveness	Food consumers, shareholders, supply chain partners, nutritionists, waste mangers, banks and financiers
13. Seafood Retailers	• Profitability and ROI • Chain risk management • Market competitiveness	Food consumers, shareholders, supply chain partners, nutritionists, waste mangers, banks and financiers
14. Seafood and product exporters	• Profitability and ROI • Chain risk management • Market competitiveness	Banks and financiers, quarantine experts and agencies, cold stores
15. Seafood and product importers	• Profitability and ROI • Chain risk management • Market competitiveness	Banks and financiers, quarantine experts and agencies, cold stores
16. Ecosystem, fishery and seafood researchers	• Resource sustainability • Interesting work • Employability	CSIRO, AIMS, Universities, Government agencies, ecosystems and climate researchers, nutritionists, researchers

4. Commercial Fishing and Seafood

Production

Australian commercial fishers harvested around 800 species for a volume of 236,000 tonnes in 2008. This represents approximately 0.16% (global rank 54th) of world commercial fishers and aquaculture production. ABARE FishStats 2009 provides further data and insights in the following tables.

Figure 34. Commercial Fisheries Production and GVP

	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08
TONNES							
Total Wild catch	192,398	207,031	223,138	231,085	191,640	183,423	173,178
Total Aquaculture	44,746	45,943	43,475	48,014	54,539	60,142	62,503
Total Commercial Tonnes	237,144	252,974	266,613	279,099	246,179	243,565	235,681
GVP $'000							
Total Wild catch	1,698,514	1,570,607	1,447,778	1,451,770	1,424,092	1,405,070	1,318,494
Total Aquaculture	731,163	734,470	731,811	634,082	742,346	805,690	868,355
Total Commercial GVP $'000	2,429,677	2,305,077	2,179,589	2,085,852	2,166,438	2,210,760	2,186,849
INDICATIVE PRICES A$/kg							
Total Wild catch	8.83	7.59	6.49	6.28	7.43	7.66	7.61
Total Aquaculture	16.34	15.99	16.83	13.21	13.61	13.40	13.89
Total Commercial	10.25	9.11	8.18	7.47	8.80	9.08	9.28

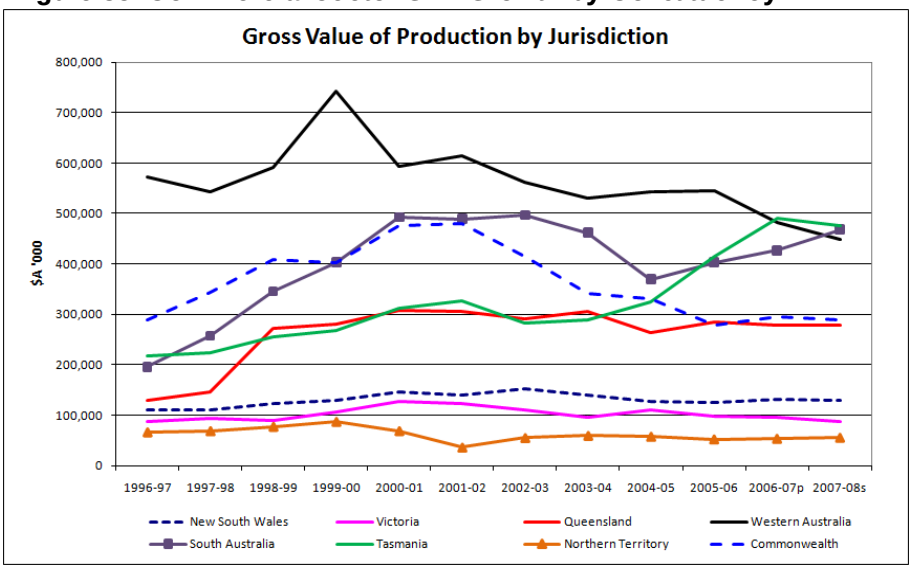
Note: Figures are in nominal $A of the day

The total commercial fishery harvest volume (from Commonwealth, State and Territory fisheries, and aquaculture) peaked after several years of growth, in 2004-05 at 279,000 tonnes. Overall, harvest volumes have since fallen 15% to retreat to their levels at the start of the decade. The contribution of the terrestrial /inland catch to this figure has been negligible.

Nominal aggregate commercial prices have been declining since the 2001-02 peak, confirming again falling prices drag GVP down even though tonnage landed may still be increasing.

The nominal landed gross value of production peaked earlier (in 2001-02) at $2.4 billion. The industry GVP has been falling reasonably consistently since 2001-02, for a 10% decline in the decade to date. In real terms, the gross value of Australian fisheries has declined 22% over the same period.

Figure 35. Commercial Sector GVP Growth by Constituency



Commercial fishery production is spread across all states and territories, and the Commonwealth. With the rise of aquaculture over the last decade there has been a major shift in gross value to Tasmania and South Australia, with a significant fall in the Western Australian contribution.

Wild Catch

Landed wild catch volumes have fallen over 25% since their historical peak 4 years ago. Tonnage is now 10%

below where it was at the start of this decade. In GVP terms, since the value peak in 2001-02 wild catch beach value has fallen consistently for a total decline of 29% in nominal terms. In the 6 years to 2008 nominal wild catch beach prices per kg have fallen 14%.

The jurisdictional ranking of contributions to wild catch value has been reasonably stable since 2000-01 (in decreasing rank WA, QLD or SA, TAS, VIC or NSW, NT) although the contribution from WA has fallen 25% in the 7 years.

Since 2000-01 crustaceans have increased their share of wild catch beach value from 45% to 55%, at the expense of finfish (a fall from 36% to 27%). The mollusc share has been stable around 18-19%.

Figure 36. Commercial Wild Catch Value by Jurisdiction and Type

BEACH GVP $'000		2000-01	2007-08				
	Jurisdiction	Total	Total	Fish	Crustaceans	Molluscs	Other NEI
1. State Wildcatch	NSW	91,779	82,114	43,582	30,208	7,504	820
	Vic	107,283	67,750	12,032	14,946	40,772	0
	QLD	247,502	203,126	87,208	105,250	10,668	0
	WA	432,007	325,607	33,809	250,452	41,264	82
	SA	206,527	205,967	34,044	133,773	38,150	0
	Tas	194,607	156,700	3,641	60,052	92,941	66
	NT	34,270	32,948	26,113	6,502	333	0
	Total	1,313,975	1,073,244	240,429	601,183	231,632	968
2. Commonwealth		479,558	201,938	108,551	93,097	290	42,345
TOTAL		1,793,533	$1,275,182	$348,980	$694,280	$231,922	$43,313

Aquaculture

Since 2000-01 landed aquaculture volume has grown 40%, and GVP value 19%. While nominal aquaculture growth is strong, in real terms it is just adequate to keep pace with inflation. Nominal aquaculture pond prices per kg have fallen 15% in the 6 years to 2008.

Community concerns regarding the impacts of large-scale aquaculture on the natural environment (marine, estuarine and terrestrial) have been present for a number of years. This concern has in some cases been exacerbated by effective lobbying by conservation groups, to the detriment of the reputation of aquaculture. However the industry appears to have managed this issue responsibly with a strong ongoing investment in science and low impact production and handling systems. Research (DAFF BRS, 2005) into community attitudes suggests aquaculture production is becoming a valued and acceptable contributor to the commercial seafood sector.

Figure 37. Commercial Aquaculture Value by Jurisdiction and Type

BEACH GVP $'000	Jurisdiction	Total	Fish	Crustaceans	Molluscs	Other NEI
2. Aquaculture	NSW	48,111	5,358	2,981	39,127	645
	Vic	18,475	11,041	10	7,424	0
	QLD	75,512	25,580	42,600	1,912	5,420
	WA	122,792	4,450	2,672	114,483	1,187
	SA	262,128	208,930	559	37,874	14,765
	Tas	318,766	290,974	0	27,792	0
	NT	22,570	0	0	0	22,570
	Total	868,355	546,333	48,822	228,612	44,587
TOTAL		$2,186,849	$895,313	$743,102	$460,534	$87,900

Summary Production Trends

The dynamics of these production trends can be summarised as follows:

- Over 70% of the gross value of Australian fisheries values comes from 7 species - rock lobster, salmon, prawn, tuna, abalone, pearl oysters and edible oysters. Sixty one percent of wild catch value comes from these species, and 84% of aquaculture value.
- There have been declines in the tonnage and value of the largest Australian commercial fishery by value, wild catch rock lobster. Based in a highly export exposed fishery, tonnage has declined only 3% in the last 6 years, but nominal GVP declined 19% from $502 million to $407 million. The WA lobster fishery forecasts further falls in production over the next 3 years due to declines in recruitment to the fishery.
- Other significant falls in value have occurred in prawns abalone and tuna. Over the last decade the real value of these species together with rock lobster has declined by $0.6 billion (ABARE FishStats, 2009).
- There has been strong growth in the tonnage and value of the second largest Australian commercial fishery by value, Atlantic salmon aquaculture. Tonnage rose 78% to 25,527 tonnes over the 6 years to 2007-08, and nominal GVP rose 167% to $299 million. Salmon is now Australia's most valuable finfish species, ahead of tuna.
- Tasmania's share of GVP has grown strongly (driven by aquaculture) to outstrip growth from SA, in the face of falling values from WA. Continuing the growth trends identified earlier this decade (Productivity Commission, 2004), aquaculture remains one of the fastest growing Australian primary industries.
- Increased production volumes over the last decade are largely the result of Australian sardines.
- Fisheries restructures driven by Governments to protect resources and underpin industry viability, have had a significant impact on the operations of the commercial wild catch sector since 2004.

Cultural Dilemma

Egyptian hieroglyphics (2052-1786 B.C.) are the proof that intensive fish culturing is an ancient practice. Chinese manuscripts from the 5th century B.C. cite the practice of fish culturing, but the Romans were the first to actively cultivate an aquatic species (oysters), in a way that has continued in some form or another to the modern day.

But aquatic cultures today are quite immature compared to terrestrial agriculture. For example industrial stud breeding for aquaculture is relatively immature. Early man found that a regular supply of animal protein was far more assured from controllable goats, oxen and pigs than from uncontrollable aquatic species.

It is not surprising then that supply chains to 21st Century supermarkets have become far more sophisticated in dealing with cultured poultry, beef, lamb and pork than they have for any aquatic animal. Paradoxically, aquaculture has become the growth industry as these advanced industries now test the limits of their land and water resources. Globally the terrestrial species have also developed techniques for optimising the biology of the species to suit their market production systems, and to reduce the biosecurity risks associated with uncontrollable regional disasters such as foot and mouth disease. For example, Australia's cattle industry, one of the most advanced and export focussed in the world, breeds its cattle in northern Australia for specific grass-fed or grain-fed markets. Moving southward, cattle are "backgrounded" for market specifications along the Tropic of Capricorn; then pushed into feedlots in temperate country where grain and silage are available. They are then slaughtered after market specific fattening periods in world class plants near to export ports.

Will the Australian aquaculture industry need to consider similar access and productivity issues in response to resource access limits and biosecurity management?

Bioprospecting

Bioprospecting is the search for new drugs and other products derived from biological processes, systems or organisms. Bioprospecting in the marine environment is a growing area of interest for researchers and pharmaceutical companies.

While this research is only in its infancy in Australia, activity is expected to increase due to advances in biotechnology and the growing knowledge of the biodiversity of marine species.

Management of the access to, and the benefits from, genetic and biochemical resources found in native species in Commonwealth areas is governed by recently introduced regulations under the EPBC Act – Part 8A Environment Protection and Biodiversity Conservation Regulations 2000 (DEWHA Biological Resources).

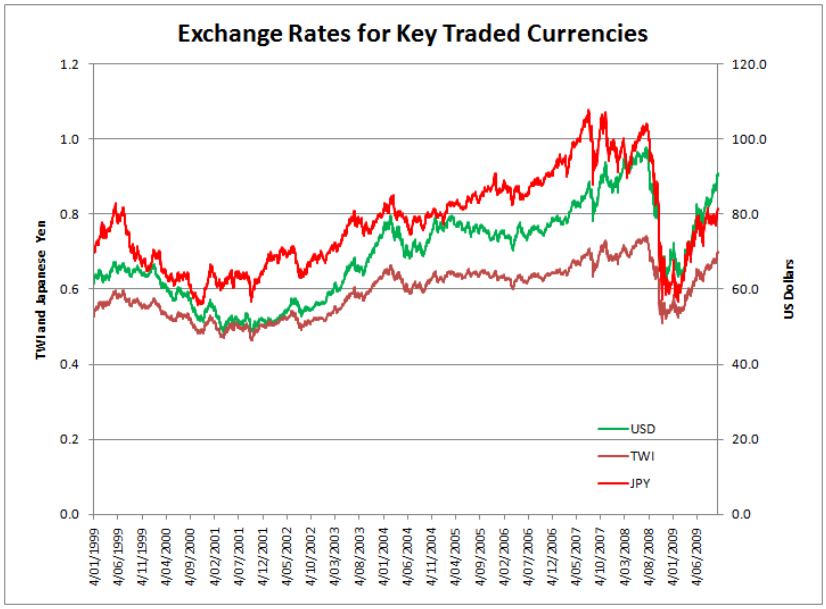
Trade

Exchange Rates

As Australia is a relatively small commercial fishery highly exposed to global seafood markets, prices received by Australian producers are set on world markets in foreign currencies - Australian fishers are largely "price takers" in both export markets and in import-competitive domestic markets.

It was noted above that the value of Australian fisheries fell 14% in the three years following 2000-01, even though production kept rising by17%. This confirms the significant impact prices and currency exchange rates have on the value of the Australian catch.

Figure 38. A$ Exchange Rates

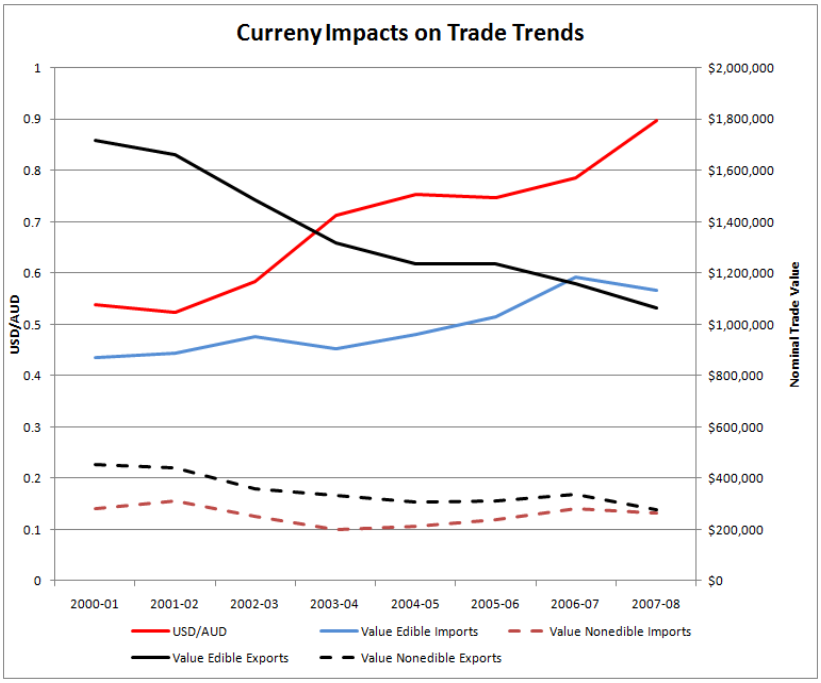


An appreciating Australian dollar results in a lower export price. Currency fluctuations have a large and direct impact on the prices flowing back up the value chain to Australian beaches and ponds.

While landed tonnages were almost the same at the start of the decade and in 2007-08, today that volume is worth 10% less at the beach in nominal terms due to exchange rates and other price impacts.

In 2007-08, the Australian dollar continued to appreciate against the US dollar and the Japanese yen, rising by 14% and 6% respectively. These exchange rate increases may partially explain the general trend towards lower unit value for export oriented fisheries products such as prawns, rock lobster and abalone in 2007-08.

Figure 39. Currency Impacts on Trade Trends



The changing value of the Australian dollar against our major trading currencies has been the largest single factor influencing the value of Australian fisheries in the last decade. The value of the Australian dollar (RBA 2009) followed a declining trend between 1998/99 and 2000/01 to a low of US 50 cents, followed by a consistent rise on the back of the commodities boom through to mid 2008. The impact of global financial instability has generated wild fluctuations in currencies since then, with parity with the US$ a real threat to exporters.

While products traded broadly against the trade weighted index have seen modest volatility, fisheries exports since 2002 in US

pegged currencies (e.g. $HK or ¥Jap.) have experienced far greater volatility and competitive pressures in servicing overseas markets.

Both edible and non edible products are impacted by currency change, but the trends graph above shows that edible products are more exposed. In GVP terms the quantum of the impact on export flows appears to be about twice that of the impact on the import trade.

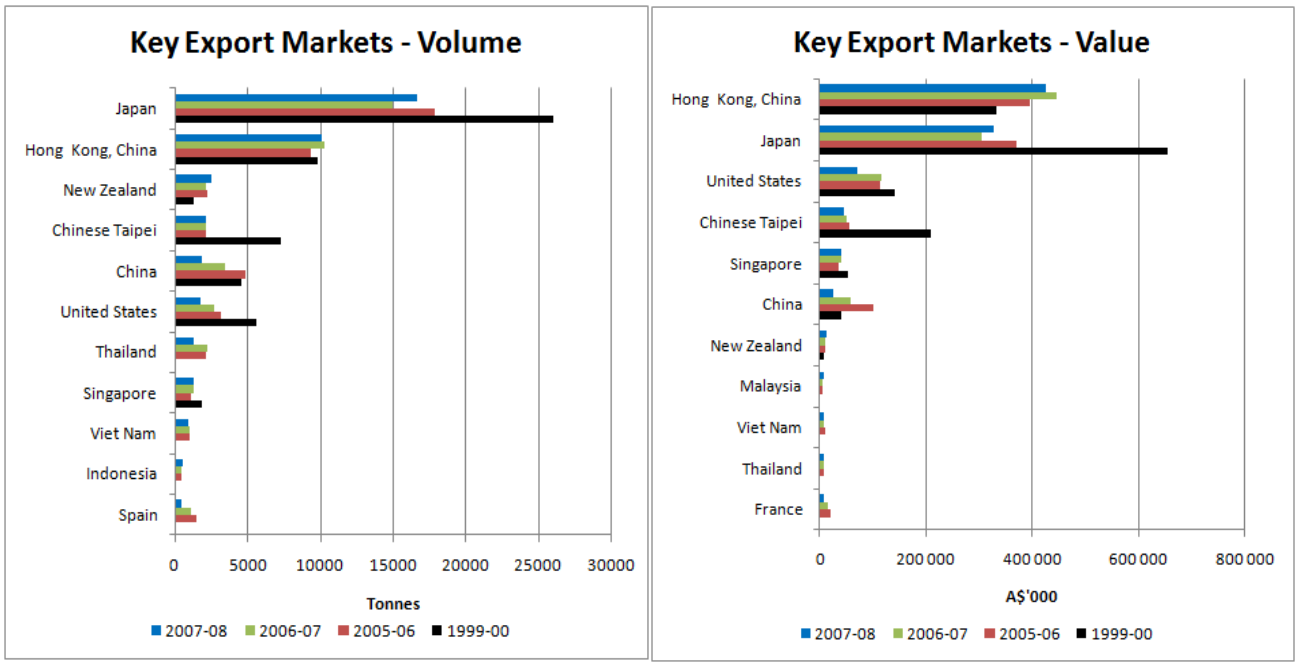
Exports

ABARE data confirms that since 2000-01 the real value of Australian fisheries exports has fallen by $1.3 billion (49%). The driving factor behind this fall has been the decline in the value of key export species. The combined value of rock lobster, pearl, abalone, tuna and prawn exports has fallen by $0.7 billion over this period.

Japan, Hong Kong/China and the USA dominate Australian fisheries product export trade (ABARE FishStats, 2009). Hong Kong has overtaken Japan as Australia's main export destination.

Since 2003-04 the real value of Australian fisheries imports has risen by $153 million (12%), being mostly driven by greater imports of fresh, chilled and frozen prawns and frozen fish fillets. The share of edible fishery imports from China and Vietnam has risen, although Thailand and New Zealand remain Australia's main source of edible imports.

Figure 40. Seafood Export Markets



Around 80% of current Australian fisheries exports by value are for edible products, a minimal change since the 77% figure recorded 10 years ago.

Exports to Japan, Chinese Taipei and the USA have decreased substantially in both volume and value in the last decade. Exports to Hong Kong /China are expanding, particularly so in value terms.

The proportion of commercial fishery production that is exported is a measure of the commercial industry's export intensity. For the last three years (ABARE FishStats, 2009) the data (see below) suggests that:

- edible seafood product export intensity has declined (primarily due to exchange rate impacts) from 21% to 19% in volume terms,
- edible product export value (FOB) intensity has declined in nominal terms from 57% to 49%,
- the estimated FOB unit value (A$/kg) of export product has increased in nominal terms around 3% per year in nominal terms

- unit prices for exported products (FOB) are consistently around 2.6 times the average comparable beach price for all landed commercial catch.

Figure 41. Export Intensity

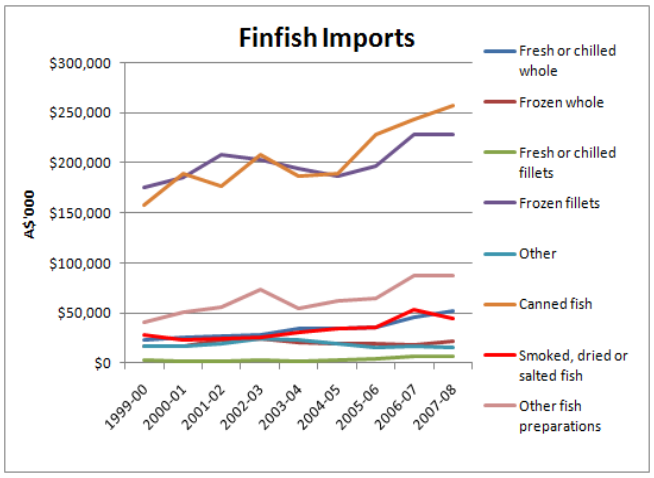
	2005-06	2006-07	2007-08
PRODUCTION TONNES			
Edible Product Exports - net product wt exported	52,302	48,010	43,998
Total Production	246,179	243,565	235,681
% of production exported	21%	20%	19%
GVP $'000			
Edible Product Exports – free on board value	1,237,341	1,157,909	1,065,415
Total Production	2,166,438	2,210,760	2,186,849
% of production exported	57%	52%	49%
AVERAGE PRICES A$/kg nominal			
Est. value of exported product FOB	23.66	24.12	24.22
Est. value (beach/pond) of production	8.80	9.08	9.28

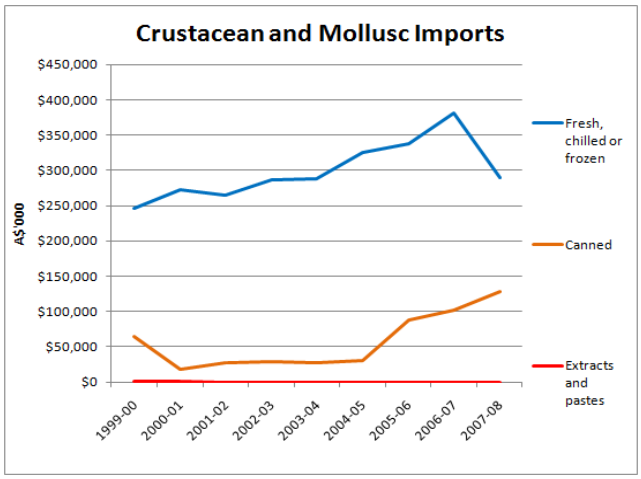
Imports

In 2007-08 seafood product imports were comprised of edible products (81% valued at A$1.13 Bn) and inedible products (19% valued at A$0.27 Bn). Imports of edible products have risen 46% by nominal value in the eight years to 2007-08.

For imported finfish products, there has been general growth across all product categories over the last 8 years, especially canned products and frozen fillets. Crustacean and mollusc imports fell by 14% in 2007-08 to $417 million, mainly due to a significant fall in fresh, chilled or frozen prawn imports, which decreased by 28% to 19,000 tonnes. The fall in the import value of this category was larger (32%) as a result of a decline in unit import values of around 6%. However, the fall in import value was offset by a 25% increase in the import value of canned and preserved crustacean and mollusc species to $129 million. Most of the increase is because of an increase in the volume of canned and preserved prawn imports, which rose by 41% to 11,000 tonnes. The value of canned and preserved prawn imports increased by 35% to $84 million in 2007-08.

Figure 42. Fishery Product Imports by Type





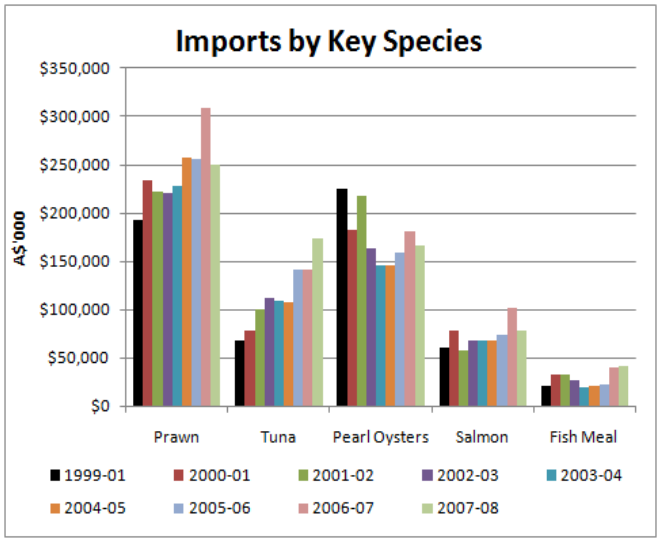
There have been several factors effecting the volume and value of Australian seafood imports since 2001/02, including (FRDC Board, 2009).

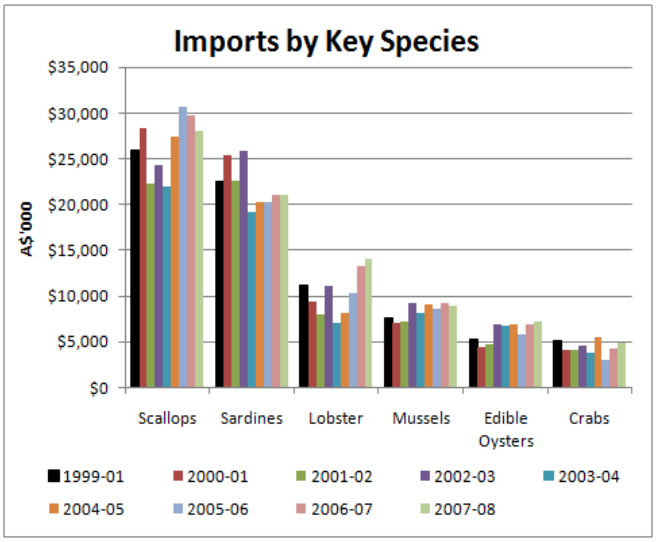
- the appreciation of the Australian dollar relative to trading partners' currencies, reducing the price that Australians pay for imports of fisheries products
- a significant increase in the supply of relatively inexpensive aquaculture products on the world market, in particular finfish and prawns, leading to a softening of prices across many categories
- gradually rising domestic consumption.

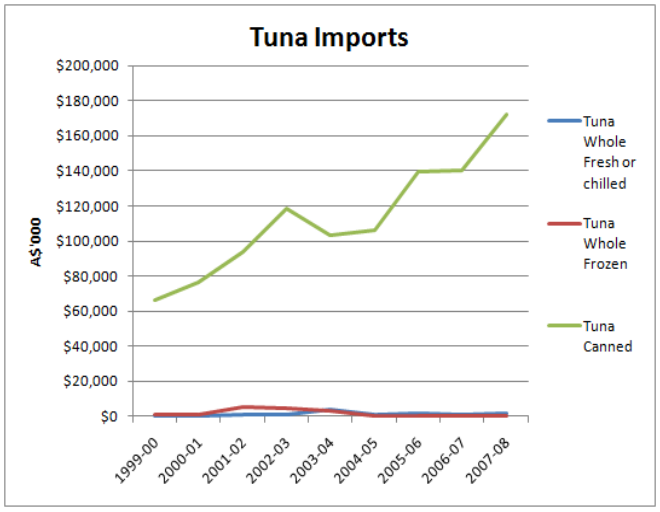
For key species in the Australian industry, import competition from a number of value added products. Tuna imports have grown 200% in the eight years ending 2007-08, due to growth in canned product alone. Canned tuna made up about 24% of the total value of finfish imports. Frozen fish fillets and canned tuna together comprise about 60% of the total finfish imports in volume terms which amounted to 82 000 tonnes.

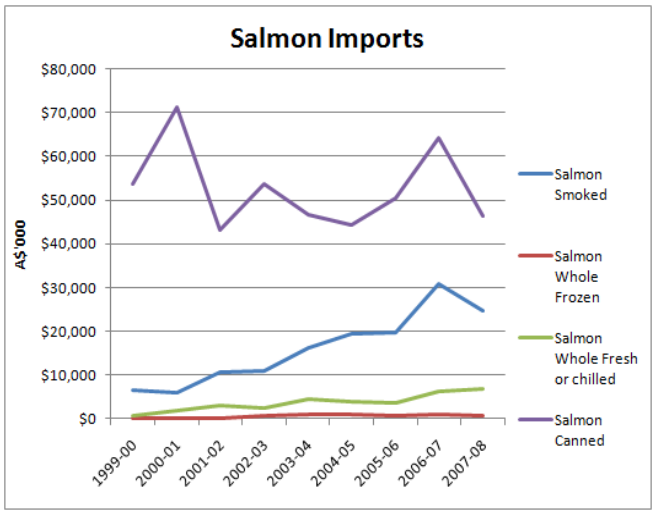
In general terms for some products, as income rises, demand for the particular good or service rises even faster than income. These goods are said to be income elastic. Many "luxury" goods are income elastic; as we get wealthier, we tend to buy more expensive clothing, and go on more overseas holidays. In most OECD economies seafood is considered by consumers to be more than a staple

Figure 43. Fish Imports - Key Species and Products









Key Species

Australian fisheries, food and recreational value chains and markets are increasingly complex and dynamic. As with other high value consumer foods (e.g. wine), seafood demand and use is driven

by emerging global consumer demands that are, in turn, as much shaped by human lifestyle and health issues as by the need for affordable staple food. It is in the interests of Australia's limited volume, specialist species to be differentiated, managed and marketed as niche seafoods wherever possible. To achieve this there must be an increasing focus on species attributes and capability to attract consumer awareness, interest and demand.

The figure below considers the 2007-08 status of key species regarding production volumes and values and trade flows. This data is for the top 33 species, ranked by GVP in that year. The data confirms:

- species with the greatest catches do not represent those with the greatest GVP values. The top 7 species by catch volume (sardine, salmon, prawn, rocklobster, tuna, edible oyster, and scallop) collectively comprise 56% of the catch for the top 33 national species. The top 7 species by GVP value (rock lobster, salmon, prawn, tuna, abalone, pearl oysters and edible oysters) collectively comprise 73% of the national value. It can be seen that sardines and scallops contribute to volume but not value, and abalone and pearl oysters are the opposite.
- 3 of the top 7 species by GVP are major species in both wild catch and aquaculture (prawn, tuna, abalone); 1 species (rock lobster) is wild catch only; and 3 species are aquaculture only (salmonids, pearl oysters and edible oysters),
- cumulative beach / pond GVP of $1.574 Billion, or 72% of all commercial fisheries,
- a cumulative beach GVP of $0.824 Billion, or 62% of all wild catch fisheries,
- a cumulative pond/cage GVP of $0.751 Billion, or 86% of the total commercial fisheries,
- each of the key species is active as an export and or import product, but the share of traded product varies considerably by species from 100% for aquaculture tuna, to 1% for aquaculture prawns.
- a number of species feature in both wild catch and aquaculture sectors – prawns, tuna, abalone, barramundi.

Figure 44. Commercial Catch and Trade for Key Species 2007-08

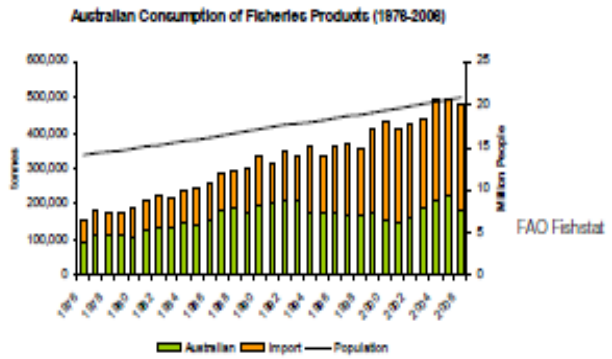
KEY SPECIES	TOTAL Australian Catch				Australian WILDCATCH				Australian AQUACULTURE				IMPORTS
Species / type	GVP Rank	Beach GVP $'000	Cumm.% Total GVP	Tonnes	Beach GVP $'000	Cumm.% of GVP	Tonnes	% tonnes Exported	Beach GVP $'000	Cumm.% Total GVP	Tonnes	% tonnes Exported	All forms tonnes
Rocklobster	**1**	**406,715**	**19%**	**13,833**	**406,715**	**31%**	**13,833**	**90%**	**-**	**0%**	**-**	**-**	**792**
Salmonids	**2**	**299,259**	**32%**	**25,527**	**-**	**31%**	**-**	**-**	**299,259**	**34%**	**25,527**	**11%**	**6,810**
Prawn	**3**	**267,524**	**45%**	**22,430**	**223,321**	**48%**	**19,342**	**25%**	**44,203**	**40%**	**3,088**	**1%**	**29,818**
Tuna	**4**	**208,716**	**54%**	**13,785**	**21,974**	**49%**	**4,028**	**75%**	**186,742**	**61%**	**9,757**	**100%**	**38,767**
Abalone	**5**	**188,542**	**63%**	**5,320**	**171,622**	**62%**	**4,816**	**95%**	**16,920**	**63%**	**504**	**75%**	**-**
Pearl oysters	**6**	**114,292**	**68%**	**Na**	**-**	**62%**	**-**	**-**	**114,292**	**76%**	**na**	**96%**	**-**
Edible oysters	**7**	**89,130**	**72%**	**12,460**	**-**	**62%**	**-**	**-**	**89,130**	**86%**	**12,460**	**2%**	**726**
Other NEI	na	87,900	76%	15,192	43,313	66%	13,300	na	44,587	92%	1,892	na	
Other fish	na	65,273	79%	14,455	42,116	69%	12,216	na	23,157	94%	2,239	na	1,624
Crab	8	53,866	81%	5,769	53,866	73%	5,769	25%	-	94%	-	-	488
Barramundi*	9	46,510	84%	4,906	12,530	74%	1,545	-	33,980	98%	3,361	10%	10,000
Snapper	10	37,261	85%	5,893	37,261	77%	5,893	-	-	98%	-	-	-
Coral trout	11	35,465	87%	1,123	35,465	79%	1,123	-	-	98%	--	-	-
Shark	12	32,933	88%	8,378	32,933	82%	8,378	-	-	98%	-	-	-
Scallops	13	32,676	90%	10,280	32,676	84%	10,280	11%	-	98%	-	-	2,460
Whiting	14	20,610	91%	3,577	20,610	86%	3,577	37%	-	98%	-	-	-
Sardine	15	19,339	92%	33,578	19,339	88%	33,578	-	-	98%	-	-	4,080
Flathead	16	18,338	93%	4,348	18,338	89%	4,348	-	-	98%	-	-	-
Other molluscs	na	17,848	93%	1,044	17,848	90%	1,044	na	-	98%	-	-	7,414
Mullet	18	13,169	94%	5,535	13,169	91%	5,535	-	-	98%	-	-	-
Blue grenadier	19	10,890	94%	3,559	10,890	92%	3,559	-	-	98%	-	-	-
Billfish	20	10,181	95%	1,834	10,181	93%	1,834	-	-	98%	-	-	-
Other lobster	21	9,392	95%	456	9,392	94%	456	-	-	98%	-	-	792
Mackerel	22	8,502	96%	1,549	8,502	94%	1,549	-	-	98%	-	-	906
Mussels	23	8,270	96%	3,153	-	94%	-	-	8,270	99%	3,153	5%	2,194
Bream	24	7,074	96%	1,269	7,074	95%	1,269	-	-	99%	-	-	-
Ling	25	6,445	97%	1,152	6,445	95%	1,152	-	-	99%	-	-	-
Spanish mackerel	26	5,970	97%	1,264	5,970	96%	1,264	-	-	99%	-	-	-
Emperor	27	4,839	97%	991	4,839	96%	991	-	-	99%	-	-	-
Squid	28	4,669	97%	1,780	4,669	96%	1,780	-	-	99%	-	-	na
Threadfin	29	3,897	98%	995	3,897	97%	995	-	-	99%	-	-	-
Blue eye trevalla	30	3,276	98%	424	3,276	97%	424	-	-	99%	-	-	-
Silver perch	31	3,195	98%	292	-	97%	-	-	3,195	99%	292	-	-
Australian salmon	32	3,127	98%	2,849	3,127	97%	2,849	-	-	99%	-	-	-
Pipi	33	3,124	98%	997	3,124	97%	997	-	-	99%	-	-	-
Key species Total		2,148,217		226,962	1,284,482		167,724		$863,735		61,981		106,871

Source: ABARE Fish Stats 2008, and Industry advice. Note: squid imports are inseparable from octopus and calamari. NEI = not elsewhere included. *Barramundi imports are not identified in ABARE statistics but industry advice suggests the import volume could be as high as 10,000 tonnes per annum.

Demand Trends

Overseas and domestic demand on Australian fisheries products for human consumption continues to grow strongly. In 2006-07 approximately half of Australian seafood production was exported. The total value of Australian Seafood Imports ($1.128 billion, 2007-08) (South Australian Food Centre, 2008) has increased in recent years and now exceeds Australian Seafood Exports ($992 million). Although imports are slightly higher in value than exports, the total volume of imports (198,000 tonnes) is more than four times that of exports (45,000 tonnes), which reflects the higher unit values of Australian export products. Import volume has only increased 5% in the last 5 years, but increasing prices has seen the total value increase 25%.

Figure 45. Australian Seafood Consumption



Total volume of seafood consumed has fluctuated. Australian consumption of seafood has grown strongly over the last 20 years, with most of the growth occurring through seafood imports. Australian yearly per capita expenditure on seafood has also increased, particularly in recent years. Despite this, Australian per capita expenditure on seafood remains much lower than many of the world's largest seafood markets such as Japan, much of Europe (e.g. Spain, France, Italy, Greece) and Hong Kong.

Major seafood imports to Australia include frozen and processed fish, prawns, canned tuna, squid, scallops and other shellfish. The imports of lobsters, abalone and oysters are small in comparison with Australian production.

Life Long Health

Establishing regular fish consumption as a healthy, cost effective option for young children has the potential to impact upon their short and long-term health. Researchers have investigated factors that influence consumption of fish and seafood among pre-primary and Year One school children in the Perth metropolitan area. The results revealed several dominant factors actively influence the frequency and type of seafood purchased and consumed in Perth households. These include perceived cost, freshness, availability/accessibility, and the level of confidence to prepare and cook a meal to suit all family members. The influence of others in the family, particularly husband or partner, also tended to impact upon the likelihood of serving fish and seafood, and the types of products mothers were willing to serve (McManus A, 2007).

Despite increasing consumption of seafood, Australia's per capita consumption remains low by world standards. Australian produced seafood competes with many protein sources - chicken, beef, lamb and pork as well as imported seafood. Fresh seafood is often regarded by consumers as being relatively expensive. At the wholesale point, fish sold in Australia is comprised of approximately ¼ Salmon, ¼ imported frozen fillets and ¼ canned fish; the remainder is a range of Australian caught and grown fish plus imported species. Supermarkets prefer supply of product to be regular and consistent, which is difficult to achieve with many wild caught fish species. In the domestic retail market, salmon is by far the largest value fish species sold. Developing the Australian market for Australian retail fresh fish products will need to consider supply capability, convenience and shelf life of fillets. To increase the consumption and value of Australian fish, consumer friendly fish products are required to effectively compete with premium red meat. With a serve of fish typically being less weight than a red meat serve, pricing and marketing that draw focus to the cost per portion, rather than the per kilo price, may make fish purchases more attractive for consumers.

Food Patriotism

Consumer surveys (South Australian Food Centre, 2008) indicate that the place of production is a major factor in the consumer preference for seafood. They believe this knowledge will endorse their need for food

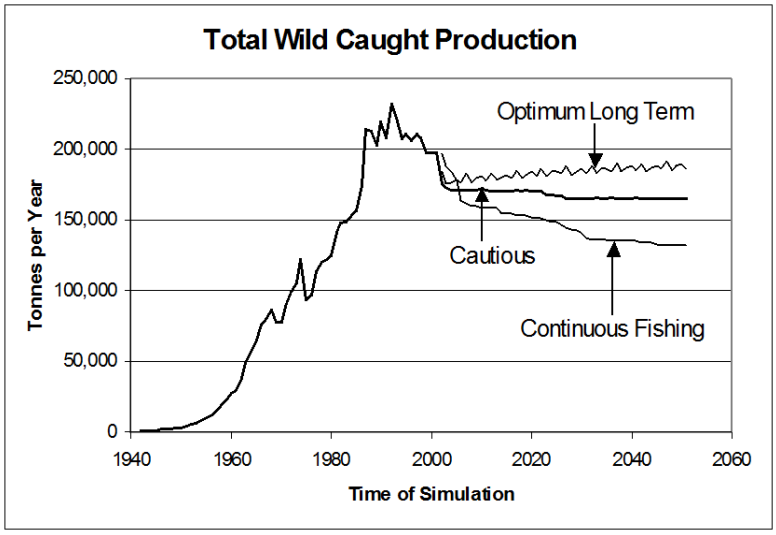
freshness. Improved availability of locally grown/caught seafood is amongst the greatest factors likely to encourage greater consumption of seafood. Other reasons for preferences towards purchasing locally produced products include perceptions of safety, and support for local producers. Price is always a consideration, but consumers are often willing to pay a premium for high quality local products, as evidenced by the rapid growth of farmers' markets in major cities. Consumers can only choose to buy local product if its provenance is revealed on the product at the point of sale. Branding and/or labeling as well as promotion are vital for consumers to be aware of the origin of products.

An emerging market is that of tourists seeking to experience the high quality food and beverages of the regions they are visiting. These typically high end consumers are known as culinary tourists. For culinary tourists, food and beverage experiences form a significant component of their travel and they have a strong interest and understanding of food and wine. These consumers seek to understand more about the produce and production of different regions and have the means to experience the premium local produce.

Demand and Imports in 2020

The FRDC Plan 2005-10 presents estimates for seafood imports through to 2050.

Figure 46. Fish Futures Demand Model



These estimates were drawn from a number of industry projects, including the comprehensive Fish Futures 2020 modeling study undertaken by industry in 2003. (FRDC 1999/160, 2003).

Recent advice from the National Aquaculture Council (Foster, 2008) suggests the sector's growth will exceed previous forecast production projections based on 2003 data.

The following table forecasts these changes to the demand scenarios based on stronger growth forecast from aquaculture. In round figures, the import requirement in 2020 will fall 34,000 tonnes per year compared to the Future Fish forecasts in 2003, and 70,000 per year by 2050.

Figure 47. Domestic Demand Shortfall

Tonnes Year	2000	2008	2020		2050		
Consumption kg/Person (tonnes commercial catch)	At 11.33		At 14.7	At 17.25	At 14.7	At 17.25	At 23
Population million	19.3	21.4	22.6		25.0		
1. Domestic demand	442,000		661,500	776,000	735,000	862,500	1,150,000
2. Wild-catch production	198,000		170,000		165,000		
3. Aquaculture production	34,000		**100,000**		**200,000**		
4. Seafood exports	70,000		70,000		70,000		
5. Required imports – new	280,000		462,000	576,000	440,000	567,500	855,000
6. Required imports – 2005	280,000		495,000	610,000	510,000	637,500	925,000
7. Change to Import requirement	**nil**		**-34,000**	**-34,000**	**-70,000**	**-70,000**	**-70,000**

Source FRDC and Industry advice

We can get a more complete picture of the demand scenarios by developing this data up based on what we see for each species in the wild catch and aquaculture sectors. This is a desirable

analysis because we need to understand what is forecast for each species in order to better prioritise and allocate the RD&E investments required for that species to achieve that outcome. Ideally we should be tracking each key species in our production, trade and consumption mix and forecasting its volumes (in all forms) and prices to see what the detailed analysis reveals. Unfortunately the species data available today is not robust enough to make sense from that analysis.

Forecasting by species for wildcatch is problematic as it can be quite unpredictable and volatile (e.g. western rocklobster) with unforeseen changes to a single species making a mockery of any broader assumptions.

For aquaculture the NAC has provided some guidance for its species through to 2020 and then to 2050. These details are presented in the table below. Data up to and including the 2008 year are actuals.

Figure 48. Forecast Aquaculture Production by Species

	YEAR ENDING JUNE			2000	2001	2002	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2050
TONNES	Growth 2009-15 % p.a.	Growth 2015-20 % p.a.	Growth 2020-50 % p.a.	34,000	-	-	**61,029**	65,526	70,428	75,777	81,617	87,998	94,974	102,608	107,840	113,443	119,453	125,911	**132,861**	**216,087**
Salmonids	10%	4%	2%	finfish	20,976	25,603	25,527	28,100	30,933	34,051	37,483	41,262	45,421	50,000	51,857	53,783	55,780	57,852	60,000	100,003
Edible Oysters	3%	3%	2%	mollusc	12,052	14,374	12,460	12,795	13,138	13,491	13,854	14,226	14,608	15,000	15,380	15,770	16,170	16,580	17,000	27,000
Tuna	4%	4%	2%	finfish	8,806	7,486	9,757	10,165	10,591	11,034	11,496	11,977	12,478	13,000	13,551	14,126	14,725	15,349	16,000	26,004
Kingfish	10%	7%	1%	finfish	-	-	2,500	2,760	3,048	3,365	3,715	4,102	4,529	5,000	5,348	5,720	6,119	6,544	7,000	10,000
Barramundi	6%	15%	2%	finfish	2,268	2,632	3,361	3,557	3,765	3,985	4,217	4,464	4,724	5,000	5,743	6,597	7,578	8,705	10,000	16,000
Mussels	7%	7%	1%	mollusc	3,189	3,208	3,153	3,368	3,597	3,842	4,104	4,383	4,682	5,000	5,348	5,721	6,119	6,545	7,000	10,000
Prawns	12%	11%	2%	finfish	3,541	3,284	3,088	3,471	3,901	4,385	4,929	5,540	6,228	7,000	7,797	8,684	9,673	10,773	12,000	20,003
Abalone	17%	11%	2%	mollusc	-	-	504	589	688	804	940	1,098	1,284	1,500	1,661	1,840	2,038	2,257	2,500	5,001
Silver perch	3%	3%	0%	finfish	383	348	292	300	308	316	324	333	341	350	360	370	380	390	400	460
Marron	15%	6%	2%	crustacean	90	120	80	92	105	120	138	158	181	208	220	233	247	262	278	503
Yabbies	15%	6%	2%	crustacean	94	100	84	96	110	126	145	166	190	218	231	245	260	275	292	529
Redclaw	15%	6%	2%	crustacean	77	79	67	77	88	101	116	132	152	174	184	195	207	220	233	422
Ornmentals	0%	0%	0%	finfish	-	est.	30	30	30	30	30	30	30	30	30	30	30	30	30	31
Eels	0%	0%	0%	finfish	-	est.	30	30	30	30	30	30	30	30	30	30	30	30	30	31
Other finfish	0%	0%	0%	finfish	-	est.	50	50	50	50	50	50	50	50	50	51	51	51	51	52
Other crust'ns	0%	0%	0%	crustacean	-	est.	30	30	30	30	30	30	30	30	30	30	30	30	30	31
Other molluscs	0%	0%	0%	mollusc	-	est.	16	16	16	16	16	16	16	16	16	16	16	16	16	17
Avg Growth /yr	**6.8%**	**4.9%**	**1.2%**																	

The data indicate that the aquaculture sector expects to better its 2003 Future Fish forecast for 2020, by around 60,000 tonnes, with volume climbing even further to 132,000 tonnes rather than the recent round figure of 100,000 tonnes. The 2050 forecast also looks bullish at 216,000 tonnes, although that number is very heroic, forty years ahead.

Importantly the NAC and its members believe their growth in the next 6 years through to 2015 will average around 7% per year and settle back to near 5% per year for the following 5 years through to 2020.

The biggest gains in aggregate tonnes are anticipated in the salmon industry, more than doubling tonnage in the next 12 years. Strong percentage gains are also forecast in Kingfish (from a standing start) and prawns, abalone, marron, yabbies and redclaw. Barramundi and prawns in particular make strong contributions to aggregate tonnage growth.

The parallel analysis for the wild capture species is not readily available.

The upward revision of forward production is welcomed by the National Aquaculture Council, the FRDC and the Government, demonstrating the confidence investors and stakeholders place in their industry.

This growth in demand is a driver at the heart of shaping research investment. Policy and management issues must be accounted for as national fisheries resources are used to meet this demand. Research undertaken in all fisheries over the next five years will address these issues and seek to develop outcomes that allow economic efficiency to be maximised while meeting social and sustainability objectives.

An Industry Growth Pathway

In 1984 eleven companies began salmon farming in Tasmania based on imported Atlantic salmon stock. From the first commercial harvest of 53 tonnes in 1987, the local industry has grown to now produce over 30,000 tonnes p. a. with a pond GPV of $350 million. (90% of sales are domestic).

As industry grew restructures boosted international competitiveness. From early beginnings as Tasmanian Atlantic Salmon P/L, the company became Tassal, acquired Nortas in 2003, and then merged with Aquatas in 2005. Today the industry is comprised of three large and several smaller hatcheries, five companies on-growing salmonids in three separate farming regions, and four companies harvesting, processing, and marketing their own fish. The three larger companies, including Tassal, are vertically integrated from hatchery to market.

Tassal employs over 450 people and produces and markets the bulk of industry production.

In 2008 Tassal generated revenue of $167 million, with profits of $21 million, up 33% on the previous period.

Highlights from the company's latest annual report (Tassal Group Ltd, 2008) identify the RD &E priorities:

- selective breeding is identifying quality and disease gains and options to manage climate change impacts
- increasing average fish size: 4.1kg up to 4.3kg
- increasing average fish survivability from 83% to 85%
- installation of plant automations including retail processing lines
- strengthening of brands in the face of stronger import competition - acquisition of **Superior Gold** brand.

While amoebic gill disease and breeding for consumer requirements are key issues today, the longer term challenge for the industry is to secure community support for access to marine waters for new growth.

In global terms Tassal is the 24th largest salmon company (by volume of sales) in the world.

Seafood Consumption

In August 2006 the FRDC commissioned an omnibus phone survey of seafood consumption (Ipsos, Aug 2006). More recently in November 2009 the FRDC completed further parallel seafood market research. (FRDC Perceptions Survey, 2009).

How often do you eat seafood?

The key conclusions from the 2006 study are summarised under 5 headings, with updates where relevant.

1. How often do you eat seafood?

In 2006 the responses were:

- Over half consume seafood at least once a week (54%).
- 30% eat seafood once a week.
- 24% consume seafood more than once a week.
- On average, respondents eat seafood 55 times a year.

In 2009, the responses to the same question were:

- More than once per week - 14.2%;
- Every week - 31.8%
- Every 2-4 weeks - 31.3%
- Every 2-6 months - 13.3%
- Less than once per year or never – 9.4%

2. Compared to 12 months ago, are you eating more or less seafood?

- Slightly over one in four consumers claim to be eating more seafood compared to a year ago.
- Whilst a small majority indicated similar consumption patterns to 12 months ago (56%).

3. Do you usually buy fresh, frozen or canned seafood?

- A large proportion of Australian consumers cite preference for fresh seafood (77%).
- To a lesser extent, canned (41%) and frozen (31%) varieties are purchased.

4. Do you usually buy local or imported seafood?

- For 67% of consumers surveyed, Australian seafood is said to be purchased normally. However, this figure may not actually be as high, if some consumers cannot clearly identify local seafood over imported seafood.
- Only 7% of consumers typically buy imported seafood.

5. Has any specific issue or event influenced your seafood consumption in the last 12months?

- Almost two-thirds of respondents indicated that consumption levels have not been influenced by any specific occurrences (65%).

- However, one in ten (9%) claim to have been influenced by health benefits.
- Health concerns such as dioxins and mercury content (6%), as well as media reports (5%) were also mentioned.
- Cost was cited as a reason by just 4% of consumers surveyed.

6. Where do you buy your seafood?

The 2009 survey revealed that 60% buy from supermarkets, 444 % buy from fish shops, an 27% buy from fish markets.

7. What is your main reason for eating seafood?

The 2009 study responses were: for meal variety -60%, as part of a balanced diet -55%, for health benefits -45%, for specific taste preference e.g. "love prawns" -40%, special event or occasion -21%, and for convenience -15%.

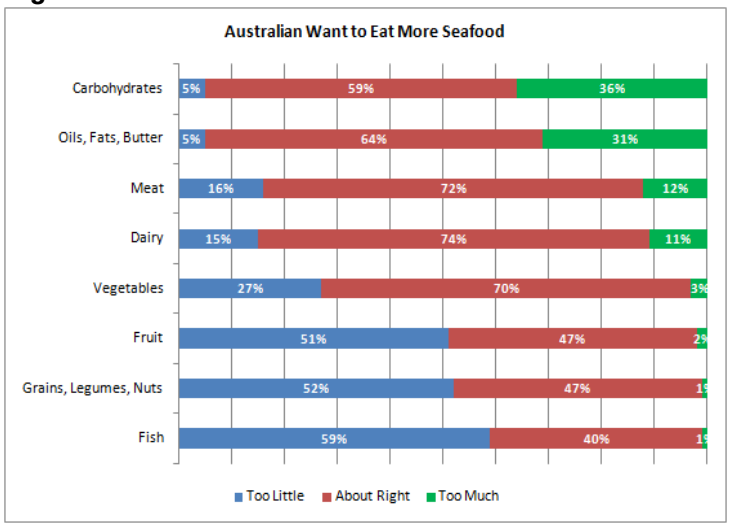
8. What are your main factors for choice of seafood?

The 2009 study responses were: where it comes from – local or imported -53%, availability and shopping convenience -45%, price and value -40%, and familiarity (cooking and preparation) and favourite recipe -35%.

The Melbourne Market survey undertaken in 2006 highlighted (FRDC, 2006) the following:

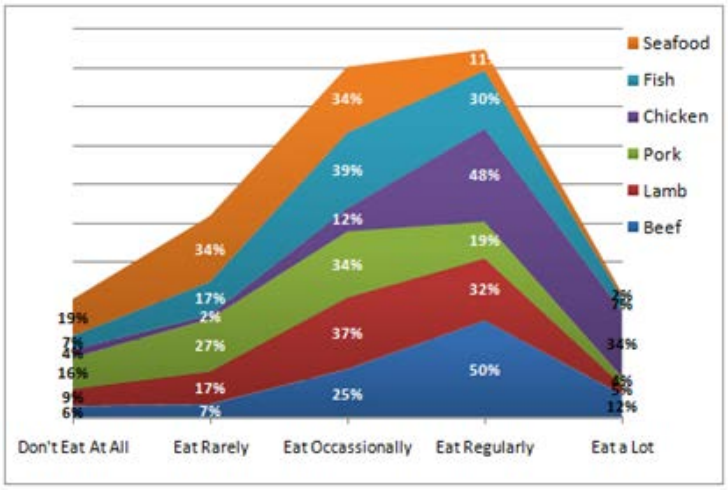
- Australian consumers have a marked preference for Australian produced seafood, as shown in surveys of Melbourne, Sydney and Perth, where 70% of consumers agreed with the statement, 'I prefer Australian seafood to imported seafood products'.
- Consumers appear to be unaware that in excess of two thirds of all seafood consumed in Australia is imported. Imported seafood volume increased 36% to from 2001/02 to 2006/07.
- Around 70% of total seafood consumption was consumed at home.
- Lack of confidence in buying and preparing fish and seafood and price are considered to be the two most important factors in constraining in home consumption of seafood.
- Out of home seafood consumption (i.e. restaurants, cafes, fish and chips shops and at friend's house) has been on the increase in capital cities since the 1990s. Perth has experienced stronger growth than Sydney and Melbourne (37%, 20% and 19% respectively). In home consumption has grown slowly in Sydney and Melbourne since the 1990s, but fallen in Perth.
- Out of home consumption patterns show a move to mid priced eateries such as cafes, upmarket fish and chip shops and inexpensive restaurants. Consumption has moved away from expensive restaurants and eating at a friend's house.
- All retail outlet categories (fishmongers, supermarkets and fish and chip shops) had increased sales of seafood since 1991 but supermarkets had the most impressive increase in sales of around 400%, albeit from a low base. Consumers are showing a distinct preference for getting their seafood from supermarkets. The supermarket sector's share of the fresh trade has doubled (from 16% to 32%) by volume. The fishmonger sector's sales have increased, however the sectors market share has fallen from 65% to 51%.

Figure 49. Australians Want to Eat More Seafood



Research commissioned by FRDC confirms that consumers believe seafood is good for them and this is translating into an increasing desire to eat more seafood, in preference to other foods. Nearly 60% of consumers believe they are consuming too little seafood in their diet, while only 1% believes they currently consume too much seafood. However the research suggests that while consumers genuinely believe they want to and should consume more seafood in their diet, they are not being reminded of this sufficiently to change their purchase behaviours.

Figure 50. Seafood not Front of Mind



While consumers want to eat more seafood, a significant proportion is a little confused about the difference between seafood and fish – they state a preference for fish. Regardless of the name, research finds that around 13% of consumers don't eat seafood at all, and a whopping 62% eat it only rarely (26%) or occasionally (37%). As a result of the minimal or limited promotion of seafood only 21% of consumers eat seafood regularly (Beef 50%, Chicken 48%, Lamb 32%, Pork 19%). Less than 5% of consumers eat seafood regularly (Chicken 34%, Beef, 12%, Lamb 5%, Pork 4%). By contrast the chicken industry has undertake extensive product development and heavily promoted their product over recent decades. A massive 82% of consumers eat chicken regularly (48%) or a lot (34%).

Profitability

Publicly available data regarding the profitability of commercial fishery sectors or businesses (including charter operators) in the fisheries industries is very limited, and often aggregated only by fishery. Prior to an analysis of sector or fisher profitability it is worth noting that:

- Global and local aquaculture will continue to meet the growing market needs and preferences of Australian seafood consumers. Wild catch will not share in any of this demand growth. As a direct consequence, Australian marine capture seafood products and their fishers and supply chains will continue to be under competitive market price pressure. Global aquaculture will increasingly set benchmark and floor prices for Australian seafoods.
- Where Australian chains compete against imports or as exports, they may face competitors who have no triple bottom line benchmarks, who devalue their economic, social and environmental capital; or who choose to meet benchmarks in different ways. This creates anomalies in pricing arrangements and results in regional pressure points and impacts such as degradation of overseas marine resources that are favoured by prices and fished unsustainably.
- In the face of sterner questioning from communities and consumers, commercial fisheries are increasingly seeking to add value to their seafood beach price, to their fishery access rights, and to their contribution to communities by offering clean and green products and practices. This "chain of custody" from resource to consumer aims to link through-chain rights to through-chain product integrity and consumer value. In response leading edge Australian fishers are testing the market and social benefits that may exist to drive increased returns from investments in green harvest and sustainable management certification schemes. For example WAL-MART, the biggest US retailer will source all its wild harvest and frozen seafood from MSC (Marine Stewardship Council) certified suppliers sustainable within five years (FRDC News).
- Chains of Custody issues reflect a broader shift by fishers and their related seafood supply chains to be more responsive to consumer wants and to voter expectations. Consumers have power over market access, sales and margins, and voters hold the veto over resource access. In order to achieve those expectations fisheries need to be managed so as to enable investment in needed technologies, training and capacity to achieve these benchmark performances. Different schemes favour different users. As an example in the face of significant economic and environmental change, weak access rights are more likely to favour those with better access to capital such as bigger corporatised concerns.

Commercial Wild Catch Sector

For the wild catch fishery there is limited data available in the public domain for State, Territory or Commonwealth fisheries. For AFMA managed fisheries the summary of findings of the economic trend of Commonwealth managed fisheries (ABARE, 2008) identifies only trend data, summarised as follows:

Figure 51. Commonwealth Fisheries Economic Trends

	GVP $million 2006-07	Trend of Economic Return	Latest Survey of Fisher Financial Return (figures in () are negative numbers)
Eastern Tuna and Billfish	$34	Strongly negative	Profit at full equity decreased from ($33,000) to ($48,000) in the 12 months to June 2007. Avg rate of return to full equity, decreased from (2.9% to (4.3%) for the same period. Over the last decade returns have been volatile but have been negative for the last 6 years.
Heard Is. and McDonald Is.	confidential	Not estimated	No survey conducted
Northern Prawn	$64	Negative	Profit at full equity increased from $84,000 to $243,000 in the 12 months to June 2008. Avg rate of return to full equity, including increased from 2.7% to 6.3% for the same period. Over the last decade returns have trended downwards to negative levels and recover slightly in the last year.
Southern Bluefin	Comm.: $41 SA Aqua: $97	Not estimated	No survey conducted
South East Scale and Shark	$98	Varied for trawl; high and relatively constant for gill, hook and trap	Comm. Trawl: Avg boat profit at full equity, which is boat business profit plus interest, leasing and rent, was ~$102,000 in 2005-06 and $161,000 in 2006-07. The rate of return to full equity rose from 6.2% in 2005-06 to 9.5% in 2006-07. Returns have risen strongly in the last 3 years. Gill Hook and Trap: Avg boat profit at full equity was ~$56,000 in 2005-06 and $92,000 in 2006-07. The rate of return to full equity rose from 4.8% in 2005-06 to 6.4% in 2006-07. Returns have been positive and been reasonably stable for the last 5 years.
Torres Strait	$25	Negative	Profit at full equity increased from ($50,000 to ($6000) in the 12 months to June 2008. The avg rate of return to full equity, including the value of quota and licences, increased from (3.5%) in 2006-07 to (0.4%) in 2007-08. Returns have been declining for 10 years.
Other small fisheries		Not estimated	No survey conducted

A study of the **South East Scale and Shark Fishery (SESSF)** (Pinnacle Management, 2007) demonstrated the rate of return to fishing vessels ranged from -7% (EBIT as % of Sales) to +21%. The profitable vessels were distinctly those that were either owner operated (5% to 7% EBIT to sales) or are operated by an experienced crew (19-21% EBIT as % of Sales). The study concluded it was highly unlikely that others in the Fishery will have the motivation to invest further in fishing resources. Even in an owner operator model returns generated were considered marginal at best, relative to financial performance expected of a sustainable business operation in a high risk sector.

A parallel analysis of the Profit and Loss statements (Pinnacle Management, 2007) provided by fishers in the **Eastern Tuna and Billfish Fishery (ETBF)** found that the average Profit Before Tax of fishing businesses was a return of +3.07% (as a percentage of revenue). The average range of Profit Before Tax returns per vessel (between one and three years) was between (30.72%) an exceptional figure, and +15.15%. However, the majority of returns were clustered around (8.00%) and +8.00%. Average sales revenue per vessel per annum was calculated at $975,709. The range of sales was from $0.34 million to $1.51 million. The wide disparity in incomes earned was directly linked to total catch.

Both theses fisheries have since been part of a structural adjustment package implemented by the Commonwealth Government. Average profitability would logically be expected to have improved as result.

For State and Territory jurisdictions, data is also variously available and in a range of formats. The **South Australian** industry has comprehensively analysed the business viability and economic contribution of their wildcatch sector over the last decade (Econsearch, 2009). For the 9 relevant fisheries (abalone, blue crabs Gulf St Vincent prawn, Spencer Gulf and West Coast prawn, Lakes and Coorong scale, marine scale, 2 rock lobster fisheries, sardine), the key per-boat or aggregate data is as follows:

Figure 52. Profitability of SA Wild Catch Fisheries

	Annual Profitability at Full Equity	Annual Return on Investment
Abalone	Average Per Boat profits ranged from $400,000 in 1999 to $600,000 in 2008 largely in line with abalone prices	ROI has fallen dramatically from ~12% in 1999 to ~5% in 2007-08 due to changes in abalone price and license values
Blue Crab	Total fishery profit increased significantly over the decade from $200,000 to $2,000,000. The number of licenses declined from ~40 to less than 15.	ROI was quite volatile, partially due to changes in license values, ranging from 4% and 10%
GSV Prawn	Average Per Boat profits ranged from $300,000 to ($100,000) largely in line with declines in catch and beach prices	ROI was quite volatile, ranging from 10% down to (6%) and at 0% in 2008
SGW Prawn	Average Per Boat profits have always been positive, ranging from $350,000 to $100,000, where they were in 2008	ROI has trended downward across the decade from 9% to the 2008 result of 2%
Lakes & Coorong	Average Per Boat profits have increased due to increased prices and catch from ~$20,000 to over $50,000	ROI was volatile but trending upward, ranging from 7% up to a 2008 return of 14%
Marine Scale	Average Per Boat profits have been negative for the whole decade within the range of ($20,000) to $0, and at ~($5,000) in 2008	ROI was quite volatile during the decade and always negative, ranging from (12%) to (1%) and in 2008 at (1%).
Nth Zone Rocklobster	Average Per Boat profits have ranged from $100,000 in 1998 to ($100,000) in 2004, and $0 in 2008. Costs have risen while beach prices have not.	ROI was quite volatile during the decade and ranged from 4% to (6%) and at ~0% in 2008
Sth Zone Rocklobster	Average Per Boat profits have trended upwards ranging from ~$70,000 in 1998 to ~$190,000 in 2008	ROI was quite volatile during the decade and ranged from 4.5%, in 1998, to 2% in 2004 and back to ~5% in 2008
Sardine	Average Per Boat profits have ranged from $200,000 in 1998 to $1,000,000 in 2004, and then crashed to $0 in 2005 where they were in 2008	ROI was quite volatile during the decade and ranged from 4% to 10% in 2004, and then crashed to ~0% in 2005 where they remained in 2008

In summary, across the estimated profits and returns for SA fisheries:

- 3 of the 9 fisheries saw negative profits at some period during the decade
- returns on investment generally trended downwards in the 10%-0% range for 5 fisheries;
- 3 suffered negative or zero ROIs in at least the last 6 years; and
- one fishery achieved rising ROIs of between 10-20% for the last 5 years.

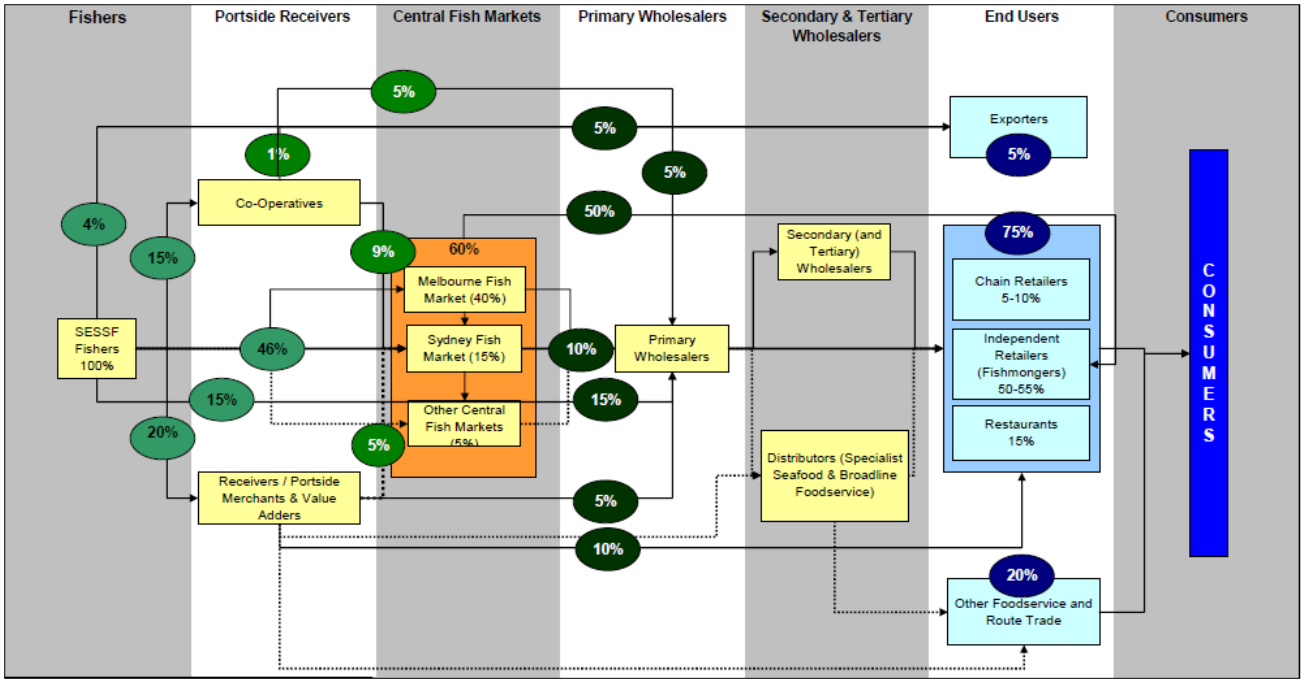
Aquaculture

The NAC advise there are no available reports on the level of profit and return generated by the aquaculture sector. Similarly there are no publicly available reports that illustrate the profitability of state based aquaculture industries.

Seafood

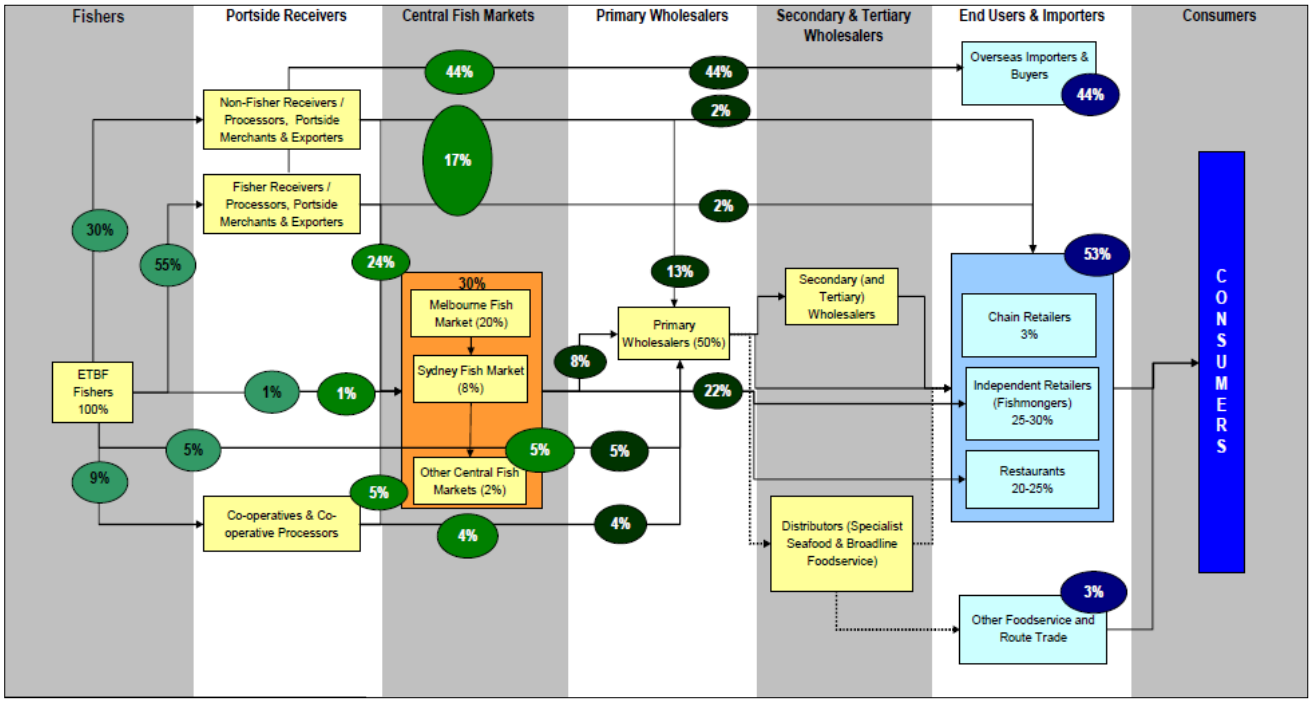
A study (Pinnacle Management, 2007) of the **SESSF** supply chain concluded that the chain was very complex, with up to 16 separate handlings of product before it was consumed. However the authors suggested this reflected the relatively modest volumes flowing through the chain, the diversity of ports and species in particular, and the lack of industry leadership in the chain to achieve improvements. Average profitability across the whole SESSF chain was described as "poor to low", but it did not appear that poor average financial performance was due to market failure but rather the skills and expertise of business operators.

Figure 53. SESSF Supply Chain



A parallel study (Pinnacle Management, 2007) of the **ETBF** supply chain concluded that average profitability was "very poor to low" across the whole ETBF Chain, noting that it did not appear that this poor financial performance was due to market failure but rather the skills and expertise of business operators.

Figure 54. ETBF Supply Chain



The study found the rate of return to all fishing vessels to be less than a 10% return on gross margin. At that level the study concluded it was highly unlikely that external investment will occur within the fishery.

The principal external factor influencing business profitability was foreign exchange rates with the USA and Japan. The authors noted that some fishers would argue that they are not influenced by exchange rates as they do not export. However if product is removed from the domestic market because it is exported this has the potential to increase returns for the remaining domestic product.

The returns to fishers and the efficiency of **the QLD seafood supply chain** were assessed in 2008 (Ruello and Associates, 2008). The study did not identify the range of profits and investment returns to participants in the chain, but concluded that:

- fishers could improve their financial outcomes by shortening and taking greater control over their supply chains through alliances with partners in the chain,
- overall there is no sign of excessive net profit in the post harvest sector although a few large retail outlets are likely very profitable,
- price mark ups for the Queensland wholesale trade and the supermarket retailers were similar to those operating in other states,
- Sydney exhibited cheaper prices, attributed to the high incidence of large volume retail outlets in relatively low rent situations,
- retail in Brisbane is dominated by relatively low volume outlets with higher operating costs per kilogram of fish sold,
- Cairns had a very large number of independent retail outlets, twice as many per capita as seen in some cities inside Sydney's metropolitan area,
- Wholesale and retail margins were clearly highly variable because of a number of factors including varying capital cost and operating costs, wastage/loss of damaged or spoiled product, and the different pricing strategies adopted for clearing stock in lean times versus times of surplus,
- about 10% of Queensland's independent retail outlets have prices and gross profit margins on many lines that were questionably high but these outlets mostly had a high standard of store presentation, seafood quality, staffing and service and had paid higher than average prices for seafood supplies and other inputs. They commonly outsell neighbouring cheaper outlets.

Sustainability Assessments

Commonwealth, State and Territory Governments maintain up to date assessments of the sustainability of commercial fisheries (DEWHA). These assessments contribute to the periodic Fishery Status Reports compiled and published by ABARE across all wild catch fisheries. For each fishery, the assessments describe and evaluate relevant aspects of the fishery's use and performance measured against key sustainability criteria, including those in the EPBC Act.

Headings in the assessment reports include a description of the fishery, target species, catch, value of fishery outputs, markets served, number and type of fishing licences, exports, stock status, harvest strategy, socioeconomic context, management arrangements, research underway and planned, status subject to the requirements of the EPBC Act, interactions with non-target species, impacts on the ecosystem, impacts on World Heritage Properties, risks, and related use and performance trends.

In northern Australia expert advice indicates aquaculture across northern Australia is well managed. In a recent communiqué (Natural Resource Ministerial Council, Nov 2009), the Council received a presentation from CSIRO on recent research into managing the environmental impacts of aquaculture and on the potential to develop aquaculture across northern Australia and increase seafood production using ecologically sustainable systems. The communiqué states "This research demonstrates that commercial, large-scale, closed system aquaculture in Australia is operating at world's best practice."

Commonwealth Fisheries

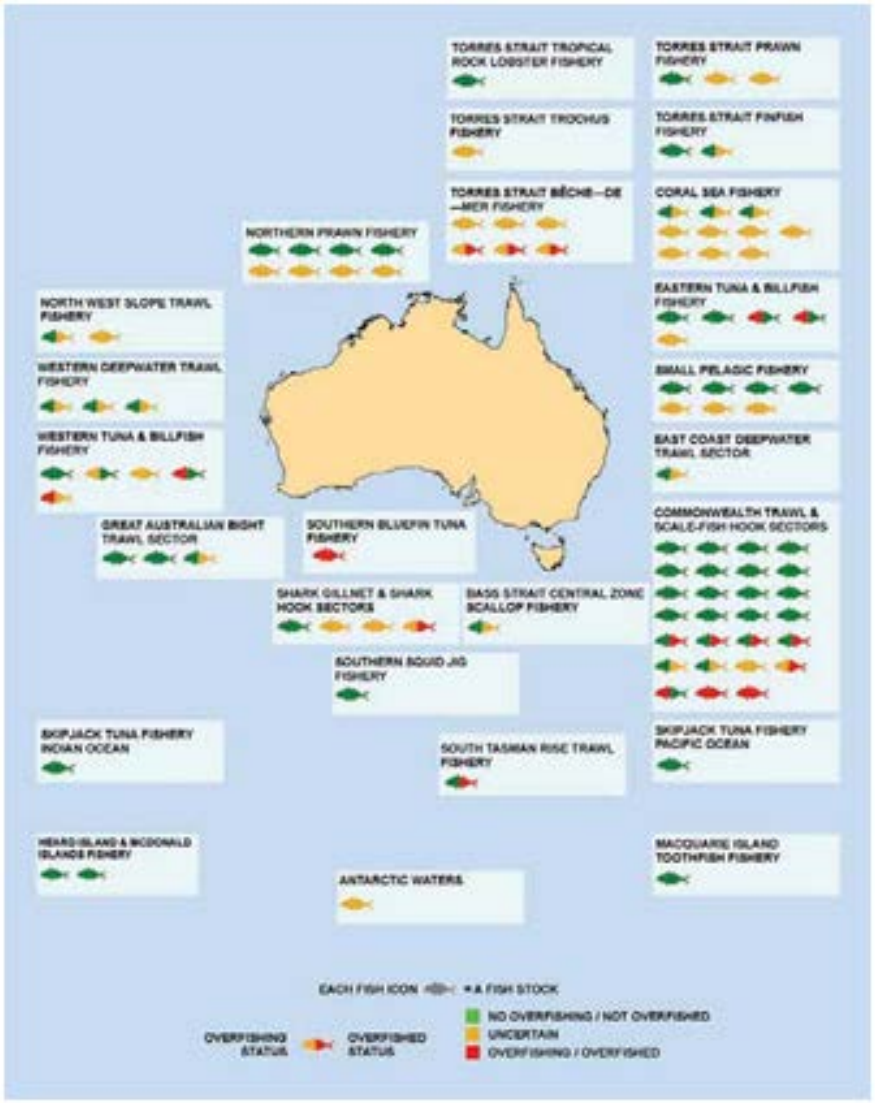
For Commonwealth managed fisheries, status trends (BRS, 2008) are discussed and presented in figures below. Colour coded classifications in both figures below are used to identify fishery status trends across Commonwealth fisheries.

Figure 55. Stock Status Trends – Commonwealth Fisheries

Biological Status		2004	2005	2006	2007	2008
Overfished Status	Not overfished	20	25	31	33	44
	Overfished	14	17	15	11	13
	Uncertain if overfished	40	41	51	52	41
Overfishing Status	No subject to overfishing	12	15	41	45	57
	Subject to overfishing	9	12	5	6	8
	Uncertain if overfishing	53	56	51	45	33
Total stocks assessed		74	83	97	96	98

Each fish icon represents a single stock assessed in the Fishery Status of 2008, by fishery or sector. The left half of each icon represents the overfishing status, while the right half represents the overfished status of the stock. From the trends it can be seen there is general improvement in both the status of the stocks and the robustness of the assessments undertaken.

Figure 56. Stock Status – Commonwealth Fisheries 2008



Summary points are as follows:

- The number of stocks assessed as <u>not overfished</u> has more than doubled since 2004, the largest yearly increase occurring from 2007 (33 stocks) to 2008 (44 stocks). Improvement evident in 2008 is largely due to an increase in the information available for stocks.
- The number of stocks classified as <u>not subject to overfishing</u> has increased substantially from 12 in 2004 to 57 in 2008. Actions by AFMA to immediately halt overfishing and more recent additional management measures have brought about recovery of overfished stocks (e.g. TAC reductions, additional area and depth closures).
- Of the 18 stocks that are classified as either <u>overfished or subject to overfishing</u> in 2008, 13 are overfished and 8 are subject to overfishing. Three of these stocks are both overfished and subject to overfishing (southern bluefin tuna, jackass morwong and upper-slope gulper sharks). In 2008, three stocks have been newly classified as either overfished and/or subject to overfishing in 2008: blue warehou, upper-slope gulper sharks and jackass morwong.
- The number of stocks classified as <u>uncertain</u> (overfished and/or overfishing categories) has been increasing. However, in 2008 this trend was strongly reversed with 11 stocks being removed from an uncertain overfished status and 12 stocks from an uncertain overfishing

status. Much of the historical increase was a consequence of the addition, over time, of new stocks not previously considered, for which insufficient information was available.

- The high proportion of stocks that remain classified as uncertain (~ 42% for overfished, and ~32% for overfishing) is a continuing cause for concern, and highlights the importance for AFMA of applying the precautionary approach in fisheries management. The reduction in the number of stocks classified as uncertain in this edition of the Fishery status reports is, in part, attributable to the implementation of the Harvest Strategy Policy and related programs.

For state and territory fisheries, the assessment is summarised as follows:

QLD Fisheries (QDPIF, 2008-09)

Figure 57. QLD Fisheries - Stock Status

Status	Description for 2008 and 2009 Assessments	Fishery
Overfished	A species is assessed as overfished	snapper
Some Performance measures triggered	One or more Management Plan objective performance measures have not been achieved	blue swimmer crab, eels, stout whiting, mud crab, rocky reef fin fish, tropical rock lobster, coral reef fin fishery, deep water fin fishery, east coast Spanish mackerel, spanner crab
All Performance measures either not triggered or Unmeasured	All Management Plan objective performance measures have not been measured or have not been trigged	shell collection fishery, coral fishery, Beche–de mer, inshore fin fishery, east coast pearl fishery, east coast trochus, Gulf of Carpentaria developmental fin fish, Gulf of Carpentaria inshore fin fishery, marine aquarium fishery, river an inshore beam trawl fishery,
Stock Status Uncertain	Stock status for a species is assessed as uncertain	Gulf of Carpentaria Spanish mackerel, crimson snapper

NSW Fisheries

Since 2001/02 there has been a steady decrease in the number of key species which are considered to have an exploitation status which is uncertain or undefined. Most of these additional assessments have determined species to be sustainably fished (and, in some cases, moderately or lightly fished).
Three species are considered to be overfished (gemfish, eastern sea garfish and mulloway).
Six species are considered to be growth overfished including eastern king prawn, redfish, school prawn, silver trevally, snapper and yellowtail kingfish. Growth overfishing does not necessarily indicate that the fishery is unsustainable, rather that harvesting is economically inefficient and that management involves greater risks and costs of monitoring. For many key species that are considered "undefined", there exists significant reporting issues that will be difficult to resolve without independent observer programs. (NSW Fisheries, 2008)

VIC Fisheries (Fisheries Victoria, 2008)

Figure 58. VIC Fisheries - Stock Status

Status	Description for 2008 Assessment	Fishery
Fully Exploited	There are sustainable levels of fishing and satisfactory abundance of fishery stocks. (Minor issues may be affecting fishery stock abundance, and/or the sustainability of fishing.)	Rock Lobster, Giant Crab, Abalone, Eel, Salmonid
Underexploited	There are sustainable levels of fishing and satisfactory abundance of fishery stocks. The fishery could potentially tolerate additional harvest pressure.	Scallop, Sea Urchin
Over exploited	Stock abundance is not satisfactory, and/or overfishing is occurring	
Environmentally Limited	Significant non-fishing (ecosystem) issues have been identified that are influencing productivity in the fishery. These issues are considered to be driving stock status.	Snapper, Black Bream, KG Whiting, Murray Cod

TAS Fisheries

Stock assessment processes for fisheries under Tasmanian jurisdiction are conducted by the Tasmanian Aquaculture and Fisheries Institute (TAFI). TAFI is a joint venture between the Tasmanian Government and the University of Tasmania. The assessment process revolves around production of annual stock assessment reports and formal structures for supporting this process. Research Advisory Committees and other ad hoc committees also support the process.

The stock assessment reports are structured and report slightly differently for each fishery depending on the assessment tools utilized and the performance measures and objectives in place for the fishery. The simplified summary into one or two word categories is not utilized and thus is not included in this summary.

SA FISHERIES (PIRSA, 2006)

Figure 59. SA Fisheries - Stock Status

Status	Description for 2006 Assessment	Fishery
Uncertain	There is limited quantitative information available to provide a reliable assessment of stock status.	nil
Under fished	Is underutilised and has the potential to sustain harvest levels higher than those currently being taken.	Nil
Fully fished	Harvest levels are at, or close to, optimum sustainable levels. Current fishing pressure is considered sustainable. Any increase in catch or fishing pressure may lead to over fishing in the long term.	All other fisheries
Overfished or depleted	Harvest levels are not sustainable and/or yields may be higher in the long term if catch or effort levels are reduced in the short term, or the stock may still be recovering from previous excessive fishing pressure. Classification of a stock as over fished or depleted may be due to recruitment or growth over fishing and/or as a result of habitat degradation. Recovery strategies will be developed for all over fished stocks to reduce fishing pressure and ensure that stocks recover to acceptable levels within agreed timeframes.	Northern zone rock lobster, Central zone blacklip abalone, Gulf St Vincent prawns, King George whiting, garfish
Environmentally limited	Has reduced productivity due to external impacts associated with habitat modifications or environmental factors. Reduced stock levels are not primarily due to fishing, although fishing may be a contributing factor to ongoing concerns regarding low stock levels.	Mulloway, black bream, and west coast prawn

Figure 60. SA Fisheries - Stock Status Trends

Biological Status	YE June	2003	2004	2005
Uncertain		1	1	0
Under fished		0	0	0
Fully fished		13	12	14
Overfished or depleted		3	4	4
Environmentally limited		4	4	3
Total stocks assessed		**21**	**21**	**21**

WA Fisheries (WA Fisheries, 2008)

Figure 61. WA Fisheries - Stock Status

Status	Description for 2006 Assessment	Fishery
Uncertain	There is limited quantitative information available to provide a reliable assessment of stock status.	bêche-de-mer, south coast crustacean, Australian herring
Adequate	reflects levels of parental biomass where annual variability in recruitment of new individuals (recruits) to the stock is a function only of environmental effects or recruit survival.	All other stocks
Increasing	reflects situations where the parental biomass has previously been depleted to unacceptable levels by fishing or some other event (e.g. the virus attacks on pilchards in the 1990s) but is now recovering due to management action and/or natural processes.	Cockburn Sound crab, Southern and West coast demersal gillnet and longline (gummy and whiskery shark)
Inadequate	reflects situations where excessive fishing pressure (catch) or some external event has caused parental biomass to fall to levels where the breeding stock is depleted to levels that may affect recruitment.	West coast demersal scale fish, and Shark Bay snapper
Depleted		Northern shark, Southern and West coast demersal hook and longline (dusky and sandbar sharks)

NT Fisheries

The 2007-08 Fishery Status Report confirms that status trigger points and comprehensive fishery assessment methodologies are currently being developed and implemented in the jurisdiction.

5. Recreational Fishing

Context

Australians enjoy a wide range of recreational activities, including fishing in marine water, estuaries and inland fresh or saline waters. Most recreational fishers undertake wildcatch fishing activities using lines or spears for relaxation, not for food. Catch and release practices are an increasing component of Australian recreational fisheries. All recreational fisheries are managed by state and territory jurisdictions. Australians also enjoy the aquatic environment in passive non extractive ways (e.g. tourism), but these are not classed as recreational fishers.

Location

The National Recreational and Indigenous Fishing Survey undertaken in 2000, presents the most comprehensive assessment of waters used for recreational fishing. Geography, population distribution and ease of access to aquatic resources were key determinant for the location of recreational fishing activities.

Figure 18 maps the location of major and minor recreational fishing centres, and the regional recreational sea and land based catch. It confirms the extensive spatial extent of the recreational fishing sector. While the centre data is current (provided by state and territory agencies), the catch data is drawn from the NRIFS in 2002, the most recent national dataset available.

New South Wales and Victoria have major urban population centres (Sydney, Melbourne) located adjacent to relatively large estuarine systems (Port Hacking, Botany Bay, Port Jackson, Hawkesbury, Port Phillip Bay, Western Port) and consequently a substantial proportion of the fishing effort was directed in estuarine waters. Queensland also has urban populations adjacent to large estuaries in addition to an extensive coastal fishing region bounded by the Great Barrier Reef. The bulk of the recreational fishing effort in that State was divided between the estuarine and coastal waters. The predominance of fishing in coastal waters was a feature of recreational fisheries in South Australia, Western Australia and Tasmania. These States have relatively limited estuarine systems and prominent extensions of the continental shelf adjacent to metropolitan centres. Fishing effort was more evenly distributed between river, estuarine and coastal waters in the Northern Territory while freshwater fishing, especially in lakes or dams, was the exclusive feature of fishery in the landlocked Australian Capital Territory.

In 2000 an estimated 80% of recreational fishing effort occurred in saltwater (offshore, coastal and estuarine waters) as opposed to 20% in freshwater (freshwater rivers, lakes and dams). However, at the State or Territory level it was apparent that saltwater fishing effort exceeded the national level in Queensland, South Australia and Western Australia (84-95%) and was slightly lower for New South Wales, Tasmania and the Northern Territory (71-76%). In Victoria there was greater reliance on freshwater fishing, with saltwater fishing effort representing just 57% of the total for that State.

Fishing Tourism Snapshot

Northern Australia offers appeal as a tourism frontier - abundant fresh and saltwater fish species, comparatively low human population and wilderness appeal. Iconic tropical species such as marlin and barramundi are draw cards for fishers globally.

This coincidence of species and locational appeal brings fishing visitors from around Australia and overseas in three categories: international, intraregional and local.

International fishing visitors, primarily from Europe, stay an average 24 nights. Of all European visitors to the NT, 7% undertake fishing as an activity while here. Research by the NT Government indicates these international European fishing visitors base their trip around fishing and stay three times as long as the general international tourist.

There are a number of charter businesses that offer Barramundi based charter tours in NT waters.

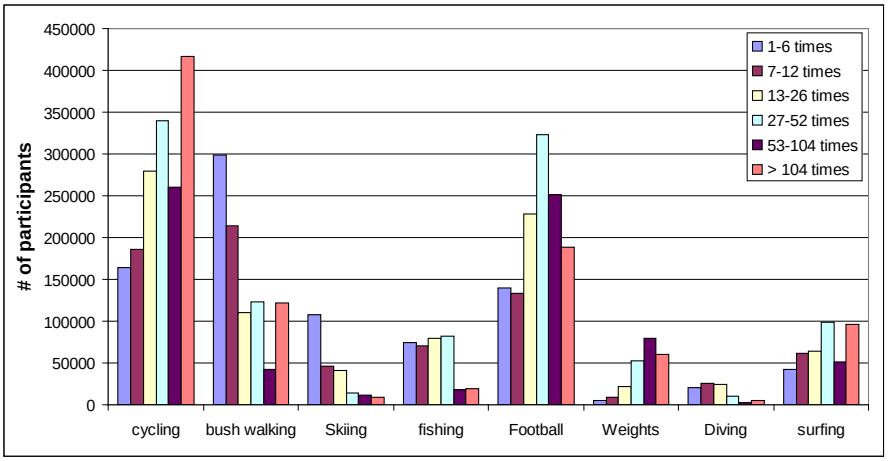
Further east in billfish waters, sport fishing operators offer sport-fishing, game-fishing and fly-fishing mother ship fishing charters along the QLD Coast and into the Coral Sea. To ensure optimal in-fishery outcomes for international tourists operators are based adjacent airline connections and offer floatplane access to large (25m) mother ships based up to 300 nautical miles from the coast. Trips are available for up to 14 people for 8 nights on the ship and 6 sportfishing boats.

Scale and Scope

Recreational fishing is a large industry and a big business - around 3.4 million people fish recreationally each year spending about $665 million on tackle alone (NRIFS, 2003) (Dominion Consulting, 2005). By comparison:

- In 2007, an estimated 3.8 million persons were involved as players in organised sport and physical activity (23% of persons aged 15 years and over) (ABS 6285.0, Apr 2007).
- In 2005- 06, Australians fished recreationally just as often as they attend an art gallery; 40% more often than they attended the nation's most popular sport (Australian Rules football - 2.5 million visits); more than twice as often as they attended a Rugby League game (1.5 million visits); and 30% more often than they attended a horse or dog racing event (2.7 million visits) (ABS 4172.0, 2008).
- In 2005-06, around 1/3rd as many adult Australians fished for recreation as attended the cinema - at 10.4 million visits per year, the cinema is Australia's most popular cultural venue. At average cinema ticket prices of $10-15/visit this creates annual revenue from ticket sales of less than $200 million, less than 1/3rd the retail value of annual tackle sales to recreational fishers.

Figure 62. Frequency of Australian Recreational Activities



National research undertaken by industry in May 2002 (NRIFS, 2003) identified 3.36 million Australian residents aged 5 or older fished at least once, representing a national participation rate of 19.5%. NSW had the greatest number of recreational fishers (999,000) followed by QLD (785,000) and VIC (550,000). The high numbers of recreational fishers in New South Wales and Victoria were more a reflection of their large population sizes, since participation rates in these States were below the national average (17.1 and 12.7%, respectively). Rates of fishing participation above the national average were recorded in the Northern Territory (31.6%), Tasmania (29.3%), Western Australia (28.5%), Queensland (24.7%) and South Australia (24.1%). The participation rate for the Australian Capital Territory (19.2%) was very close to the national average.

In a literature review undertaken by CSIRO, a number of studies have demonstrated that the recreational catch may exceed or be significant compared to the commercial catch for many fin fish species (CSIRO, 2009). Australian examples include snapper, King George whiting, tailor, queenfish, yellowfin bream, and dusky flathead. CSIRO also not that the recreational catch is also significant for other species shared with the commercial sector, including prawns, blue swimmer crabs, rock lobsters, pipis and squid.

The catch and release percentage varies by species – sharks and rays as high as 80%, garfish as low as 12% and marlins as low as 5% (NRIFS, 2003). Key recreational species by number of fish include bream (63% released), flathead (45%), whiting (34%) and herring (17%).

Catch

Available data for recreational catch is presented below drawn from NRIFS, QDPIF and Ridge Partners. The data provide estimates for 2009, based on the NRIFS survey data augmented by more recent relevant state or territory data. The tonnage figures have been estimated by Ridge Partners based on industry estimates of the average catch weight of species caught in relevant jurisdictions.

Figure 63. Recreational Harvest

Jurisdiction	Total Harvest	Fish	Crustaceans	Molluscs
Number of Fish				
NSW	31,088,895	14,357,779	16,541,256	189,860
Vic	13,269,106	9,562,107	3,497,442	209,557
QLD	41,014,069	32,141,383	8,678,045	194,641
WA	15,316,049	10,442,286	4,442,562	431,201
SA	14,896,245	10,817,156	3,013,405	1,065,684
Tas	2,831,433	2,580,456	98,044	152,933
NT	763,075	638,729	124,082	264
ACT	55,671	35,735	19,936	-
Total fish	119,234,543	80,575,631	36,414,772	2,244,140
Estimated Tonnes				
NSW	7,438	6,949	413	76
Vic	3,624	3,359	173	93
QLD	13,474	12,298	1,136	39
WA	6,087	5,085	896	107
SA	4,178	3,130	616	432
Tas	1,109	957	73	79
NT	1,144	1,075	69	0
ACT	24	24	1	-
Total tonnes	37,078	32,876	3,376	825

Figure 64. Recreational Catch and Release

Jurisdiction	Total Catch	Harvest	Released	% Released
Number of Fish				
NSW	45,934,041	31,088,895	14,845,146	32%
Vic	22,631,282	13,269,106	9,362,176	41%
QLD	69,962,022	41,014,069	28,947,953	41%
WA	23,935,045	15,316,049	8,618,996	36%
SA	21,133,132	14,896,245	6,236,887	30%
Tas	5,318,834	2,831,433	2,487,401	47%
NT	1,835,299	763,075	1,072,224	58%
ACT	73,386	55,671	17,715	24%
Total fish	190,823,041	119,234,543	71,588,498	38%
Estimated Tonnes				
NSW	10,989	7,438	3,552	32%
Vic	6,181	3,624	2,557	41%
QLD	22,983	13,474	9,510	41%
WA	9,513	6,087	3,426	36%
SA	5,927	4,178	1,749	30%
Tas	2,083	1,109	974	47%
NT	2,752	1,144	1,608	58%
ACT	32	24	8	24%
Total tonnes	60,460	37,078	23,383	38%

Profitability

By definition recreational and customary fishing are not commercial activities for profit. But subsets of the sectors do support charter and tour guide businesses that commercially motivated (See Figure 1).

A study across over 100 boats in the ETBF recreational fishery in 2004 (ABARE, 2004) found the profitability of charter businesses to be very low. Profit at full equity provides a measure of the return that would have been earned by the business unit had the boat and other capital been fully owned by the operator. For 2001-02 the study found that average profits per boat at full equity for various jurisdictions were $500 in NSW, $15,700 in QLD, and ($9800) in Tasmania. The rate of return to capital is the percentage annual return to the capital invested in the business (i.e. profit at full equity divided by total capital). This was estimated to be only 1.7%, ranging from 3.2% to (7.6%). However the analysis showed considerable variation existed in the returns per boat across regions and subregions of the fishery. In QLD there were a number of sampled boats that were making significant net returns. In general the primary business activity of these operators was charter fishing.

Tackle Trade

The retail recreational fishing tackle (RFT) industry in Australia is conservatively estimated (Dominion Consulting, 2005)to have:

- a retail value of sales in 2003-04 of $665million (incl. GST), of which 12.3% is for bait,
- 1,520 retail businesses, with 30% selling RFT products only and 70% selling tackle and other related products and services,
- most RFT retail outlets achieve annual sales in the $250,000-$500,000 range, with a lesser but substantial number also achieving sales of $500,000 - $1,000,000.
- Sales (in descending sales frequency) from businesses that sell tackle and other related products and services include tackle, camping, sports goods, boats and motors, clothing, diving / shooting equipment, food, accommodation and tourism services. The highest sales amounts come from sales of boats and motors.
- a seasonal sales profile, with sales highest in the summer months (Nov-Dec) in southern Australia, and in winter (Apr-Sep) in tropical Australia.
- 1,720 full time jobs and 830 part time jobs, - an aggregate of 2,550 jobs nationally. The analysis report's suggests around 2,280 of these jobs are in the retail sector.
- investment in RFT retail assets nationally is in the order of $600 million,
- retail RFT sector annual growth averaged 6.5% between 2000-01 and 2003-04.

Supporting the retail sector is the RFT wholesale sector comprising importers, distributors, and manufacturers. This sector is estimated to have (Dominion Consulting, 2005):

- national sales value of $394 million, $36 million of which is contributed by Australian manufacturers of RFT, and $31 million from publications / media and bait wholesalers,
- a total of 1,798 jobs comprising 1,406 full time and 392 part time positions,
- investment in wholesale assets totalling $144 million,
- wholesale RFT sector annual growth averaged 9.0% between 2000-01 and 2003-04.

The RFT trade sector considers its key issues to be

- competition from relatively cheap imported products,
- a trend by recreational fishing consumers to purchase more expensive tackle,
- the significant contribution to the sectors by local and tourist fishers and new fishers,
- impacts of government policy on small businesses, and in particular regarding the closure of recreational access to waters and the commercial depletion of fishing stocks.

The consultant's report found an average annual retailer:

- achieved a gross profit margin of 53% of gross sales, with a stock turnover of 3.2 times
- had an asset value of $368,000.

Regional Economic Impacts

The nature and extent of human recreational activity is often closely aligned to specific regional population demographics. For example child care centres are more common in family neighbourhoods than near aged care or retirement centres. Similarly, the nature and intensity of recreation based on fishing is often predisposed and collocated where certain demographic traits

predominate. Obviously the proximity to the fishery resource is also a key factor. As a result regional impacts of recreational fishing across Australia will be highly variable.

The economic impact of the recreational fishing industry to the national economy has long been debated. Traditionally, hard, comprehensive analysis and reporting has been difficult to find in the public domain. Thankfully this is now changing. A couple of recent reports demonstrate the complexity of recreational issues, and strong evidence for the sector's economic contribution apart from the well documented social contributions of the sector.

NSW Region

A NSW regional report undertaken in 2005-06 (Ernst & Young, 2006) considered two significant regional recreational fishing areas in NSW (Port Stephens Region, and Narooma/Bermagui Region) and the economic impacts of the declaration of marine parks in each region. The study found that :

- recreational angling in Port Stephens and Narooma/Bermagui is an activity that attracts mainly men:
    - aged between 30 and 59 years old (74% of recreational anglers in Port Stephens and 68% of recreational anglers in Narooma/Bermagui),
    - whose highest level of education is high school (67% of recreational anglers in Port Stephens and 45% of recreational anglers in Narooma/Bermagui). However, over 30% of the recreational anglers surveyed in Port Stephens had a university degree, college diploma or post graduate education, as did over 40% of recreational anglers surveyed in Narooma/Bermagui,
    - who earn less than $100,000 of gross income per annum (over 74% of recreational anglers in Port Stephens and over 68% of recreational anglers in Narooma/Bermagui). A large proportion of recreational anglers earn less than $50,000 per annum (over 31% of recreational anglers in Port Stephens and over 40% of recreational anglers in Narooma/Bermagui).
- most recreational anglers oppose the creation of the Port Stephens – Great Lakes Marine Park (> 84% opposed, >64% strongly opposed) and the Batemans Marine Park (>63 % of opposed, ~50% strongly opposed),
- most recreational anglers believe the establishment of these marine parks will have a significantly adverse impact on their ability to catch fish in those areas (>66% in Port Stephens, > 54% in Narooma/Bermagui);
- most recreational anglers would support the creation of those parks if they were reasonably satisfied that their favourite fishing locations would not be affected by the creation of the marine park (>64% in Port Stephens, >45% in Narooma/Bermagui),
- most recreational anglers would reduce the number of times they visit Port Stephens and Narooma/Bermagui by more than 50% if the creation of Marine Park went ahead,
- recreational anglers are broadly divided (60% oppose/40% support) the inclusion of Recreational Fishing Havens within marine parks.

For Port Stephens Region in 2005-06, the recreational fishing sector:

- comprised 5,920 anglers whose aggregate expenditure totalled $81 million ($291 per day),
- contributed an estimated annual gross output of $65 million, and
- supported 176 jobs to the regional and NSW economies.

For the Narooma/Bermagui Region in 2005-06, the recreational fishing sector:

- comprised 8,244 anglers whose aggregate expenditure totalled $49 million ($177 per day),
- contributed an estimated annual gross output of $23 million, and
- supported 267 jobs to the regional and NSW economies.

Victorian Study

A Victorian state report undertaken in 2008-09 (Ernst & Young, 2009) considered the participation and economic contribution of Victorians (excluding any interstate or overseas fishers' impacts) to the Victorian economy. The study found:

- an estimated 721,000 Victorians participated in recreational fishing during the year
- the number of trips per fisher averaged 12 during the year, with the total number of trips by all recreational fishers estimated to be 8.7 million,
- the average expenditure per trip per fisher was estimated to be $250 including both variable costs (accommodation, bait, fuel, etc) and fixed costs (equipment and capital),
- an average of 2.4 people accompanied a fisher on each trip,
- the average number of locations regularly fished in Victoria by each fisher was 2.8,

The major demographic characteristics of Victorian fishers were:

- 67% were male,
- fisher age ranges were relatively evenly spread, although most were in the 45-54 years age group,
- 64% of recreational fishers reside in metropolitan Melbourne and 36% in regional Victoria,
- 75% of recreational fishing trips are undertaken in Spring and Summer,

The results of the economic analysis include:

- expenditure directly related to recreational fishing amounted to $2.3 billion, with a forecast increase to $2.9 billion by 2028-29,
- the state sector produced an estimated total Gross State Product in 2008-09 of$825 million in 2008-09. There are significant regional components for the 2008-09 economic impact including $229 million in Melbourne/Port Phillip; $173 million in Gippsland; $178 million in North East Victoria, $57 million in North West Victoria, and $188 million in South West Victoria. The sector is forecast to have a net present value (20 year analysis) of $10.6 billion.
- recreational fishing contributed 5,200 jobs (including direct jobs, and indirect flow on jobs) to the Victorian economy.

Implications for Direct Expenditure

There are no current estimates of the value of the national recreational fishing sector.

Drawing substantive implications on a small sample is always perilous – hard data across the whole population is always the best way to add truth to data to create fact. But we may be able to make some back-of-the-envelope estimates of the current direct expenditure for the national recreational fishing sector, based on these studies.

The Victorian state study suggests direct expenditure (from all sources) per recreational fisher per year is around $3,190 ($2.3 billion/721,000 fishers). The comparable estimates for the NSW studies conducted in the more intensive and popular recreational fishing regions suggest ~$13,682 per fisher per year for Port Stephens Region ($81 million / 5,920 fishers) and $5,944 per fisher per year for Narooma/ Bermagui Region ($49 million / 8,244 fishers) respectively. These estimates seem in order and logical – average direct expenditure intensity across all fishers in a state would be lower than for a popular recreational fishing region.

The National Recreational Fishing Survey Economic Report (FRDC 99/158 - NRFS Economic Report, 2005) found that regional attributable expenditure was generally related to the size of the population and the number of fishers. In nominal 2003 dollars, New South Wales had the largest expenditure ($554 million), followed by Victoria ($396 million) and the Australian Capital Territory the smallest ($19 million). The national average attributable expenditure was $552 per fisher per annum, with the highest per capita expenditures in Victoria ($721) and Western Australia ($706) and the lowest in the Australian Capital Territory ($362).

Based on the assumption that Victoria has a stronger demographic (dominant large urban centre), and spatial predisposition to recreational fishing (proximity to marine, estuarine and terrestrial resources), we might assume that the national average direct expenditure per fisher is say, 75% of the Victorian rate of $3,190. (i.e. $2,395). This seems reasonable as the NRFS figures above would suggest 76.6% ($552/$721).

Assuming little change in the level of participation in recreational fishing nationally since 2003, a rough estimate in 2009 dollars of national annual direct expenditure by the 3.4 million recreational fishers in the sector is $8.1 billion ($2,395 x 3.4 million).

What Is Missing

This recent progress made especially by some state agencies and industry stakeholders to develop our understanding of recreational fishing is commendable. However for a sector that is estimated herein to expend up to $8 billion per annum, the investment is long overdue. Many use, performance and economic impacts for the recreational sector are very poorly reported and analysed. Regional and national Australian economies and communities are considerably worse off as result.

The major gap is our industry lack of data to inform our understanding of the sector and its resource use and performance, and our knowledge of the quantum and efficiency of the economic value chains for recreational fishing products and services. We can not hope to manage what we do not understand or measure. Greater and more efficient joint invest is required by agencies and stakeholders to overcome this substantial gap.

Strategy

The recreational fishing sector has recently identified a vision, and policy and research priorities to guide its policy, investment and development.

The vision developed by the Recreational Fisheries Industry Development Strategy Committee (RFIDS Committee, 2009) is for all Australian to have the opportunity to enjoy the benefits of a sustainable, healthy and diverse recreational fishing experience.

The key principles developed to guide he actions that achieve this vision are:

- recreational fishing is a legitimate activity that contributes to Australians' health and well-being at individual, family and community levels,
- healthy environments are fundamental to sustainable recreational fishing and fish resources,
- recreational fishers share in the stewardship of fish resources through partnerships in decision-making processes affecting recreational fishers,
- the recreational fishing sector has the capacity to play a greater role in addressing current and future issues affecting the industry,
- management decisions affecting recreational fishing should be based on sound scientific ecological, social and economic information,
- recreational fishers and government should share the responsibility and costs of managing and enhancing recreational fishing,
- fish resource allocation should be based on providing optimal benefits to the community,
- recreational fishers are encouraged to use best practices in all aspects of their fishing activities,
- recreational fishers and government should work in partnership to play a positive role in dealing with climate change,
- Australian communities benefit by improving the range and quality of recreational fishing opportunities,
- responsible participation in recreational fishing provides valuable social, and economic benefits and should be actively encouraged,
- recreational fishing can be a valuable addition to schools and other education programs on environmental studies, sustainable resource use, social responsibility and community health and well-being.

Business research priorities (Recfish Australia, 2009), supported by desired outcomes, encompass both social and health benefits, and economic benefits for the community from the sector.

- **Social, health and economic benefits of recreational fishing**. Desired Outcome: Communities and governments recognise and value the social, health and economic benefits of recreational fishing, and consider these in decisions that affect recreational fishing.
- **Building capacity in the recreational fishing sector**. Desired Outcome: The recreational fishing sector has the leadership, capability, resources and funding to research and advocate its views effectively in decision-making forums.

- **Recreational Fishing Statistics**. Desired Outcome: Data on attitudes, motivation, demographics, participation, fishing methods, catch and effort are available at state and national levels to assist decision making on recreational fishing.
- **Best practices in recreational fishing**. Desired Outcome: Recreational fishing practices are sustainable, ethical and humane. The priorities in relation to best practices in releasing fish are the extension of material promoting best practices. There has been considerable research in this area and significant new knowledge is available. Getting this information into recreational fisher networks and to recreational fishers is the priority.
- **Impacts of management measures**. Desired Outcome: Management measures that affect recreational fishers are implemented with maximum engagement of fishers and result in minimum adverse impacts. Recreational fishers' access rights are acknowledged by water, land and biodiversity conservation agencies.
- **Enhancing Recreational Fisheries**. Desired Outcome: Fishery enhancement is conducted in an environmentally sustainable manner and is socially and economically beneficial to communities adjacent to where it occurs.
- **Impacts of environmental and climate change**. Desired Outcome: Recreational fishers understand the impacts of environmental and climate change and have the knowledge to change practices to help mitigate the impacts or be able to adapt to the change.

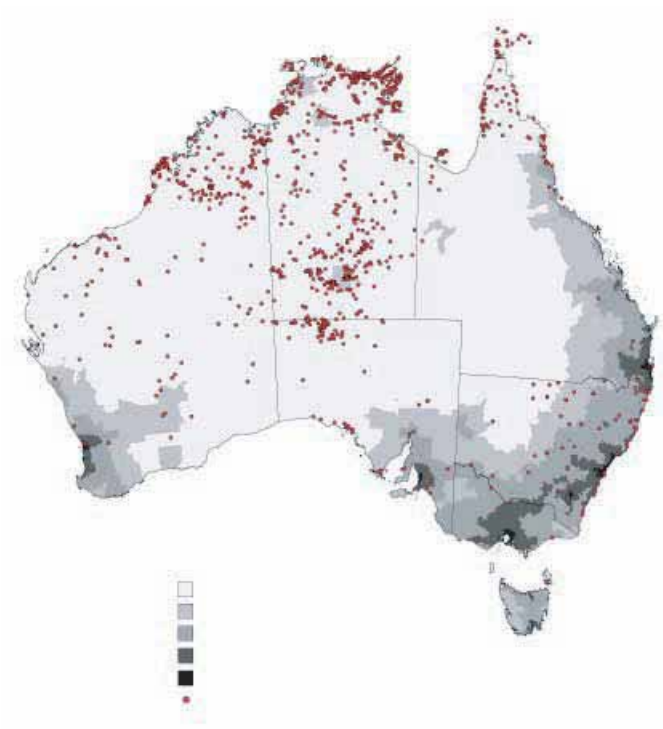
6. Customary Fishing

Context

Indigenous people were the first custodians of Australian marine and freshwater environments. Fish and fishing are important to the dietary, cultural, ceremonial and social aspects of Australian indigenous people.

Indigenous people are far more likely to live in remote Australia than non-indigenous people (ABARE, 2006). The figure below illustrates the discrete Indigenous communities across Australia.

Figure 65. Location of Remote Indigenous Communities



The 2001 Census identified almost 495 000 people as indigenous Australians. Over half of the indigenous population within Australia resides in New South Wales (29%) and Queensland (27%).

Approximately 27% of Indigenous people were classified as living in remote and very remote locations, in contrast to only 2% of the non-indigenous population living in remote or very remote locations. Over 50% of these indigenous communities are located in the Northern Territory, with a further 23 % in Western Australia.

Definition and Debate

Indigenous people participate in three existing categories within the Australian fishing industry – customary, commercial wild catch, and recreational fishing – as well as aquaculture. However any consideration of RD&E investments needs to be fully informed as to the specific meaning of customary fishing endorsed by Agencies:

> *Customary fishing* (Aboriginal Fishing Strategy Working Group, May 2003) *applies to persons who are of Aboriginal descent and who are fishing for the purpose of satisfying personal, domestic, ceremonial, educational or non-commercial communal needs. Establishing who can fish in accordance with Aboriginal tradition in specific areas is the responsibility of the Aboriginal community and Government should not play a role in legislating or enforcing this practice. Customary fishing encompasses the elements of barter or exchange of fish as long as it occurs within or between Aboriginal communities, is for other food or for non-edible items other than money, and if the exchange is of a limited and non-commercial nature.*

This definition was consolidated in March 2004 (NIFTWG, 2003)when a technical working group identified a preferred pathway and general principles to guide the future development of Indigenous fishing strategies within the sustainability limits that currently apply to all other stakeholders. The preferred pathway was endorsed by managers and stakeholders based on 7 key principles:

1. Indigenous people were the first custodians of Australia's marine and freshwater environments: Australia's fisheries and aquatic environment management strategies should respect and accommodate this.

2. Customary fishing is to be defined and incorporated by Governments into fisheries management regimes, so as to afford it protection.
3. Customary fishing is fishing in accordance with relevant Indigenous laws and customs for the purpose of satisfying personal, domestic or non-commercial communal needs. Specific frameworks for customary fishing may vary throughout Australia by reference, for example, to marine zones, fish species, Indigenous community locations and traditions or their access to land and water.
4. Recognition of customary fishing will translate, wherever possible, into a share in the overall allocation of sustainable managed fisheries.
5. In the allocation of marine and freshwater resources, the customary sector should be recognised as a sector in its own right, alongside recreational and commercial sectors, ideally within the context of future integrated fisheries management strategies.
6. Governments and other stakeholders will work together to, at minimum, implement assistance strategies to increase Indigenous participation in fisheries-related businesses, including the recreational and charter sectors.
7. Increased Indigenous participation in fisheries related businesses and fisheries management, together with related vocational development, must be expedited.

Surveys of indigenous fishing (DAFF BRS, 2000), (NRIFS, 2003) confirm general trends relevant today:

- most Indigenous fishing effort occurs in northern Australia, with over 65% of that effort occurring in the Northern Territory,
- an estimated 37,000 Indigenous people, or 92% of the indigenous population, aged 5 years or older and living in communities in northern Australia, fished at least once,
- in a twelve months period completed in November 2001, the catch comprised 0.91 million finfish, 0.98 million small baitfish, 0.18 million crabs and lobsters, 0.66 million prawns and yabbies, 1.15 million molluscs, and 0.93 million other species,
- in northern Australian waters 53% of Indigenous fishers used lines to fish, 26% hand collected, 12% used nets, 9% used spears,
- Indigenous fishing effort falls largely within the near shore of jurisdictions: 55% inshore; 15% coastal; 19% in rivers; 9.5% in lakes, and 1.5% offshore.

Federal initiatives (DAFF, 2002) and state legislation is coming forward to clarify the access rights of indigenous fishers.

- The **Western Australian** Dept of Fisheries is currently developing its Aboriginal Fishing Strategy (referred to as customary fishing) following a report from a working Group (Aboriginal Fishing Strategy Working Group, 2003).
- The relevant **Northern Territory** legislation (Fisheries Act 1988) exempts Aboriginal people from the restrictions of bag limits, size limits, or taking protected species, if they are fishing or hunting within their own traditional country (NT Fisheries, 2004). A number of indigenous strategies have been successfully implemented by stakeholders and managers over time, including (NT Government, 2007):
    - establishing (2004) the six community ranger programs for the purpose of natural resource management and protection,
    - establishing five regional Aboriginal Fisheries Consultative Committees (AFCC). A key role of AFCCs is to provide a mechanism that allows information flow between Aboriginal people engaging in customary fishery management practices and Territory Government agencies using contemporary management approaches. Information obtained from AFCCs is incorporated into fisheries management decision making processes. In addition, these committees provide Aboriginal communities with an avenue to voice their concerns to Government about matters relating to fisheries.
    - establishing and maintaining recreational fishing campsites on Aboriginal land,
    - establishing agreements with commercial fishermen,
    - developing an indigenous aquaculture policy for the NT,

  - implementing a dugong code of practice for the commercial fishing sector,
  - donating vessels to coastal ranger groups to carry out coastal surveillance,
  - funding from the Natural Heritage Trust for pilot trial of an indigenous survey for impacts on sharks and rays,
  - introducing new and innovative aquaculture farming models suitable for remote indigenous communities.
- In **Queensland**, Legislation was introduced to State Parliament (National Native Title Tribunal, 2008) in 2008 that will amend laws protecting the rights of Aboriginal and Torres Strait Islander people fishing in a traditional way. Legislative changes and Fishery Management Plans will likely lead to a tightening of the entry rights for fishers to indigenous waters.

The following table summarises current state and territory legislation regarding customary fishing.

Figure 66. Summary of Customary Fishing Legislation

Jurisdiction	Access Arrangements	Key Species
QLD	Indigenous fishers have legislated rights to fish in the traditional manner. Traditional Use of Marine Resource Agreements (TUMRAs) provide management arrangements for hunting, and fishing along Great Barrier Reef coast (GBRMPA)	Coastal and freshwater fisheries
NSW	Indigenous people use same bag and size limits s non-indigenous fishers but also have exemption from freshwater fishing license fees. Indigenous fishers can obtain permits for increased catch for community events	Coastal and freshwater fisheries
VIC	Indigenous (or 'customary') fishing is not currently defined or explicitly recognised in Victorian fisheries legislation, and non-commercial fishing by indigenous people is therefore treated as recreational fishing. The Fisheries Act 1995 recognises indigenous fishing for traditional use, for cultural and ceremonial purposes. Permits are required for catches above bag and size limits. Customary Fishing Policy is under development.	Coastal and freshwater fisheries
SA	Fisheries Management Act 2007 recognises traditional use of fisheries resources. ILUAs (Indigenous Land Use Agreements) with Fish Management Plans are under negotiation.	Coastal and freshwater fisheries
TAS	No fishing license required for indigenous cultural and ceremonial use of fisheries resources, but indigenous fishers must comply with bag and size limits	Coastal and freshwater fisheries
WA	Proposed amendments of Fisheries Act to include Customary Fishing as a recognised sector. This will allow different bag and size limits. Sea Country Plans of management are being developed and implemented.	Coastal and freshwater fisheries
NT	Customary fishing activities are excluded from NT Fisheries Act, no bag or size limits apply. Co-management arrangements and Sea Country Plans are being developed. Recent Spanish mackerel management plan has quota allocation for indigenous customary fishing.	Coastal and freshwater fisheries

A brief review of industry media (Indigenous Fishing Bulletin, June 2008) suggests that a stable legislative platform for the management of customary fishing rights is still emerging. However there are new fishing activities emerging for indigenous peoples as stakeholders and agencies come to grips with opportunities (e.g. tour operators). Given this dynamic fishery management interface, the identification of priorities and management of projects in national research, regional development and local extension for customary fishers must be lead by experienced stakeholders and flexible approaches. The contribution of indigenous fishers to Australia's marine capture fisheries is geographically, culturally and socially extensive, but economically negligible.

Catch

Available data for recreational and customary catch is presented below.

Figure 67. Customary Harvest

Jurisdiction	Total Harvest	Fish	Crustaceans	Molluscs	Other
Number of Fish					
NSW	No data available	-	-	-	-
Vic	No data available	-	-	-	-
QLD	706,696	422,253	162,438	109,721	12,284
WA	784,537	206,158	532,471	42,093	3,815
SA	-	-	-	-	-
Tas	-	-	-	-	-
NT	1,445,382	384,908	141,887	853,101	65,486
ACT	-	-	-	-	-
Total fish	2,936,615	1,013,319	836,796	1,004,915	81,585
Estimated Tonnes					
NSW	No data available	-	-	-	-
Vic	No data available	-	-	-	-
QLD	391	317	26	6	42
WA	387	185	184	3	14
SA	-	-	-	-	-
Tas	-	-	-	-	-
NT	668	415	93	82	77
ACT	-	-	-	-	-
Total tonnes	1,446	917	304	91	132

(Sources NRIFS 2000, QDPIF 2005, Ridge Partners)

Indigenous Aquaculture

The Australian Government has identified aquaculture as a suitable business for indigenous people in remote locations.

ABARE reported in 2006 that 141 people who worked in the aquaculture industry identified themselves as being of indigenous descent. Although there are no recent official government estimates of the size of the industry, based on information obtained from state and territory governments, it is estimated that employment of indigenous people in aquaculture has increased over the past five years. Across the state and territory jurisdictions, indigenous employment in aquaculture is estimated to range from 1% in QLD, up to 8% in the NT, of all employees in aquaculture.

While data is not available, ABARE found there are around 48 aquaculture licensed farms with significant Indigenous involvement (a farm or hatchery that has significant indigenous involvement, either through management, financial investment, or a large proportion of indigenous employees). Western Australia has the largest representation of indigenous people in the industry, with 32 farms at various stages of development. The majority of the farms in Western Australia are involved in intertidal reef reseeding of trochus. This is followed by New South Wales (15 farms), Northern Territory (14 farms), and Queensland (11 farms). Tasmania (5 farms) and Victoria (4 farms) have lower levels of indigenous involvement in the industry, and currently the South Australian Government does not record the number of farms with significant indigenous involvement.

Figure 68. Aquaculture Farms with significant Indigenous Involvement

	Farms with approved license	Farms with license pending license approval	Farms close to applying for license	Expressions of Interest in an aquaculture farm
NSW	12	0	0	3
Vic	2	0	0	2
QLD	2	1	1	7
SA	na	na	na	na
WA	24	2	3	3
Tas	5	0	0	0
NT	3	0	2	9
Australia	**48**	**3**	**6**	**24**

The release of the Commonwealth Government's Aquaculture Action Agenda in 2000, included an objective to "create an aquaculture industry for all Australians (including indigenous aquaculture)". This initiative was 'to enhance the growth of the aquaculture industry by improving the opportunities for indigenous Australians to contribute to, and participate in, its sustainable development'. To achieve this objective the National Aquaculture Development Committee recommended the development of the National Aquaculture Development Strategy for Indigenous Communities in Australia. The aim of the development strategy was to:

- develop a national framework to increase indigenous involvement in the aquaculture industry and
- recommend a plan to increase the economic independence of indigenous people and provide them with the opportunity to become self reliant.

Each jurisdiction has subsequently created their own programs, supported by existing or modified aquaculture legislation, to implement this strategy, using a common 7 stage template, as follows:

Figure 69. Business Steps for Indigenous Aquaculture Projects

1. •Idea. Identify aquaculture project opportunity
2. •Preliminary Study. Assess the suitability of species and requirements, suitability of site and availability, production system(s), human resource requirements, infrastructure and technology, and community attitude. 2-3 months
3. •Skills Development & Training. Address training and development requirements of prospective workers to develop practical skills - TAFE and business courses, on the job experience. 6–18 months
4. •Feasibility Study and Business Planning. Assess the viability of the venture and produce a business plan. Experts to be employed as necessary. 6-18 months
5. •Community Consultation and Funding Sources. Consult with the community to define commitment and long term objectives, and potential funding sources. 3-18 months
6. •Pilot Project. Construct a facility to gather information on production, marketing and training for research purposes.
7. •Commercial Stage. Develop a commercial production facility.

A workshop (DAFF, 2008) of indigenous, aquaculture and agency stakeholders identified four main planning themes to direct and support the indigenous aquaculture sub sector.

- Capacity building – technical and business skills development;
- Networking and information sharing among stakeholders in the field;
- Long term sustainability of projects; and
- The potential for an Indigenous brand to be developed.

These key themes are not representative of any one group's dialogue but have been drawn out of all discussions as well as the interaction of the group as a whole. The four key themes are:

Case Studies

In 2005, Federal Agencies endorsed a number of case studies to demonstrate the scope and opportunity for indigenous aquaculture. Some of these ventures continue today with others being added. Current ventures summarised below illustrate the scale, scope and structure of emerging Indigenous aquaculture ventures.

Figure 70. Indigenous Aquaculture Case Studies

	Case 1	Case 2	Case 3	Case 4	Case 5
Project	Sea cucumber restocking, Goulburn and Groote Islands, NT	Sponge farming, Kailag Enterprises Ltd, Torres Straits, QLD	Eel farming enterprise, Warrnambool, VIC	Marron Farm, Collie, WA	Multispecies at Pandanus Park in West Kimberley, WA
Vision and Objective	Stock enhancement trial using hatchery reared juvenile sea cucumber for harvest of commercial quantities	• Commercial development of bath sponge farming technology • Create job opportunities on Masig, Yorke Islands • Social and economic development benefits to the Yorke Island community	• Create a community based eel farming facility	• Establish marron farm using treat mine void water. • Return on Capital of > 10% • Produce and sell live marron to domestic and international markets. • To build the capacity of the NBCAC to self govern the commercial entity within 5 years • To build the capacity of local people to participate in an emerging aquaculture industry • To develop long term "value to community" solutions for existing mine voids.	• Aquaculture of a range of endemic species, including cherabin freshwater prawns and barramundi fingerlings. • Tourism display venture as well to provide cash flow
Commercial Structure	Goulburn & Groote Island indigenous communities, in partnership with Tasmanian Seafoods P/L and Darwin Aquaculture Centre	Public Co. Limited by guarantee as trustee for community trust	Framlingham Aboriginal Trust, in partnership with two eel grower groups	Ngalang Boodja Enterprises Pty Ltd. Sole share holder Ngalang Boodja Council Incorporated represents around 400 residents of the Collie Noongar Community.	Pandanus Park Community (150 people) with WA Fisheries and Kimberley Aquaculture Aboriginal Corp. (KAAC).
Site	Embayment areas close to both islands, previously used for sea cucumber harvest	10 ha approved marine site, Yorke Island, Torres Straits	800 acres of dairy land at Port Fairy, with access to 480 ml borewater	Commercialise mine lake aquaculture by undertaking a 2.5 ha commercial pilot project 15km east of Collie, Wesfarmers Premier Coal.	Cherabin freshwater prawn juveniles from Fitzroy R. To earth ponds
Production	Trial 150,000 juveniles, to yield 25-50t. of product	First year 12,000 sponges on farm	500 tonne is first year target	5 tonne production in 2011/12	Small scale production for tourism display
Contact Oct 2009	Anne Fleming, NT Fisheries	Chris Robertson Kailag Ltd	Phillip Kerr, VIC Seafoods	Dan Machin, WA Aquaculture Council	Dan Machin, WA Aqua. Council

7. Operating Environment and Scenarios

The first part of this chapter summarises the conclusions from the business and operating environment for all sectors of the fisheries and aquaculture industry. Assessments and conclusions listed are drawn from the Sector Overview.

The conclusions are listed against a standard set of key attributes common to all sectors – scale and scope, economic returns from markets, etc. The analysis of conclusions is expanded through use of a SWOT Analysis (Strengths, Weaknesses, Opportunities and Threats) for each sector over the next planning period.

The second part of the chapter builds on these conclusions to consider the likely operating scenarios for each industry sector based on the assessments, SWOT, conclusions drawn and the accompanying analysis. Each scenario includes a "Base Case", "Growth Case" and "As Usual/ Decline/ Underweight Case" to explore the likely outcomes for each sector except Customary Fishing. The high and low cases are not considered for the Customary Sector as these cases are not realistic.

The final aspect illustrated for each scenario lists the likely implications for R,D an E from that scenario.

Commercial Wild Catch Fishing Sector Assessment

What Does the Sector Overview Tell Us?	
1. Scale and Scope	Global wild catch commercial fisheries (marine and freshwater) are fully fished at around 92 million tonnes; yields are stable but will likely moderate. Aquaculture will expand to meet global demand for aquatic products. Australia's 160 odd fisheries are generally small, geographically diverse, and low yielding. Wild catch fisheries are declining in volume and value, and the F&A sector is declining across the food sector. Seven species contribute >60% of sector GVP. Communities are increasingly concerned (rightly or not) regarding the use and performance of wild fisheries generally and seeking greater scrutiny of resource use.
2. Economic Returns from Markets	While ongoing structural adjustments have reduced latent effort and encouraged harvest efficiencies, experts believe these fisheries operate below their best economic performance. Estimated foregone aggregate returns are ~$1 million per day. Gains will come from more efficient management and harvesting of wild fish, not necessarily catching more. Consumers love the products but most fishers would be economically better off putting their capital in a bank. All too often the volatile A$ determines which exporters (and many domestic market fishers) are viable. Low returns mean no free profits to reinvest for growth or efficiency.
3. People	6,100 people are directly employed in wildcatch sector. Estimated direct and indirect employment in wildcatch is estimated to be 60,000. The trend is for declining wildcatch employment and increasing aquaculture employment. There are many skilled entrepreneurs across the sector, but this means little without investable capital and collaboration encouraged by a strong industry body. Fishers need the motivation and security of clear rights; managers more engaged to help create the efficiency and profits that their clients can reinvest in better outcomes for all; and leaders in national/ regional organisations that look past denial and see that no one else will solve their problems.
4. Capital Access	The small scale of and latent effort in many wild fisheries means capital is often underutilized or performs poorly. This is clear in the available ROI data. Current trends show that many in the sector will become unviable, and that significant restructure is required: to match effort and MEY, to invest in innovative business and production activities; and to invest in marketing and promotion and increased export market development. Current poor returns will not attract financiers.
5. Technology	The technologies employed by the sector are at or near best practice.
6. Environment	Australia's 160 odd fisheries are well managed and increasingly sustainable, based on regulatory assessments and monitoring. However the perception is stronger that the reality-it is likely the sector will face mounting pressure to reduce its resource access. Greater attention to ecological footprints will draw community focus to higher yield fisheries where it matters most.
7. Climate	Climate change will drive a number of adjustments in the sector, due largely to the impacts on our two southern flowing tropical currents. There will be gains and losses. Initial impacts are now evident and better informed plans are needed, but impacts in the next 5 years are uncertain.
8.Community	Wild fisheries have a worsening public image, unfairly in most Australian cases. Wild fishers are doing little to address this major threat to their access rights and therefore long term viability. The sector has a good story to tell downstream, but is silent.

Strengths

- great ecosystem range creates diverse line of natural products
- demonstrably well managed fisheries
- sector have a good story (health, environment) to tell (but it is not being told!)
- high profile for a relatively small industry sector
- well established profile in domestic and export markts
- ongoing restructuring is better matching effot to MEY
- strong links to local communities where fishing is based
- adaptability and resilience of fishers and people in the sector

Weaknesses

- lack of vision and ineffective national leadership arrangement
- high profile is often for the wrong reasons - related to environment - leads to poor public image.
- wide geographic spread creates many issues, stretches resources and reduces communication and collaboration
- low profitability of fishers compounds their lack of awareness and poor community engagement
- few commercial fisheries have the scale, free profits or leadership capacity to reinvest in joint operational efficiencies
- many absentee investors with little understanding of issues
- lack of awareness of issues by fishermen of issues and opportunities
- lack of interaction with local communities
- poor communication and engagement with managers

Opportunities

- look for ways to jointly create better fishery performance and capture these economic gains without increasing the catch
- assimiliate all F&A RD&E into a single joint national plan
- establish specialist RD&E centres under a national program
- establish a national extension service delivered locally
- establish and fund a national body to practively manage /stakeout/defend key issues critical to resource access
- promote the real facts about sustainable fisheries to local communities
- with capped growth in wild catch, look for postharvest and downstream social ways to add value and margin to the catch
- secure commitment by industry and managers to improve communications with each other and with communities
- establish one national licensing regulator, with a species focus
- develop national and regional initiatives to promote wildcatch sector - don't let health benefits of seafood fall off the agenda
- collaborate with other rural industries on key resource issues

Threats

- Performance by wild fisheries has been declining for a decade. The drivers for the these trends will likley continue, and may gather pace as the critical mass for each fishery is breached.
- loss of capacity and skills in agencies and managers
- ongoing lack of viability, and stakeholder complacency

Aquaculture Sector Assessment

What Does the Sector Overview Tell Us?	
1. Scale and Scope	Global aquaculture will dominate consumer demand for seafood an aquatic products. Australian aquaculture will double in the next decade but remain small. As imports threaten it must be cost competitive, and look for and promote unique species and differentiations to attract consumers. Six species contribute >85% of sector GVP. Marine and inshore aquaculture is more likely to drive growth than land or inland saline.
2. Economic Returns from Markets	At 40% of Australia's F&A beach GVP, aquaculture has proven its growth based corporate model works. But this is only keeping pace with inflation. Too many current operators have a cottage feel and no free profits to reinvest for growth. External financiers (those alive post GFC) are still wary of the sector. Production technologies and systems are now proven so margins can increase on the back of industry scale, both from eliminating costs and inefficiencies from resource access, and also from enhancing and promoting great products to consumers.
3. People	In 2006 3,628 people were directly employed and around 17,000 indirectly employed in aquaculture. The trend to a greater share of F&A employment for aquaculture will continue. Most of these work where the jobs are – SA & TAS. Industry is quite volatile so employment is risky. Industry has a strong incentive to ensure it values its people so they stick through the next commodity cycle.
4. Capital Access	The GFC will pass, and capital markets will again assess aquaculture as a moderately risky venture with more potential that capacity. Many smaller ventures will continue to make marginal returns in the face of volatile currencies, paternal government, limited commitment to R&D, imports, and lack of scale. However, it is clear there is now emerging a core of skilled operators in businesses with scale and corporate approaches to aquaculture as a food business. It is hoped they will drive a stronger culture, profits, and confidence to invest in the sector
5. Technology	Australia is a minor global player. We will continue to scan world technologies, select off the shelf applications suited to our species, and innovate and adapt locally to minimise installed costs and suit local environments and regulations. While there may be some areas of lead technology (e.g. saline aquaculture) there will be few benefits from greenfield startups of local technology. A challenge will be to build sufficient industry scale to enable our businesses to capture the benefits from adapting overseas innovations and technologies.
6. Environment	Over the next 5 years aquaculture will face increasing pressure from the community and NGO proxies to demonstrate its sustainability credentials and adopt commensurate products and risk management systems. Access to growth (and possibly existing resources) will be denied by doubting communities. Aquaculture must engage its communities and jointly plan, monitor and report their resource use and beneficial performance.
7. Climate	Climate change will impact aquaculture over time, with limited implications for the next 5 years. Sea level rises will drive low-lying coastal inundation. Changes in rainfall patterns will alter salinity, nutrients etc of coastal waters, and proximate aquaculture. Regional and ecosystem changes will impact species biology and disease risks. Selective breeding and farm design will be a priority.
8.Community	Aquaculture has neglected its obligations to resource owners. Its profitable future depends heavily on better engagement and securing their endorsement.

Strengths

- focus on fresh local product, often from parochial domestic consumers
- great product with high nutritional capabilities from a clean environment
- key Australian species are well established in global seafood markets
- strong consumer demand for and acceptance of aquacuture products
- cohesive, collaborative operators and species groups with single peak body
- increasing pool of experienced people in industry
- diverse geography, waters and ecosystems enables species differentiation

Weaknesses

- risk of local product substitution due to lack of differention to consumers
- low return on invested capital by many operators is not sustainable
- lack of joint investment and support for market development initiatives
- lack of support for aquaculture from many governmnets and agencies
- excessive, unaligned state regulations impede efficiency and development
- excessive reliance on spat/seed stock from the wild
- no awareness by local industry of competitors capability, especially Asia
- experienced people generally located in SA & Tas. Too many operators in other states have a cottage industry approach.
- some industries lack commitment to invest in precompetitive joint RD&E
- low commitment to demonstrate sustainability - social license to operate
- declines in state services /infrastructure replaced by increases in regulation

Opportunities

- benchmarking against competitor industries in Asia and elsewhere
- increase scale and scope of sector (130,000t. by 2020), and industries
- stop the state focus on managing industry - naytional approach
- increase industry member focus on ways to enhance return on investment
- develop a profit driven Business Plan/strategies for each aquaculture sector
- enhance the presentation of our products to markets - Seafood CRC as hub
- promote the great advantages of seafood to Australian consumers
- more research on new technologies - pond and cage systems, recirculation
- secure community to access new production areas based on demonstrated improvemenets in management techniques - e.g. fallowing
- foward sales of product to manage currency volatility and risk
- scoping and market differentition of regional seafoods' provenance

Threats

- fragmentation of aquacuture sector based on species or state lines
- Rising A$ relative to China and other competitors
- increased import competition from frozen seafood sourced from Asia
- erosion of CRC R&D dividends as relative cost of government increases and excessive investmnet is allocated to environmental impacts
- International trends suggest aquaculture will be pushed further offshore, resulting in greater operating risks (eg storms) and capital requirements
- intractable aqautic animal health disease and risks - amoebic gil, disease in salmon, seals and other predators
- high retail prices (compared to beef, pork, poultry) will push seafood away from the centre of the plate, to an occasional luxury or "occasion" purchase

Recreational Fishing Sector Assessment

What Does the Sector Overview Tell Us?	
1. Scale and Scope	Global wild catch commercial fisheries (marine and freshwater) are fully fished at around 92 million tonnes; yields are stable but will likely moderate. Aquaculture will expand to meet global demand for aquatic products. Australia's 160 odd fisheries are generally small, geographically diverse, and low yielding. Wild catch fisheries are declining in volume and value. Recreational fishing is a significant users of the resource and will continue to be so. Communities are increasingly concerned (rightly or not) regarding the use and performance of wild fisheries generally and seeking greater scrutiny of resource use.
2. Economic Returns from Markets	Estimated annual net economic output from the recreational sector is ~$300 million. This is a significant component of aggregate fisheries contribution to the economy. But this contribution is very diverse and not well documented. Australian recreational spend per capita is around 50% of leading economies.
3. People	Recreational fishing involves around 3.4 million Australians annually, a rate 40% higher than annual attendees to Australian rules football games. There are many active leaders and supporters across the sector but there is very limited organisational capacity and investment by stakeholders or governments.
4. Capital Access	n/a
5. Technology	The technologies employed by the sector are at or near best practice.
6. Environment	Australia's 160 odd fisheries are well managed and increasingly sustainable, based on regulatory assessments and monitoring. However the perception is stronger that the reality-it is likely the sector will face mounting pressure to reduce its resource access. More detailed assessment is required, and it may show that the recreational harvest and impact on fisheries is significant in many fisheries.
7. Climate	Climate change will drive a number of adjustments in the sector, due largely to the impacts on our two southern flowing tropical currents. There will be gains and losses. Initial impacts are now evident and better informed plans are needed, but impacts in the next 5 years are uncertain.
8.Community	Wild fisheries have a worsening public image, unfairly in most Australian cases. Wild fishers (be they commercial or recreational) are doing little to address this major threat to their access rights and therefore long term viability. The sector has a good story to tell downstream in direct and indirect contributions to health and community wellbeing, but is silent.

Strengths

- high level of particpation by communities
- legitimate and significant user of fishery resources that adds variety and resilience to communities, complementing contributions from other sectors
- important social and sporting activity in urban, regional and rural Australia
- strong contribution, directly an indirectly to the Australian economy, nationally and regionlly
- increased recognition by all stakeholdes that good management ofthe sector pays dividends to the community

Weaknesses

- lack of sector unity across organisations and stakeholders-no investment
- no capacity to match agency / FRDC RD&E investments
- property rights for sector are yet to be defined and allocated - very slow
- no established measures to value of recreational fishing experiences
- aging leadership in the sector
- high participant churn rate
- declining participation in the sector
- sector has limited data or organisational capacity, and is often ignored
- inability to fully engage/contribute to community decisions (e.g. MPAs)
- no recognition/quantification of contribution to Australians' wellbeing
- agency comanagement approach is too paternalistic - limits collaboration
- paternalistic fish manager focus on biology and control limits innovation
- poor data /understanding of he impacts on rec sector on biomass
- disparate and poorly coordinated club structures

Opportunities

- finalise the resource allocation and rights matters for all shared fisheries
- look for ways to jointly create better participation, performance and capture these economic gains without increasing the harvest
- assimiliate all F&A RD&E into a single joint national plan
- establish specialist RD&E centres under a national F&A program
- establish and fund a national body to proactively manage /stakeout/defend key issues critical to resource access
- promote the real facts about sustainable fisheries to local communities
- better engagement/dialogue with other sectors, agencies, communities
- establish one national licensing regulator, with a species focus
- collaborate with other rural industries and sectors on key resource issues
- establish common management approaches across all jurisdictions
- people development and succession planning
- research that looks at quantifying the experiental value of these fisheries across all demographics

Threats

- Performance by wild fisheries has been declining for a decade. The drivers for the these trends will likley continue
- failure of sector leadership and organisations to engage, advocate and effectively plan and implement the potential for the sector
- ongoing lack of investment by recreational fishery users and stakeholders and expectations of free service

Customary Fishing Sector Assessment

What Does the Sector Overview Tell Us?	
1. Scale and Scope	Globally, customary fishers are recognised as joint users of aquatic resources. Australia's customary fisheries are 160 odd fisheries are generally small, geographically diverse, and low yielding. Wild catch fisheries are declining in volume and value, and the F&A sector is declining across the food sector. Seven species contribute >60% of sector GVP. Communities are increasingly concerned (rightly or not) regarding the use and performance of wild fisheries generally and seeking greater scrutiny of resource use.
2. Economic Returns from Markets	Customary fishing, as promulgated by NIFTWIG, is fishing in accordance with relevant Indigenous laws and customs for the purpose of satisfying personal, domestic or non-commercial communal needs
3. People	Existing records of customary fishing do not generally identify customary fishing as a separate category from commercial and recreational fishing by indigenous people. However, the NRIFS (2003) data estimates that 37,000 indigenous people (92%) of the indigenous population I northern Australia, fished at least once in the 12 months prior to the survey. Across the bioregions many tribal groups have been identified: East Region 60; South West Region 35; and North West Region 30. The North Region has the highest number o indigenous groups.
4. Capital Access	The conventional use of economic capital is not relevant to Customary Fishing.
5. Technology	The technologies employed by the sector are based on tradition, culture and customary practices.
6. Environment	Customary fishing largely (55%) falls within the inshore marine zone, and less so in coastal (15%), rivers (19%), lakes (10%) and offshore (1%). While these ecosystems and related habitats are assessed as part of broader jurisdictional responsibilities, there is limited current data specifically regarding customary fishery environmental use and status.
7. Climate	Climate change will drive a number of adjustments in the sector, due largely to the impacts on our two southern flowing tropical currents. There will be gains and losses. Current climate change knowledge suggests that northern Australian may become wetter, with significant changes to river flows and impacts on aquatic species food webs used by customary fishers.
8.Community	Customary fishing by definition is community based for communal non commercial benefit.

Strengths

- contribute supply of health fresh seafood to indigenous communities
- local presence of stakeholders and long history in region
- motivation is to sustain community, not to make profit
- some customary fishers also active as indigenous commercial fishers
- facilitates the continuation of cultural practices, traditional fishing knowledge and language

Weaknesses

- often a lack of commitmnet to improved performance and productivity
- lack of innovations in approach - often some fear of technology
- where there is no cap on licences (eg Torres St.) there is no incentive to improve productivity and financiers will not lend capital
- while partially acknowledged by governments and managers, customary fishers are not fully engaged in management of fish stocks.
- lack of coordination of customary fishing
- lack of a specialised research centre or relevant RD&E capacity
- lack of trust with fisheries managerment agencies

Opportunities

- greater productivity through inovation and technologies to improve catch, post harvest handling
- negotiation of fishing agreements between traditional owner groups and governments that support the continuation of indigenous cultural fishing
- integration of the management of indigenous with commercial and recreational fisheries with better representation of Indigenous rights in all decision making processes at the same time
- Indigenous communities with the capacity to engage with centralised fisheries management processes
- an increase in the number of Indigenous people engaged in commercial fisheries, both wild caught and aquaculture
- dedicated research centre for customary fishing

Threats

- inconsistent comunity leadership - excessive turnover
- daily life priorities are often more important than effective management and use of the fishery - customary obliogations to families, funerals, etc
- rejection by agencies and other stakeholders of the notion that Indigenous people have distinct fishing rights, as summarised under the NIFTWIG communique in 2004
- lack of Indigenous community capacity to engage effectively with fisheries management systems
- over consultation and lack of action by governments and agencies to adopt Indigenous fishers input
- customary fisheries research done without the partnership or contribution of Indigenous communities

Commercial Wild Catch Fishing Sector Scenarios

	Assumptions & Risks	Operating Scenarios to 2020	RD&E Targets and Implications
COMMERCIAL WILDCATCH - BASE CASE	**A$ and Trade:** Weakening US$ and new commodity boom means trade is in US90–100c range. Imports increase and exports struggle. Capital markets stabilize but no impact as limited new capital invested in industry. **Resource Access:** Resource access arrangements to wildcatch will come under greater scrutiny from communities. The sector demonstrates its improved performance and secures access to 170,000 - 195,000t. **Environment:** Growing global power of environmental lobby. EPBC reporting is pervasive across all jurisdictions. Sector demonstrates improved sustainability. **Climate:** Big issue for the marine sector–both positives and negatives. Early impacts evident. Find collaborative ways to identify new data and integrate with strategies. **Consumer Demand:** Consumer demand continues to grow for products, boosted by targeted promotion. Greater RD&E focus on improving the consumer (domestic/export) offer and increasing margins. **Products:** Slow catch decline forces more differentiation for each species and market. Theft of high value species is reduced. National biosecurity approach implemented. Aquaculture growth to supermarkets, food service, and fish mongers drives wildcatch prices and chain efficiency. **Technologies:** Sector invests to maintain best practice technologies. More focus on collaborative use. **People:** Risk point for sector, as it is unable /unwilling to pay to retain skills. Need to do more with existing talent **Community:** Sector addresses its worsening image. **Has RD&E been well targeted and managed to date:** Fair, but all agree it can be better.	**SCENARIO - Base Case** • Wildcatch volume will decline, very slowly, from 195,000t/yr at ~0.2%/yr. • Structural adjustment continues across all waters with fewer more efficient, more profitable fishers now matching effort to MEY under harvest strategies. • At the resource level, the sector starts to build credibility and retain access by demonstrating sustainability and better performance. It looks to rationalise the costs of management and improve efficiency through comanagement. • Downstream the sector faces greater competition from aquaculture and so looks to differentiate its unique and sustainable species. It invests much more in finding new consumer benefits (domestic and export) from the same catch, and telling a positive story through active promotion. • Cultural and organisational change is glacial. This severely limits the sectors ability to respond and engage communities/ consumers with one voice, claim access to resources and improve its image. **Factor X.** • An A$ on commodity export steroids.	**National Research:** • Maintain a single national Plan for Wildcatch RD&E under a joint FRDC-AFMF banner, managed by FRDC • Establish a national research network of specialists R centres with leaders/ followers (Excellence Research Australia clusters) • Build closer links - investors, researchers and communities • Determine resource shares and mortalities for all users • Establish national sectoral performance report cards to engage with communities and improve sector image • Boost joint industry and government investment in infrastructure in key specialist R network laboratories • Establish a nation leading centre/hub for seafood marketing and expertise clusters – value for both wild and aquaculture • Promote domestic seafood: wildcatch + aquaculture + imports • Measure RD&E against retail / export performance not GVP, so that impacts on returns are more meaningful. • Biosecurity and animal health • Climate change and ecological footprints • People development and social capacity building • Structural adjustment economics • IUU issues **Regional Development:** 1. Establish regional plans and priorities with sector and community driving a common national framework 2. Benchmarking for ecosystem, species, social, efficiency **Local Extension:** 1. Establish a proper F&A extension service to better engagement with and educate stakeholders. 2. Engage with and report to communities - image improvement.
GROWTH	✓ There will be limited volume growth. Margin growth is realistic for selected fisheries but will take time for strong aggregate performance to be realized.	**SCENARIO – Growth Implications** ✓ Excessive growth is not a realistic scenario	**GROWTH Scenario Implications for RD&E:** 1. As above
AS USUAL	× Fisheries are on a care and maintenance basis and reactive to currency, competitors and community imposts. × Industry leadership is unable to address the issues	**SCENARIO – Decline Implications** × Depressed sector performance and profitability × Investment in promotion or innovation falls × Focus stays on resource management	**DECLINE Scenario Implications for RD&E:** 1. Without free profits, innovation is not affordable and shrinks. 2. Limited funds contract to RD&E related to sustainability and public good. 3. Expectations of downstream promotion are unmet.

Aquaculture Sector Scenarios

	Assumptions & Risks	Operating Scenarios to 2020	RD&E Targets and Implications
AQUACULTURE - BASE CASE	**A$ and Trade:** Weaker US$ plus resurgent commodity boom means trade is in US90–100c range. Seafood imports increase and exports struggle. Capital markets stabilize and provide support for new investments. **Resource Access:** Resource access arrangements are harmonised across all jurisdictions within 5 years. Community endorses investors to double volumes. **Environment:** EPBC reporting becomes more comprehensive and is adopted across all jurisdictions. **Climate:** Big issue on the horizon: both positives and negatives. Impacts >5 years away, but plan now. **Supply Chain:** Increased volume sees aquaculture assume a greater share of seafood chains. It drives greater efficiency for aquaculture products. **Consumer Demand:** Ongoing growth in consumer demand for great products, boosted by promotion. **Products:** Industry volume increases 117% to 130,000t by 2020. Most growth is finfish in temperate waters. Fresh product focus but some value added product now used to broaden offer to domestic consumers. **Technologies:** Lifecycles closed, cage, pond and recirculation technology adopted and adapted locally. **People:** Aquaculture's growth attracts new investors, new employees, and indigenous people. **Community:** Community expectations and demands on aquaculture performance and resource sustainability continue to rise. Increased power of NGOs and media. **Has RD&E been well targeted and managed to date:** Industry is divided, but all agree it can be much better.	**SCENARIO - Base Case** • Aquaculture moves beyond technical and organisational infancy to moderate stable growth from better margins, consumer offer differentiation, and growing consumer demand. • Volume grows at around 6% per year to 130,000 t. (edible volume) by 2020. Gains come from expanding volumes and margin in existing large industries due to scale, better technology (salmon, oysters, tuna, prawns, barramundi, pearls) and community endorsement. New industries expand - kingfish, mussels, and abalone. • The increased scale and scope of aquaculture and collaboration with importers, enables greater supply chain efficiencies and increased regional gearing of RD&E and joint promotion of great seafood direct to consumers. • Aquaculture achieves greater community endorsement and uniformity across state regulations that reduce costs and enable planned growth and investment return. **Factor X.** • An A$ on commodity export steroids.	**National Research:** 1. Maintain a national Business Plan for Aquaculture 2. Establish a nation leading centre/hub for seafood marketing 3. Promote domestic seafood: aquaculture + wildcatch + imports 4. Establish national community engagement campaign and sectoral performance report cards to improve sector image 5. Implement uniform national EIS parameters – remove states/NT from EIS design, management and monitoring 6. Establish a national research network with leaders/ followers 7. Boost joint industry and government investment in infrastructure in key aquaculture network laboratories 8. Establish national centres for aquaculture disease, diagnostics, production and health research 9. Establish APVMA policies that facilitate access to improved antifolants and disease control measures 10. Establish a domestic feed base that is less reliant on fishmeal **Regional Development:** 1. All regional development should be species based 2. Each sector to establish own Development Plan, including community strategies 3. Government and industry designation of model farms with best practices 4. Establish hubs of expertise and enhancement of local industry skills **Local Extension:** 1. Industry rationalisation of representation to better engage with local communities, governments and stakeholders 2. With communities, manage uniform EIS regulations and monitor operational performance
GROWTH	✓Stronger collective sector focus on consumers ✓The A$ remains relatively weak against revaluing Asian currencies, enabling some exports to emerge ✓Better RD&E networks deliver breakthroughs in animal health sooner, driving improved yields ✓Progress re harmonised EIS and resource access approvals, endorsed nationally. Investors respond.	**SCENARIO – Growth Implications** ✓RD&E investment grows beyond state/NT government paternalism, and spreads down-chain toward consumers ✓SEA launches a national seafood promotion campaign with wild+imports ✓Strong, early, joint RD&E across regions	**GROWTH Scenario Implications for RD&E:** 1. Planning for aquaculture RD&E becomes more collaborative between stakeholders, and based on one forum 2. New and emerging aquaculture species and sectors launch sooner and attract free capital investment 3. Return on capital improves. Aquaculture is better able to attract and retain new consumers, and to attract new people
UNDERWEIGHT	× SBTuna suffers further cuts in resource access × Reduced competitiveness of pearling industry × Barramundi / prawn industries remain susceptible to import competition × Adverse impacts above cause fall in sector capacity and scale. Lesser profile and image see a loss of people, community support and investment capital.	**SCENARIO – Underweight Implications** × Depressed sector growth is constrained to ~80,000t. in 2020. Business as usual! × Free profits are not able to drive new seafood demand and increase margins. × Focus stays on resource access rights, and production, not on markets.	**UNDERWEIGHT Scenario Implications for RD&E:** 1. Without free profits, innovation is not affordable and shrinks. 2. Sectoral influence to improve supply chain efficiencies is reduced and product development stalls. 3. Significant adverse impacts on regional RD&E infrastructure and confidence. 4. Limited support on aquatic animal health

Recreational Fishing Sector Scenarios

	Assumptions & Risks	Operating Scenarios to 2020	RD&E Targets and Implications
RECREATIONAL FISHING - BASE Case	**A$ and Trade:** Weakening US$ and new commodity boom means trade is in US90–100c range. Imports of equipment are cheaper. Capital markets stabilize but no impact as limited new capital invested in industry. **Resource Access:** Resource shares and access arrangements for recreational fishers will come under greater scrutiny from communities. The sector must demonstrate its share of impact is justified. **Environment:** Growing global power of environmental lobby. EPBC reporting is pervasive across all jurisdictions. Sector demonstrates improved sustainability. Impact of recreational activity is poorly understood & documented. **Climate:** Big issue for the marine sector–both positives and negatives. Early impacts evident. Find collaborative ways to identify new data and integrate with strategies. **Consumer Demand:** Community demand for recreational fishing activity is declining as competing recreational activities abound. **Products:** The experiential nature of recreational fishing and relation to community wellbeing is poorly understood. **Technologies:** Sector invests to maintain best practice technologies. More focus on catch and release. **People:** High user churn continues, fresh leadership and organisation approach provide the solid base for better engagement and organisational effectiveness on key issues. Fishers start to reinvest. **Community:** Clearer understanding of community's expectations. Sector addresses its worsening image. **Has RD&E been well targeted and managed to date:** Industry is divided, but all agree it can be much better.	**SCENARIO - Base Case** • Recognition of sector share and benefits but increased regulation of recreational fishing activities and access to fishery resources, as a result of: o competing recreational activities o sectors inability to coordinate an effective response to community concerns o climate change. • Slow decline in sector participation as governments go to a stronger cost recovery model • Increased move away from catch and kill approach to the quality and value of the fishing experience **Factor X.** • Sector leadership's success in resolving its challenges	**National Research:** 1. Maintain a single national Plan for Wildcatch (Commercial and Recreational) RD&E under a joint FRDC-AFMF banner, managed by FRDC 2. Establish a national research network of specialists R centres with leaders/ followers 3. Build closer links - investors, researchers and communities 4. Determine resource shares and mortalities for all users 5. Establish national sectoral performance report cards to engage with communities and improve sector image 6. Climate change and ecological footprints 7. Confirm property rights 8. Increased focus on comanagement by all users in fisheries 9. People development and social capacity building 10. Clear understanding of the social and economic drivers and triple bottom line benefits of the sector, and public good **Regional Development:** 1. Establish regional/ fishery plans and priorities with sector and community driving a common national extension framework 2. Benchmarking for ecosystem, species, social, efficiency 3. Understanding of habitat enhancements & carbon footprints, recruitment 4. Identify sustainability hotspots 5. Develop effective regional partnership with governments **Local Extension:** 1. Better engagement, education and dialogue with recreational and other fishers and stakeholders, including best practices, gear selection, energy use, fuel efficiencies etc. 2. Better engagement with and reporting to communities - image improvement 3. Identification and support for young leaders and key people.
ENGAGEMENT	✓ Regulators and communities better recognise the role and contribution of the sector and ✓ Increased recognition of benefits and contribution by sector to Australia ✓ Less politicization of the sector leads to better engagement with agencies ✓ More moderate fishers participate and recognise the need to reinvest in their fishery	**SCENARIO – Growth Implications** ✓ Sector participation stabilises between 2-3 million participation events annually, based on the true believers are experientially driven	**ENGAGEMENT Scenario Implications for RD&E:** ✓ As above
DECLINE	× Fisheries are on a care and maintenance basis and reactive to currency, competitors and community imposts. × Industry leadership is unable to address the issues	**SCENARIO – Decline Implications** × Sector declines due to its inability to demonstrate is value to community × Ineffective management by sector	**DECLINE Scenario Implications for RD&E:** 5. Without free profits, innovation is not affordable and shrinks. 6. Limited funds contract to RD&E related to sustainability and public good.

Customary Fishing Sector Scenarios

CUSTOMARY - BASE Case

Assumptions & Risks

A$ and Trade: Weakening US$ and new commodity boom means trade is in US90–100c range. Imports increase and exports struggle. Capital markets stabilize but no impact as limited new capital invested in industry.
Resource Access: Customary fishing is a full participant in active wild fisheries and is responsible for a dedicated share of the resource via TACs
Environment: EPBC reporting is includes customary fisheries. The sector is able to demonstrate sustainability in all cases. The Natural Resource Management Ministerial Council confirmed in 2009 that all fisheries in northern Australia are achieving best practice outcomes.
Climate: Climate changes have minimal impact on customary fisheries in the next 5 years.
Consumer Demand: The outputs from customary fisheries are for communal, non-commercial use. The profile and prevalence of substitution by indigenous communities between food from customary fishing and retail outlets is unknown.
Products: Products from customary fisheries are all in fresh unprocessed form and include mullet, catfish, bream, barramundi and other inshore or stream finfish, shellfish, crabs, lobsters, prawns, turtles, seals, dugongs, rock lobster, abalone, scalefish, and eels. Non edible products are also harvested in small volumes.
Technologies: The technologies employed by the sector are based on tradition, culture and customary practices.
People: Customary fishing is undertaken generally by ~95% of the members of any indigenous communities
Community: Customary fishing is community based.

Operating Scenarios to 2020

SCENARIO - Base Case

- Customary catch will change little from the current 1500 tonnes sourced primarily from northern Australia over the next 5 years.
- Customary fishing will become a full partner in nominated fisheries, will appropriate legislation introduced in all jurisdictions.
- With more support now forthcoming from agencies, Indigenous people will increase their awareness of other commercial activities (commercial fishing, charter operations and tour guides, etc) that they can participate in.
- Initial aquaculture ventures initiated were well supported and quite sophisticated. However a number have been delayed, remodeled, or terminated. From a slow start Indigenous aquaculture ventures will be successfully established and provide learning opportunities and cultural maintenance options for participants and communities, and aquatic products for consumption and retail sale.

Factor X.

- The current lack of distinction between customary practices and indigenous fishing (which includes commercial and recreational activities) may impede the development of a clear customary focus.

RD&E Targets and Implications

National Research:

1. Maintain a single national Plan for Wildcatch (Commercial and Recreational) RD&E under a joint FRDC-AFMF banner, managed by FRDC
2. The emerging fishery management arrangements will meet the intent of the NIFTWIG Communiqué, and the specific legislation being developed in each jurisdiction. The appropriate time to undertake more detailed RD&E planning for customary fishing will be when all legislation is in place (expected in 1-2 years).
3. Human capacity development to support the development of leaders in the sector, and their community's management of their TACs and resource within compliance requirements. (e.g. introduce model MAC's and fishery management programs to high school students in relevant indigenous communities)
4. Joint programs between indigenous communities (for customary fishing and other sectors) and fishery managers to promote collaboration, trust, and better dialogue between individuals and between organisations.
5. Socioeconomic studies to better understand and support communities in balancing their participation in commercial and recreational fishery activities, with their cultural needs and use of customary fishing practices.
6. Provide learning opportunities for indigenous communities to raise their awareness of wildcatch and aquaculture technologies and practices, gear, and innovations (e.g. stock assessment practices, log books, etc) that will support them better manage the performance of their fisheries.
7. Create opportunities for indigenous fishery leaders to better understand indigenous overseas fishing management and activities.
8. Provide a long term mentoring program for indigenous leaders to support them develop efficient an effective organisation and fisheries for their communities.

Regional and Local Development:

1. Create regional capacity (trade and technology training, organisational support, fishery and business management training, etc) for customary fishers.
2. Create media programs for broader Australian consumption that demonstrate the social aspects and benefits of customary fishing.
3. Support customary (and indigenous fishing and aquaculture) ventures that have specific requirements – e.g. recirculation systems for tropical lobster

8. Appendices

Appendix 1. Bioregional Summary

The details presented in this summary are drawn from the published data regarding Bioregions, at http://www.environment.gov.au/coasts/mbp/publications/south-west/sw-region-profile.html together with some industry advice to Ridge Partners.

Name	Key Points	Commercial Fishery	Recreational Fishery	Customary Fishery
1. East Region	• Comprises waters from the eastern side of Cape York to just north of the NSW-Victoria border, as well as the waters around Norfolk and Lord Howe Islands, and an area of the Coral and Tasman Seas. The Region does not include the Great Barrier Reef Marine Park or the Torres Strait. • The largest Region by area, it is adjacent the most heavily populated coastline in Australia. • Population in the coastal areas adjacent to the Region is concentrated around the capital cities of Sydney and Brisbane with Sydney being home to 4.3 million people and Brisbane to 1.8 million. Other major population centres include the Shoalhaven (including Batemans Bay, Ulladulla and Nowra), Wollongong, Newcastle, Port Macquarie, Coffs Harbour and Lismore in New South Wales and the Gold Coast, Hervey Bay, Bundaberg, Gladstone, Rockhampton, Mackay,	• The Region hosts 18 commercial fisheries: o 9 AFMA managed fisheries - Coral Sea, Eastern Skipjack Tuna, Eastern Tuna and Billfish, Small Pelagics, Southern Bluefin Tuna, South East Scalefish and Shark, Norfolk Island, Southern Squid Jig, and Torres Strait Turtle. In 2006 the landed catch was 19,800 tonnes valued at $35 million - ~80% from the ETBF. The ETBF has suffered a sharp decline in recent years and has since been subject to successful structural adjustment. Key unloading ports are Cairns, Mooloolaba, Brisbane, Southport, Wollongong, Greenwell Point, Ulladulla and Bermagui. o **Key species** include sharks, trochus, lobsters, sea cucumber, rosy jobfish, alfonsino, red emperor, various aquarium species, yellow fin tuna, big eye tuna, albacore tuna, broadbill swordfish, striped marlin, trumpeter, kingfish, cod, snapper, salmon, trevally, jack mackerel, yellowtail scad, blue mackerel, redbait, southern bluefin tuna, arrow squid, blue warehou, deepwater sharks, eastern gemfish, orange roughy, red fish, silver trevally, dories, blue eye trevalla, blue grenadier, flathead, and alfonsino, green turtle, and hawksbill turtle. o 6 QLD managed fisheries – East Coast Otter Trawl, East Coast Stout Whiting, East Coast Inshore Fin Fish, Line, Blue Swimmer Crab, and Spanner Crab. In 2006 these QLD fisheries landed 8863 tonnes valued at about $65 million. Key home and landed ports in QLD include Cairns, Innisfail, Townsville, Mackay, Gladstone, Bundaberg, Mooloolaba, Brisbane and Southport**. Key species** include blue swimmer crabs, spanner crabs, barramundi, king salmon, blue threadfin, grey mackerel, various sharks, flame snapper, ruby snapper, pearl perch, tragalin jew, coral trout, red throat emperor, Spanish mackerel, tiger prawns Endeavour prawns, red spot king prawns, banana prawns, scallops, stout whiting. o 3 NSW managed fisheries – Ocean Trap and Line, Ocean Trawl, and Rock Lobster. These fisheries operate from the coastline out to the 4000 m isobath, or roughly 80 nm from land. In 2006, these fisheries landed 3500 tonnes valued at ~$30 million. Key unloading ports are Tweed Heads, Richmond, Clarence, Coffs Harbour, Hastings, Manning, Wallis Lake, Port Stephens, Hunter, Central	• Recreational fishing is popular with ~4% taking place in C'wealth waters. The NRIFS (2003) suggests NSW had 999 000 recreational fishers and QLD 785 000, the largest numbers of recreational fishers of all Australian jurisdictions. That survey estimated recreational fishing in NSW contributed ~$554 million to the economy and in QLD, $320 million. • It is likely that offshore fishing contributes more per fisher to the economy than inshore fishing given the higher equipment and charter costs associated with fishing in the open ocean. Given the steady increase in boat registration numbers in both QLD and NSW, it is reasonable to assume that there has been a proportional increase in the number of private boat owners entering the Region for recreational fishing close to the shore. In the 2006-07 financial year maritime agencies in NSW recorded a 2% increase in recreational boat registrations with 213,387 vessels registered. In QLD, authorities recorded a 10% rise in recreational boat registrations in 2003-06 with the number of vessels surpassing 200,000. • Key recreational fishing ports (main stream fishers, sport and tournaments) are Sydney, Port Stephens, Coffs Harbour, Wollongong, Batemans Bay, Bermagui, Tweed Heads, Narooma, Gold Coast, Brisbane, Mooloolaba, Cairns, Port Douglas, Cooktown, Townsville, Rockhampton, the Whitsundays and Gladstone. • **Key species** are albacore tuna, nannygai, bar cod bass, ocean jacket, bass groper, pearl perch, black marlin, porbeagle shark, blue mackerel, sailfish, blue marlin, samson fish, blue-eye trevalla, skipjack tuna, broadbill swordfish, snapper, cobia, Spanish and spotted mackerel, flathead, striped marlin, hammerhead shark, teraglin, hapuka, tiger	• Over 60 Indigenous tribal groups have been identified along the coastline adjacent to the Region. These people have a spiritual connection to the Region through cultural traditions, ancient sites of cultural importance and enduring relationships with marine species such as whales, turtles and dolphins. • In 2006 more than half of Australia's Indigenous population resided in QLD and NSW with an estimated 28.3% (146,400 people) living in QLD and 28.7% (148,200 people) living in NSW. • In 2003, 93% of the local Indigenous community participated in fishing activities, and about 5% of that activity took place more than five kilometres offshore in the Great Barrier Reef Marine Park. • **Key species** for customary fishers in the Region are shellfish, crabs, lobsters, prawns, turtles, seals, dugongs and mutton birds. • Many indigenous people also participate in the commercial wildcatch and aquaculture sectors, and

	Townsville and Cairns in Queensland. These cities have generally formed around industry and tourism, including recreational fishing activities. • Many of the regions ports have a history of commercial fishing and others, such as Cairns and the Gold Coast, are centres for tourism. • Marine-based tourism is a significant industry in the Region.	Coast, Greater Sydney, Illawarra, and Bateman's Bay, Ulladulla and Bermagui. **Key species** include rock lobster, Australian bonito, snapper, leatherjackets, yellowtail kingfish, grey morwong, blue eye trevalla, spanner crabs, silver trevally, yellow fin bream, banded rock cod, gummy shark, eastern king prawn, school prawn, royal red prawn Balmain bugs, octopus, silver trevally, tiger flathead, sand flathead, southern calamari, school whiting, fiddler shark. • Commercial fishing effort in the Region is heavily concentrated along the NSW and southern QLD coastlines. Activity in the deeper waters of the Region is widespread although much less intensive than in areas closer to shore. • There are no major marine aquaculture operations currently within the Region. The major land based aquaculture industries in waters adjacent to the Region include the farming of scallops, prawns, edible oysters and silver perch.	shark, john dory, striped trumpeter, mahi mahi, wahoo, mako shark, yellow fin tuna, mirror dory, yellowtail kingfish, and morwong.	in recreational fishing.
2. South East Region	Comprises waters off Victoria, Tasmania (including Macquarie Island), southern NSW around the town of Bermagui, and eastern South Australia from the South Australia-Victoria border to Victor Harbor. No data available yet as this bioregion is still being developed.			
3. South West Region	• Comprises waters from the eastern end of Kangaroo Island, South Australia, to waters off Shark Bay, Western Australia. • Today, the population along the south-west coast is concentrated in and around the major urban centres of Adelaide and Perth, and a number of other regional centres including Geraldton, Albany, Esperance, Port Lincoln and Whyalla	• There are 17 fisheries in the Region, including main centres of Perth, Geraldton, Albany, Esperance, Adelaide, Whyalla, Port Lincoln, Ceduna, and Streaky Bay. • 5 AFMA managed fisheries – Great Australian Bight Trawl, Southern Bluefin Tuna, Southern and Eastern Scalefish and Shark (Gill Hook and Trap Sector), Southern and Western Billfish and Tuna, and Western Deepwater Trawl Fishery. **Key species** include Deepwater flathead, orange roughy, Bight redfish, Southern bluefin tuna, pink ling, blue-eye trevalla, gummy shark, yellow fin tuna, big eye tuna, skipjack tuna, albacore tuna, billfish species. • 4 SA managed fisheries – Northern Zone Rocklobster, Northern Zone Giant Crab, Sardine, Marine scalefish (whiting, snapper, garfish, southern, calamari, ocean leatherjacket, molluscs). • 7 WA managed fisheries – West Coast Rock lobster, Abrolhos Is. and Mid west Trawl, South west Trawl, West coast Deep Sea Crab, West Coast Demersal Scalefish, South Coast Crustacean, and South Coast Trawl. **Key species** are western rock lobster, southern saucer scallops, western king prawns, giant snow crabs, crystal crabs, champagne crabs, WA dhufish, pink snapper, bald chin groper, and southern rock lobster. • 1 Jointly managed fishery – commercial gillnet and longline fishery, where **key species** are dusky sharks, whaler sharks, whiskery sharks, and gummy sharks. • There are currently only three aquaculture sites in the Region - one in the Geelvink Channel off Geraldton, and a further two leases off Mandurah and Bunbury. All sites are for scallop production. Most aquacultural activity occurs within State waters adjacent to the Region. Off the Eyre	• The main recreational use currently undertaken in the Region is offshore recreational fishing. Recreational fishers of the Region target a range of deep-water fish including snapper, samson fish, groper, Australian salmon and tunas off WA, and tunas, striped marlin, snapper, Australian salmon and trevally off SA. Major areas of activity include waters off the Eyre Peninsula and Kangaroo Is. and off Perth and the Capes Region. • There are no data to establish the economic value of the sector. • Charter fishing is a popular tourism activity with around 258 registered charter boat businesses operating within and adjacent to the Region in 2005. In WA the most important centres from which charter fishing operates are Geraldton, Perth, Mandurah, Bunbury, Albany, Bremer Bay and Esperance. In SA charter fishing operators are based on Kangaroo Island, the Eyre Peninsula and at Streaky Bay. Of particular relevance to Commonwealth waters are those charter fishing operators targeting deeper water or 'offshore' **species** including tunas, snapper, Samson fish (off WA) and striped marlin (off SA).	• This Region is home to over 30 Aboriginal coastal language or clan groups. The relationship of these groups with the sea is underpinned by a tradition of custodial rights and responsibilities that extend back many thousands of years. • Fishing, hunting and the maintenance of maritime cultures and heritage through ritual, stories and traditional knowledge remain important activities for the region's Aboriginal people.

		Peninsula in SA the sea-cage culture of southern bluefin tuna captured in the Great Australian Bight has become the most economically important component of Australia's aquaculture industry. With a GVP of approximately $200 million the bluefin tuna industry represents around 90% of the total SA and WA aquaculture production combined. Second in importance is the oyster industry, with production occurring at various sites in State waters, including a small but growing industry centred on Albany. **Other species** include blue mussels, abalone, marine algae and pearl oysters.		
4. North West Region	• Comprises Commonwealth waters between the Western Australian / Northern Territory border to Kalbarri, south of Shark Bay. • In 2006, 91, 841 people lived adjacent to the Region, 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 has a large Indigenous population (15,195 or 17% of the total population) with significant populations in Roebourne, where over 50% of the • Town's 992 residents are of indigenous descent; Derby (40%) and Wyndham (35%) as well as the smaller Indigenous settlements of Bardi, Beagle Bay and Kulumbaru in the Kimberley region.	• There are 14 fisheries in the Region with another 12 primarily operating in State waters adjacent to the Region. The total commercial catch of fisheries operating in the Region was ~7000 tonnes of fish, prawns and crab, and 538 882 pearl oysters. The GVP of this catch was an estimated $165 million, of which $122 million was from pearls o 4 AFMA managed fisheries - Western Deepwater Trawl, North West Slope Trawl, Western Tuna and Billfish Fishery, and Northern Prawn. The 2006 status of these fisheries is uncertain, but not overfished. In 2005‑2006, the combined catch value of these fisheries was $7 million and the total landed catch was ~780 tonnes. **Key species** are scampi, deepwater prawn, Yellow fin, big eye, skipjack, albacore tuna, some billfish species, banana prawn, tiger prawn and mixed species. o 10 WA managed fisheries – Pilbara Demersal, Northern Demersal, Pearl Oyster, West Coast Deep Sea Crab, Shark Bay Snapper, Mackerel Interim Managed, West Coast Demersal Scalefish, Kimberley Prawn, Bêche–de-mer, and WA Tropical Shark. State fisheries adjacent also include Shark Bay Prawn, Exmouth Gulf Prawn, and Shark Bay Scallop Fisheries. The 2006 status of these fisheries is largely adequate, with one overfished and one uncertain. **Species targeted** include blue spot, emperor, crimson salmon, threadfin bream, gold band snapper, pink snapper, red emperor, silver lipped oysters, giant (king) crabs, crystal (snow) crabs, champagne (spiny) crabs, oceanic stock of pink snapper, Spanish mackerel, grey mackerel, scalefish, banana prawns, tiger prawns, Endeavour prawns, king prawns, sandfish, black tip sharks, tiger sharks, hammerhead sharks, lemon sharks, sandbar sharks, scampi and bêche-de-mer (trepang or sea cucumber). • The main fish processing and wholesaling facilities adjacent to the Region are located at Denham, Carnarvon, Exmouth, Onslow and Broome. In 2006 there were ~300 people employed in state fisheries, an unknown number in AFMA fisheries and a further 700 in shore based downstream processing, mostly in pearls.	• Recreational fishing is a popular activity in the Northwest 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 game fish. Recreational fishing tends to be concentrated in State waters adjacent to population centres. While it difficult to disaggregate bioregional effort data, 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. • Detailed information about the economic contribution of recreational fisheries to the Region is not available. • Charter fishing (from Broome and Exmouth), diving, snorkeling, whale, marine turtle and dolphin watching and cruising are the main commercial tourism activities in and adjacent to the North-west Marine Region. In 2005‑2006 there were 181 licensed fishing tour operators and 35 restricted fishing/eco-tour operators, although only around 50% of the 181 holders used their licences during that year. • There are several offshore pelagic sport and game fishing tournaments held each year in or adjacent to the Region. **Species** targeted include marlin, sailfish, mackerel, tuna and swordfish.	• There are at least 35 different language groups in the area. Fishing, hunting and the maintenance of maritime cultures and heritage through ritual, stories and traditional knowledge continue as important uses of the near shore region and adjacent areas. • Aboriginal fishers hold six of the 10 licences in the commercial Shark Bay Beach Seine and Mesh Net Managed Fishery. 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. • Indigenous people have significant roles in managing the Region's marine and coastal resources, including as rangers patrolling the

		• In 1974 Australia and Indonesia signed an MoU to enable traditional fishermen to access a range of species in a limited "MoU Box" adjacent Ashmore and Scott Reefs. These **species** include trochus, trepang (bêche-de-mer or sea cucumber), abalone, green snail, sponges, molluscs and finfish including shark. As a result of overfishing the parties are currently renegotiating this jointly managed fishery. • 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. • Apart from pearling activities, no offshore aquaculture currently occurs in the Region. 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. 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.		Kimberley coast for illegal foreign fishers, and to sustainably manage marine turtles and dugongs, including monitoring their populations and habitats, and identifying research and management needs.
5. North Region	• Comprises waters on the western side of Cape York in the Gulf of Carpentaria, Arafura Sea and the Timor Sea as far west as the Northern Territory–Western Australia border. • Around 167,000 people live on the mainland and islands adjacent to the Region, with two thirds of these living in Darwin and surrounding areas.	• There are 15 fisheries licensed to operate in the Region. Important fisheries by jurisdiction are: o 1 AFMA managed fishery - Northern Prawn o 7 QLD managed fisheries - Gulf of Carpentaria development finfish trawl, Gulf of Carpentaria inshore, Gulf of Carpentaria line, mud crab, spanner crab, blue swimmer crab, and developmental jellyfish. o 7 NT managed fisheries - aquarium, demersal, finfish, mud crab, offshore net and line (shark), Spanish mackerel, Timor Reef. • The aggregate GVP for these fisheries in 2005 was $110 million. Around 0.6% of people in the Region work in the commercial fishing industry. Karumba, Normanton, Burketown, Weipa and Darwin are the main centres for sector employment. Most of the vessels operating the largest fishery are based in large centres outside the Region (e.g. Cairns, Brisbane Fremantle) and therefore employment is not recorded for this Region. • Commercial aquaculture ventures in the coastal waters of northern Australia include pearl farming, barramundi and prawns. In 2004, the two highest production value aquaculture industries were pearling ($17.1 million) and barramundi farming ($9.4 million). Although it is a significant industry for the NT, much of the modern pearling industry is based in WA due to the fact that the NT does not have economically viable wild-stock pearl fisheries and relies predominantly on hatchery production. • IUU fishing is a significant issue for the Region.	• Recreational fishing is very popular in the Region. Most (~95%) of the effort occurs in NT waters. • There is limited coastal access to recreational fishing sites on the mainland or islands, and virtually all recreational fishing effort occurs within 50 km of road access points. • Key locations include Darwin Harbour (~50% of annual total hours spent fishing and half the total fish catch), Nhulunbuy, Groote Eylandt, Borroloola, Burketown, Normanton, Karumba and Weipa. • A 2003 study found a total of 1.83 million aquatic organisms were caught by recreational fishers in the NT, with just over half released. Barramundi was the primary target **species** in near shore waters (>40% of fishing effort)with others inshore including coral trout, red emperor, jewfish, threadfin salmon, snapper and mud crab. Offshore species in C'wealth waters were tuna, mackerel, queenfish, trevally, barracuda, cobia, sailfish, black marlin, jewfish, and snappers. • In 2000‑2001, recreational expenditure in the coastal areas adjacent to the Region was ~$40 million, mostly for fishing gear, boats and vehicles. Average annual spend by anglers was $614/person (NT), and $408/person (QLD). • Charter fishing is very popular in northern	• Indigenous people's spiritual connections to the land and sea are important values of the Region. • Marine **species** (fish, molluscs, marine turtles, dugongs, crabs, shellfish) are staple dietary items for many Indigenous communities, where food is very expensive and fresh produce is often unavailable or of poor quality. • Under QLD / NT/ C'wealth laws, Indigenous peoples are exempt from bag limits, size limits or restrictions against the taking of protected species if activities are undertaken according to traditional custom. • In 2000 90% of the Indigenous people in northern Australia were involved in fishing almost exclusively for food

	Australia - more fishing charter and hire boats operate in the NT and QLD than elsewhere in Australia. In 2004, there were 120 fishing tour operators licensed in the NT (88 active) and in 2006 there were 34 Queensland, there were 34 Charter Fishing License holders operating in the Gulf of Carpentaria. While most fishing tour operators target barramundi in coastal or inland waters, a small number of operators (less than 10) offer blue water fishing trips within and adjacent to the Region. Fishing resorts also operate in Weipa, Mornington and Sweers Islands, Maningrida and Nhulunbuy, and Wessel and English Company Islands. The popularity of helicopter-based fishing tours to remote areas is growing.	collection. The number of finfish caught by Indigenous people through subsistence fishing in northern Australian waters was around half the number of fish caught by recreational fishers in the same area. • There are now at least 35 Indigenous ranger groups in the Northern Territory, of which 14 coordinate works in and adjacent to the Region. • In Queensland, there are at least five established ranger programmes around the Gulf of Carpentaria. A number of other Indigenous communities are also interested in establishing land and sea management organisations involving sea ranger programmes

9. Bibliography

ABARE. (2004). *Economic Value of Charter and Recreational Fishing in Australia's Eastern Tuna and Billfish Fishery.* Canberra: Commonwealth of Australia.

ABARE. (2008). *Fisheries Economic Status Report.* Canberra: DAFF.

ABARE FishStats. (2009). *ABARE FishStats.* Canberra: Australian Government.

ABARE. (2006). *Indigenous people in aquaculture.* Canberra: Australian Government.

Aboriginal Fishing Strategy Working Group. (2003). *Aboriginal Fishing Strategy - draft report.* Report: WA Government.

Aboriginal Fishing Strategy Working Group. (May 2003). *Aboriginal Fishing Strategy, Fisheries Management Paper no. 168.* Canberra: Department of Fisheries.

ABS 4172.0. (2008). *Arts and Culture in Australia: A Statistical Overview, 2008 (Second Edition).* Australian Government.

ABS 6285.0. (Apr 2007). *Involvement in Organised Sport and Physical Activity, Australia.* Australian Government.

AFMA. (2005). *Strategic Research Plan 2005-2010.* Canberra: Australian Government.

Arlinghaus, R., & Cooke, S. (2008). *Recreational fisheries: socio-economic importance, conservation issues, and management challenges.* Oxford, UK: Blackwell Science.

BRS. (2008). *Fisheries Status Reports.* Canberra: Commonwealth Government.

CCRSPI. (2009). *Australian Primary Industris Responding to Climate Change - fact sheet.* Canberra: Australian Government - Product code PN22340.

Cooke, S., & Cowx, I. (2006). Contrasting recreational and commercial fishing: Searching for common issues to promote unified conservation of fisheries resources and aquatic environments . *Biological Conservation* , 128:p93-108.

Cooke, S., & Cowx, I. (2004 Sept). The Role of Recreational Fishing in Global Fish Crises . *BioScience* , Vol. 54 No. 9, p857-859.

Cowx, I. (2002). Recreational Fisheries. (H. P., & J. Reynolds, Eds.) *Handbook of Fish Biology and Fisheries, Vol. II* , 367-390.

CSIRO. (2009). *Developing innovative and cost-effective tools for monitoring recreational fishing in Commonwealth fisheries.* Hobart: CSIRO.

CSIRO. (2008). *Implications of climate change for Australian fisheries ansd aquaculture: a preliminary assessment .* Hobart: CSIRO.

CSIRO Marine and Atmospheric Research. (Sept 2006). *Impacts of Climate Change on Australian Marine Life.* Canberra: Australian Greehouse Office.

Cuthbertson, B., & Marks, N. (2008). *Beyond Credence? Emergiung Consumer Trends in Internationl Markets.* Melbourne: Victorian Governmnet.

DAFF. (2008). *A Discussion Paper - Outcomes of the Indigenous Aquaculture Workshop.* Canberra: DAFF.

DAFF. (1997). *Australia's Oceans Policy - Management instruments for marine allocation and use.* Canberra: Dept of Agriculture, Fisheries and Forestry.

DAFF BRS. (2005). *Community perceptions of aquaculture.* Canberra: Commonwealth of Australia.

DAFF BRS. (2000). *Indigenous Fishing Survey.* Canberra: Bureau of Rural Sciences.

DAFF. (2002). *The Principles and Strategies to underpin the development of Recreational Fishing Rights and Resource Allocation in Commonwealth Managed Fisheries.* Canberra: Department of Agriculture, Fisheries and Forestry.

DEWHA. (n.d.). *Approved wildlife trade operations*. Retrieved Oct 23, 2009, from Environment: http://www.environment.gov.au/biodiversity/trade-use/sources/operations/index.html#commercial

DEWHA Biological Resources. (n.d.). *Access to Genetic resources in Commonwealth areas*. Retrieved November 5th, 2009, from DEWHA: www.environment.gov.au/biodiversity/publications/access/regs/pubs/regs.pdf

DEWHA. (2009). *Marin Bioregional Planning - information sheet.* Canberra: DEWHA.

Dominion Consulting. (2005). *An Economic Profile of the Australian Fishing Tackle Indutry.* Sydney: Australian Fishing Tackle Association.

Drucker, P. (2008). Retrieved September 9, 2008, from The Drucker Institute: http://www.druckerinstitute.com/

Econsearch. (2009). *Economic Trends in SA Commercial Fisheries, 1997/98 to 2007/08.* Adelaide: Fisheries Council of SA.

Ernst & Young. (2009). *An Economic Study of Recreational Fishing in Victoria.* Melbourne: Ernst & Young.

Ernst & Young. (2006). *Economic Impact of Recreational Fishing in Port Stephens and Narooma/Bermagui.* Sydney: Ernst & Young.

Ernst & Young. (2004). *Economic Impact of the NSW Striped Marlin Fishery.* Sydney: Ernst & Young.

EU Green Paper. (2009). *Reform of the Common Fisheries Policy.* Brussels: European Union.

FAO. (2007). *Cage Aquaculture - Regional Reviews and Global Overview.* Rome: FAO.

FAO Calipso. (2006). *Fish and seafood consumption study and Biomarker of Exposure to Trace Elements, Pollutants and Omega 3.* Geneve: Agence Francaise de Securite Sanitaire des Aliments.

FAO. (2007). *Fish consumption in the European Union in 2015 and 2030.* Rome: FAO.

FAO Globefish. (2009). *Highlights 2nd Quarter Oct 2009.* Rome: FAO.

FAO Guidelines. (n.d.). *Technical Guidelines on Aquaculture Certification*. Retrieved Nov 8, 2009, from FAO.org: ftp://ftp.fao.org/docrep/fao/meeting/013/k2754e.pdf

FAO. (2007). *Laurenti, G. (comp.) 1961-2003 Fish and fishery products: world apparent consumption statistics based on food balance sheets. Appendix I - Fish and fishery products.* Rome: FAO.

FAO. (2008). *The State of World Fisheries an Aquaculture.* Rome: FAO.

FAOSTAT. (n.d.). *FAOSTAT*. Retrieved Sept 28, 2009, from FAO: http://faostat.fao.org/site/610/DesktopDefault.aspx?PageID=610#ancor

Fisheries Victoria. (2008). *Fisheries Status Report 2008.* Melbourne: Victorian Government.

Foster, C. (2008). Australasian Aquaculture Conference. Brisbane.

FRDC 1999/160. (2003). *Fish Futures 2020 Project.* Canberra: FRDC.

FRDC 2004/241. (2008). *Development of industrial-scale inland saline aquaculture: Coordination and communication of R&D in Australia.* Canberra: FRDC.

FRDC 2006/068. (2008). *Co-management: managing Australia's fisheries through partnership an delegation.* Canberra: Australian Government.

FRDC 2006/071.20. (2009). *Evaluating the Performance of Australian Marine Capture Fisheries.* Canberra: Australian Government.

FRDC 99/158 - NRFS Economic Report. (2005). *National Recreational Fishing Survey Economic Report.* Canberra: FRDC.

FRDC AOP. (2009-10). *Annual Operating Plan.* Canberra: Australian Government.

FRDC Board. (2009). Board Meeting 104 - Agenda Item 3.5. *Paper By J. Fitzgerald* .

FRDC. (2007). *Fish Vol 15 #2*. Retrieved Oct 8, 2008, from FRDC: http://www.frdc.com.au/pub/news/152.php?article=13

FRDC. (2005). *Investing in Tomorrow's Fish.* Canberra: Commonwealth Government.

FRDC Ipsos. (2008). *FRDC Stakeholder Research 2008 - Ipsos Final Report of Findings.* Canberra: FRDC.

FRDC News. (n.d.). *R&D News.* Retrieved September 18, 2008, from FRDC: http://www.frdc.com.au/pub/news/142.01.php#wal

FRDC Perceptions Survey. (2009). *Community Perceptions Survey.* Canberra: FRDC.

FRDC R&D News. (2008). *R&D News*. Retrieved September 18, 2008, from FRDC: http://www.frdc.com.au/pub/news/142.01.php#wal

FRDC. (2006). *Retail sale and consumption of seafood.* Canberra: Australian Government.

Globefish. (2008). *Homepage*. Retrieved Sept 28, 2009, from Globefish: http://www.globefish.org/dynamisk.php4?id=4713

Greenpeace.org. (n.d.). *Greenpeace Seafood*. Retrieved Oct 6, 2009, from Greenpeace USA: http://www.greenpeace.org/usa/campaigns/oceans/seafood/certification

Ipsos. (Aug 2006). *Seafood Consumption - Omnibus Results.* Canberra: FRDC.

Kearny, B., Foran, B., Poldy, F., & Lowe, D. (2003). *Modelling Australia's Fisheries to 2050: Policy and Management Implications .* Canberra: CSIRO.

LWA. (2005). *Futures thinking about landscapes, lifestyles and livelihoods in Australia.* Canberra: Land and Water Australia.

MAFF Japan. (May 2009). *White Paper on fisheries.* Tokyo: Japanese Government.

McManus A, B. S. (2007). Factors influencing the consumption of seafood among young children in Perth: a qualitative study. *BMC Public Health* , 7:119.

MTSRF. (2009). *Assessing the socioeconomic implications of climate change (coral bleaching) in the Great Barrier Reef catchment.* Canberra: DEWHA - Marine and Tropical Sciences Research Facility.

National Health and Medical Research Council. (May 2005). *Dietary Guidelines.* Canberra: Australian Government.

National Native Title Tribunal. (2008, June). Traditional Fishing Rights snagged by legislation. *National Native Title Tribunal Indigenous Fishing Bulletin* .

Native Title Tribunal. (June 2008). *Indigenous Fishing Bulletin.*

Natural Resource Ministerial Council. (Nov 2009). *Communique #16.* Canberra: Australian Government.

NIFTWG. (2003). *The Principles Communique on Indigenous Fishing - Technical Working Group.*

NOAA. (2008). *Business Report 2008.* Silver Spring, Maryland: US Government.

NOAA. (2009). *http://www.noaanews.noaa.gov/stories2008/20080717_seafood.html.* US Government.

NRIFS. (2003). *National Recreational and Indigenous Fishing Survey - FRDC Project 99/158.* Canberra: Commonwealth of Australia.

NSW Fisheries. (2008). *Status of Fisheris Resources in NSW 2006-07.* Sydney: NSW Government.

NT Fisheries. (2004). *Fisheries Status Reports 2004.* Darwin: NT Government.

NT Government. (2007). *Fishery Status Report 2007.* Darwin: NT Government.

Pinnacle Management. (2007). *Eastern Tuna and Billfish Fishery Supply Chain.* Canberra: DAFF Project 73/06.

Pinnacle Management. (2007). *SESSF Seafood Supply Chain Analyses.* Canberra: DAFF Project 73/06.

PIRSA. (2006). *SA Fisheries Resources - Current Status and Recent Trends.* Adelaide: SA Government.

Pitcher, T., Kalikoski, D., Pramod, G., & Short, K. (Feb 2009). Not Honouring the Code. *Nature* , 658-659.

Productivity Commission. (2004). *Assessing Environmental Regulatory Arrangements for Aquaculture.* Canberra: Australian Government.

QDPIF. (2008-09). *Qld Government - DEEDI - Fisheries.* Retrieved Nov 12, 2009, from Annual Status Reports: http://www.dpi.qld.gov.au/28_10916.htm

Rabobank. (2009). *Trading Down in the seafood Sector.* Utrecht: Rabobank.

RBA 2009. (n.d.). *Reserve Bank of Australia*. Retrieved 2009 13Oct09, 2009, from http://www.rba.gov.au/Statistics/HistoricalExchangeRates/index.html

Recfish Australia. (2008). *Home*. Retrieved September 16, 2008, from Recfish Australia: http://www.recfish.com.au/

Recfish Australia. (2009). *Recfishing Research Business Plan.* Canberra: FRDC.

RFIDS Committee. (2009). *Draft National Recreational Fishing Policy.* Canberra: DAFF.

Ruello and Associates. (2008). *Queensland Seafood Supply Chain Study.* Brisbane: QDPI&F.

South Australian Food Centre. (2008). *SA Food.* Regents Park, Adelaide: Government of South Australia.

Southern Rocklobster Ltd. (2004). *Clean and Green Program*. Retrieved September 17, 2008, from Australian Southern Rocklobster: http://www.southernrocklobster.com/cleangreen/default.aspx

Spring Bay Seafoods. (2009, April 27). Press Release. *Spring Bay Seafoods wins coveted 'Friend of the Sea' global award* . Spring Bay Seafoods.

Tassal Group Ltd. (2008). *Annual Report.* Hobart: Tassal Group Ltd.

Thyer, R. (2008, June). To 100,000 tonnes and beyond. *Fish* , pp. 14-17.

TRaCK. (2009). *River Food Webs - Fact Sheet 1.* Canberra: DEWHA - Tropical Rivers and Costal Knowledge.

UN. (2004). *World Population to 2300.* New York: United Nations.

US Dept of Health and Human Services. (2005). *Dietary Guidelines for Americans.* Washington DC: US Government.

US Interagency Ocean Policy Task Force. (Sept 2009). *Interim Report of the Interagency Ocean Policy Task Force.* Washington DC: US Government.

Valdimarsson, G. (2007). Fish in the Global Food Supply Chain. *World Seafood Conference.* Dublin: FAO.

Venn, T., & Quiggin, J. (2007). Accommodating indigenous cultural heritage value in resource assessment: Cape York Peninsula and the Murray-Darling Basin, Australia. *Ecological Economics* , 61: 334-344.

WA Fisheries. (2008). *State of the Fisheries Report 2007/08.* Perth: WA Government.

World Bank. (2008). *The Sunken Billions. The Economic Justification for Fisheries Reform.* Washington DC: World Bank.

Worm, B. (Jul 2009). Rebuilding Global Fisheries. *Science* , 578-584.