

*Report to client*

Market demand  
for Australian aqua-  
culture products

# Market demand for Australian aquaculture products

ABARE report to the  
Fisheries Resources Research Fund

Debbie Brown and Peter Connell

January 2001

## *DEMAND FOR AQUACULTURE PRODUCTS*

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### *1. Introduction*

Demand for fisheries products has grown steadily both in Australia and internationally over the past decade. This demand has been driven by a number of key trends, including the increase in eating outside the home, a trend toward healthier foods, greater diversity in food intake and improvements in the availability of seafood.

Over the decade there has also been increased focus on the potential for aquaculture as a seafood supply system to overcome many of the problems apparent in capture fisheries. Aquaculture (including growout or ranching) has a range of potential advantages over the capture fisheries in meeting some types of seafood demand. These strengths result from the greater control over the type of species produced, the volume produced, the time of harvesting, the size composition of catches and, potentially, over quality processes.

Some of the market opportunities for aquaculture result from the high dependence of seafood markets on supplies from wild capture fisheries and their operating characteristics. The wild catch sector of the fishing industry has two distinguishing features that reduce the control over the level and characteristics of its output. The first is that it depends on the wild fish stock. The total production from wild caught fisheries is constrained by fish yields and by the need to conserve wild stocks. Strong consumer demand and high prices do not generally lead to a sustained increase in supplies because wild catches are constrained by the potential resource yield. Catches can only be increased in the short term at the cost of lower catches in the longer term and ultimately the sustainability of the fish stock.

The second distinguishing feature is that in many fisheries, adequate private property rights do not exist or are difficult and costly to establish and enforce. While some aquaculture activities also rely on wild fish stock, they operate within a much stronger property rights framework than do wild fisheries. Moreover, in wild fisheries the common property nature of the resource may result in suboptimal use patterns that affect demand. For example, fish sizes may be smaller than required by markets because no incentives exist for fishers to defer catches as other operators in the fishery may catch those fish in the interim.

Tuna farming opportunities in Australia, for example, have resulted from the improvements in property rights in the southern bluefin fishery that have allowed operators to better address market requirements. Prior to the

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introduction of individual transferable quotas (ITQ), catches of southern bluefin tuna in the wild were mainly of small fish suited to canning. The improvements in property rights allowed the industry to change the operations in the fishery to provide increased focus on larger fish suited to more valued uses. Moreover, the wild catch and farming sectors combined when growing out tuna to optimal market sizes was found to be a more profitable alternative to a fishery based on targeting large fish in the wild.

The nature of Australian wild stocks of fisheries products provides opportunities for aquaculture. Australian fish stocks are characterised by very wide species diversity that occur in relatively small volumes. As a consequence aquaculturists can work with a large stock of native genetic material. While only a limited number of these species have well established consumer demand, for some of those that do (such as snapper and barramundi) this demand is largely unmet. For other species, the problem in gaining consumer acceptance is a key influence on their commercialisation. Silver perch is one example of an aquaculture species that has faced this problem.

Not all the opportunities for aquaculture are related to the wild catch supply. Aquaculture also provides opportunities to supply species not readily available in the wild. Even with the large number of available fish species within and around Australia, there are species with high consumer demand that are not available in commercial volumes. Atlantic salmon and trout are two species where farming has established an Australian market for species with worldwide recognition where none existed previously.

Many possibilities exist to create or meet new demands for products in Australia and overseas. The expansion in food diversity available in Australia reflects a similar diversity overseas and creates opportunities for producers to creatively adapt products to meet existing demands of consumers. For example, there is a range of products not presently available in Australia that are met by imports. There are undoubtedly other products for which demand is not currently being met. Moreover, as consumer tastes, incomes and prices change, opportunities to expand production of seafood will arise.

The purpose in this paper is to examine the longer term demand opportunities facing aquaculture products in general. Given that Australia's major trading opportunities are in the Asia Pacific region, the report is focused on developments in this region.

The key factor in assessing the long term potential of aquaculture production of a particular species is whether the activity is likely to be profitable. To identify the most promising opportunities for farmed product, information is

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required on market opportunities, on the technical feasibility and the likely economics of production under Australian circumstances. In making such assessments, however, these issues can be interrelated. For example, market opportunities in relation to a new product are strongly influenced by price, which in turn is influenced by the technical feasibility and production costs. The rates of change for these aspects are important when considering the feasibility of aquaculture. These issues are discussed in the individual ABARE case studies published in *Profitability of selected aquaculture species* (Weston, Hardcastle and Davies 2001).



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### 2. An overview of world fisheries production and trade

#### *Growth in aquaculture production*

Total world production of fisheries products in 1998 has been estimated at around 117 million tonnes (excluding aquatic plants), with 26 per cent sourced from aquaculture (table 1). Over the 1990s recorded world production increased by around 2 per cent a year, most of which was from higher aquaculture production, which more than doubled over the period. Most of this growth in production was for human consumption, rather than for nonfood (feed) use. About 45 per cent of global fishery production used for human consumption was consumed in a fresh/chilled form, 30 per cent as frozen product and the remainder as salted, dried, smoked or canned product (FAO 2000c).

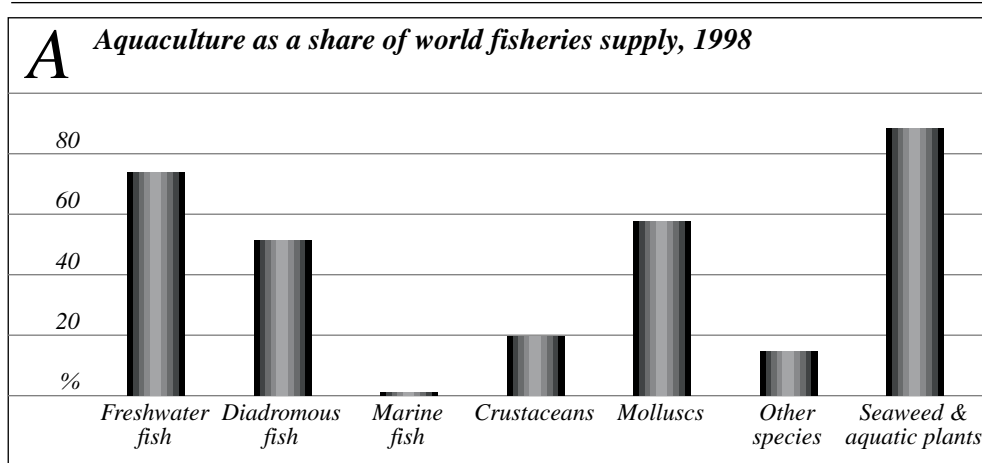
There is some evidence that the recorded expansion in aquaculture production may be overstated, in part reflecting the difficulties in verifying both produc-

#### **I** *World fisheries production and utilisation*

	1990	1991	1992	1993	1994	1995	1996	1997	1998
	Mt	Mt	Mt	Mt	Mt	Mt	Mt	Mt	Mt
<b>Production</b>									
<b><i>Inland</i></b>									
Aquaculture	8 152	8 389	9 353	10 556	12 134	14 010	15 962	17 579	18 727
Capture	6 588	6 382	6 134	6 525	6 705	7 249	7 433	7 532	8 003
Total inland	14 740	14 771	15 487	17 081	18 839	21 259	23 395	25 111	26 730
<b><i>Marine</i></b>									
Aquaculture	4 936	5 352	6 122	7 340	8 686	10 451	10 858	11 246	12 136
Capture	79 292	78 706	79 168	79 983	84 731	84 328	86 041	86 087	78 296
Total marine	84 228	84 058	85 290	87 323	93 417	94 779	96 899	97 333	90 432
<b><i>Total</i></b>									
Aquaculture	13 088	13 741	15 475	17 896	20 820	24 461	26 820	28 825	30 863
Capture	85 880	85 088	85 302	86 508	91 436	91 577	93 474	93 619	86 299
World fisheries	98 968	98 829	107 777	104 404	112 256	116 038	120 294	122 444	117 162
<b>Utilisation</b>									
Human consumption	70 655	69 559	72 834	75 332	78 725	85 272	89 226	93 272	93 292
Other purposes	26 440	27 062	26 143	27 272	31 731	29 057	31 068	29 171	23 870

Source: FAO (2000a,b,c).

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tion levels and composition (for some countries, production estimates include aquatic plants while others do not). However, there is little doubt that the aquaculture industry has grown strongly over the past decade.

While over three-quarters of the total world capture landings are of marine fish, world aquaculture production is dominated by the farming of freshwater fish species (FAO 2000b). The overall contribution of aquaculture to world fisheries production has risen sharply over the 1990s rising from 13 per cent in 1990 to 26 per cent in 1998. Around 70 per cent of fresh water fish production is farmed, while farmed molluscs provided around 60 per cent of total mollusc production (those that are not farmed are mainly squid, octopus and cuttlefish). Marine fish farming remains in its infancy, providing less than 1 per cent of marine fish production (figure A).

### 2 *World aquaculture production, by continent <sup>a</sup>*

	1990	1991	1992	1993	1994	1995	1996	1997	1998
	kt	kt	kt	kt	kt	kt	kt	kt	kt
Africa	82	93	101	93	96	105	120	119	189
North America	411	470	525	541	532	560	563	644	656
South America	186	257	295	287	342	409	556	660	670
Asia	14 498	15 955	18 881	22 173	25 206	28 563	30 955	32 732	35 814
Europe	1 610	1 445	1 379	1 379	1 505	1 608	1 690	1 766	1 960
Oceania	46	68	71	74	73	95	107	110	141
Total	16 835	18 287	21 253	24 547	27 754	31 340	33 992	36 031	39 431

<sup>a</sup> Includes aquatic plants.  
Source: FAO (2000b).

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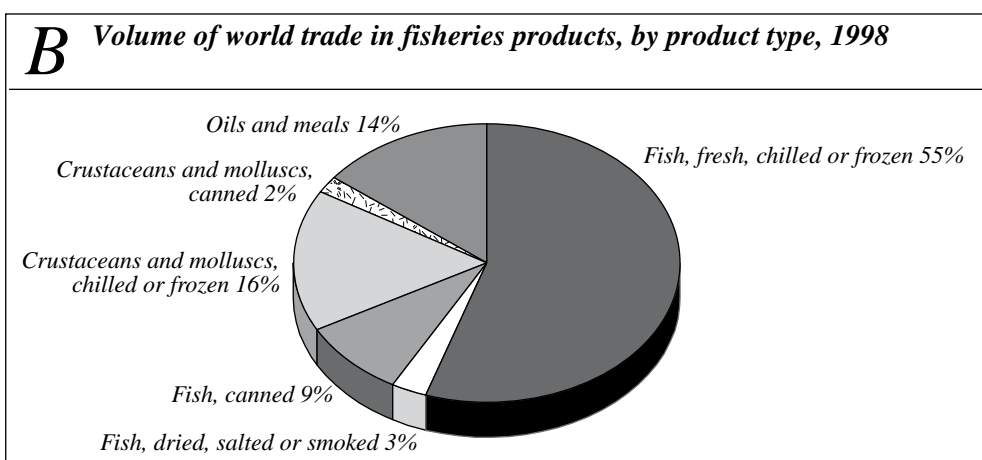
The Asian region dominates both wild catches and aquaculture production, accounting for around 90 per cent of the world aquaculture production in 1998 (table 2). While aquaculture is well established as a mainstream source of fisheries products in Asia, in both North America and Europe it is strongly focused on a limited range of species (mainly catfish and salmon) for specific markets.

### *World trade in fisheries products*

Parallel with increases in production, world trade in fisheries products continued to grow over the past decade. In 1998, international trade in fish and fishery products (excluding seaweed) traded as both food and feed products was around 39 million tonnes (live weight) valued at US\$51.3 billion (FAO 2000c). In value, fishery exports are almost entirely (95 per cent) composed of food products, although in volume, fishmeal and fish oil account for a much greater share (figures B and C).

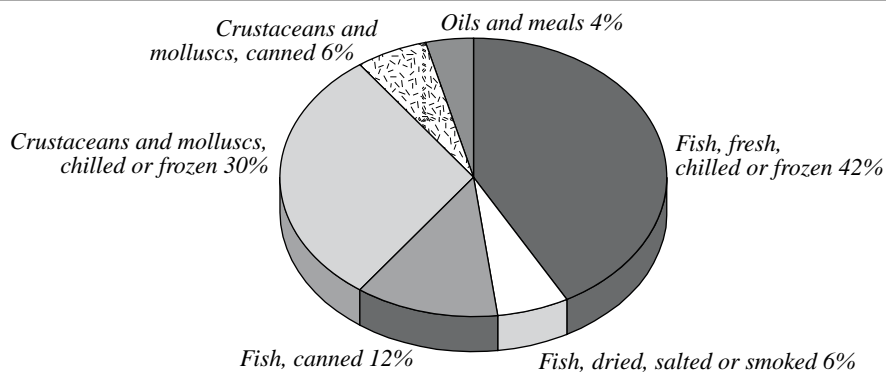
More than half of the fisheries export trade in value terms originates in developing countries, where fisheries exports provide a significant source of foreign currency. The level of concentration of fisheries exports is relatively low, with Thailand accounting for 8 per cent of the total value of exports in 1998, followed by Norway, Denmark, China and the United States (FAO 2000c) (figure D).

By comparison, imports of fisheries products are highly concentrated in a limited number of mainly developed countries. Japan is the world's largest individual market for fisheries products, importing 23 per cent of the total value of world fishery imports in 1998, while the United States accounted for a further 16 per cent (figure E). These two countries together with the European

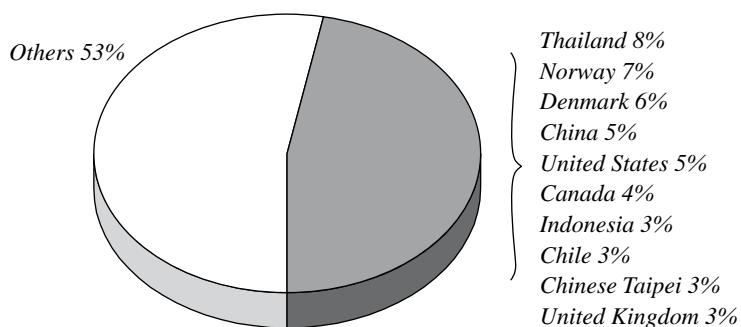


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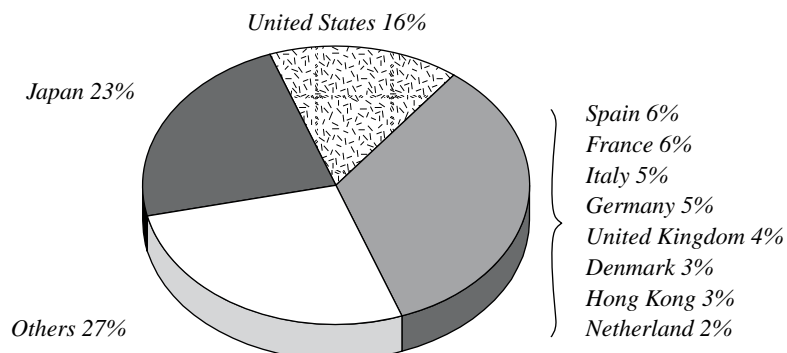
**C** Value of world trade in fisheries products, by product type, 1998



**D** Value of world trade in fisheries products, by source, 1998



**E** Value of world trade in fisheries products, by destination, 1998



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Union (including the value of intra-EU trade) account for three-quarters of the world's imports of fishery products (FAO 2000c) (table 3).

While the APEC region overall has a low reliance on imports as a source of seafood — 18 per cent for the three years 1995–97 — some countries have a

### 3 Import of seafood products

	1991–93		1993–95		1994–96		1995–97	
	Share of consumption		Share of consumption		Share of consumption		Share of consumption	
	Imports	tion	Imports	tion	Imports	tion	Imports	tion
	kt	%	kt	%	kt	%	kt	%
<b>Selected APEC countries</b>								
Australia	222	65.9	233	68.7	234	69.8	249	71.8
Canada	352	52.7	453	67.2	485	74.3	537	80.8
Chile	21	5.2	27	6.7	31	9.0	35	10.9
China	429	3.0	701	3.1	689	2.6	648	2.2
Chinese Taipei	138	18.1	142	17.7	182	23.9	197	24.7
Hong Kong	435	127.9	428	124.7	432	121.9	422	117.2
Indonesia	9	0.3	15	0.5	17	0.5	19	0.5
Japan	3 589	43.1	3 858	44.2	3 942	44.5	4 060	46.8
Korea, Rep. of	361	17.3	434	19.2	494	21.3	550	23.7
Malaysia	315	56.9	318	29.6	312	28.5	332	29.0
New Zealand	23	37.8	21	26.7	22	26.6	18	21.1
Singapore	256	251.8	262	252.9	268	259.2	261	238.7
Thailand	663	45.8	746	49.9	711	38.6	585	30.5
United States	2 358	42.5	2 366	40.8	23 442	40.6	2 429	43.1
Total APEC	9 535	21.4	10 558	19.3	10 917	18.8	11 296	18.3
<b>Selected European Union countries</b>								
France	1 331	81.4	1303	83.0	1 375	82.6	1 392	84.2
Germany	1 085	108.4	1144	110.7	1 189	112.7	1 188	116.6
Greece	85	36.7	93	35.9	98	37.3	121	45.3
Italy	854	68.1	816	66.1	807	65.1	855	67.7
Netherlands	517	281.9	530	245.5	557	253.1	576	240.2
Portugal	4 361	74.1	449	77.7	472	80.1	486	82.5
Spain	1199	87.3	1 278	75.7	1 254	86.5	1 318	82.2
United Kingdom	815	74.2	828	74.5	843	75.5	874	74.0
Total EU	7 528	91.8	7 801	91.1	7 993	94.1	8 253	95.0

a Imports as a share of consumption may exceed 100 per cent in some countries because further processing of imports may be undertaken and the product then reexported.

Source: FAO (2000c).

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significant reliance on imports, such as Australia, Canada, Hong Kong and Singapore. The European Union has a higher reliance on imports (95 per cent in 1995–97) than does the APEC region. This strong dependence is reflected across all member countries.

### *World seafood consumption*

World consumption of fisheries products used for human consumption increased by 3.9 per cent a year over the period 1991–93 to 1995–97. Per person consumption increased by 3 per cent a year over the period, while population increased by 0.8 per cent a year (table 4).

#### *4 Population and per person consumption of fisheries products, by country*

	Population				Per person consumption <sup>a</sup>			
	1991 –93	1993 –95	1994 –96	1995 –97	1991 –93	1993 –95	1994 –96	1995 –97
	'000	'000	'000	'000	kg	kg	kg	kg
<b>Selected APEC countries</b>								
Australia	17 297	17 676	17 941	18 136	19.5	19.2	18.7	19.1
China	1 162 624	1 87 205	1 99 273	1 11 100	12.4	19.1	22.0	24.1
Chinese Taipei	20 634	21 018	21 213	21 393	37.0	38.2	35.8	37.3
Hong Kong	5 866	6 041	6 228	6 366	57.9	56.8	56.8	56.6
Indonesia	188 688	194 521	197 472	200 420	15.6	17.1	17.6	17.9
Japan	124 222	124 794	124 461	125 760	67.0	69.9	70.7	69.0
Korea, Rep. of	43 681	44 500	44 945	45 342	47.7	50.7	51.6	51.2
Malaysia	18 796	19 694	20 106	20 547	29.5	54.5	54.6	55.7
New Zealand	3 435	3 519	3 668	3 717	17.8	22.2	22.2	22.4
Singapore	3 143	3 267	3 320	4 400	32.4	31.8	31.2	32.4
Thailand	56 793	57 780	58 613	59 173	25.5	25.9	31.4	32.4
United States	259 388	264 605	266 990	269 410	21.4	21.9	22.1	20.9
Total APEC	2 271 976	2 319 978	2 264 771	2 368 134	19.6	23.3	25.1	26.1
<b>Selected European Union countries</b>								
France	57 307	57 850	58 017	58 248	28.5	27.1	28.7	28.4
Germany	80 300	81 190	81 626	81 876	12.5	12.7	12.9	12.4
Greece	10 321	10 412	10 488	10 530	22.5	25.0	25.1	25.4
Italy	57 107	57 176	57 332	57 360	22.0	21.6	21.6	22.0
Netherlands	15 166	15 380	15 456	15 538	12.1	14.0	14.2	15.4
Portugal	9 845	9 834	9 857	9 860	59.7	58.8	59.7	59.8
Spain	39 452	39 575	39 567	39 591	34.8	42.7	36.7	40.5
United Kingdom	58 035	58 222	58 528	58 652	18.9	19.1	19.1	20.1
Total EU	368 151	370 683	372 100	373 055	22.3	23.1	22.8	23.3
<b>World</b>	<b>5 446 019</b>	<b>5 606 472</b>	<b>5 664 840</b>	<b>5 743 643</b>	<b>13.0</b>	<b>14.5</b>	<b>15.2</b>	<b>15.7</b>

<sup>a</sup> Live weight.

Source: FAO (2000c).

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The Asia Pacific region accounts for around two-thirds of the total fisheries products used for human consumption and this proportion continues to grow. The region's aggregate consumption of fisheries products increased by around 8.5 per cent a year over the period 1991–93 to 1995-97. This was a result of average per person consumption increasing by 7.5 per cent a year and about a 1 per cent annual increase in population.

Trends in seafood consumption in individual APEC countries have varied since the early 1990s. In the non-Asian countries of Australia, New Zealand and the United States, per person consumption has been relatively static or in the case of New Zealand per person consumption has declined. There have been major gains in per person consumption in China (94 per cent), Malaysia (89 per cent) and Thailand (27 per cent), while average per person consumption in the high consuming countries such as Hong Kong, Japan and Korea had relatively small changes in seafood consumption over the same period.

Countries in the European Union consume about one-tenth of the total world fisheries products. Consumption in the European Union grew by about 1.4 per cent a year over the period 1991–93 to 1995-97. This was a result of average per person consumption increasing by about 1.1 per cent a year and an average population increase of 0.3 per cent a year.

### *Future outlook for fish production*

Production from marine capture fisheries accounted for 90 per cent of all catches from all sources in 1998. However, landings of marine fish continue to level off in most of the major fishing areas in the world. FAO analyses on capture fisheries indicate that there have been few changes in the level of exploitation of marine resources since 1990. Inland fish stocks, although relatively small in relation to marine resources, have increased following enhancement practices in Asia.

FAO projections are that by 2010 world fishery production will be between 107 and 144 million tonnes, of which about 30 million tonnes will probably be reduced to fishmeal and oil for nonfood use (table 5). Thus the estimated quantity available for human consumption range between 74 million tonnes and 114 million tonnes. (In the late 1990s, annual human consumption use was around 93 million tonnes (table 1).) Most of the increase in fish production is expected to come from aquaculture. It is estimated that total aquaculture production will be between 35 and 40 million tonnes of fish, crustaceans and molluscs by 2010 (compared with around 30 million tonnes harvested in the late 1990s).

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### 5 *FAO projections for fisheries production by 2010*

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	<b>Pessimistic scenario</b>	<b>Optimistic scenario</b>
	Mt	Mt
Capture	80	105
Aquaculture production	27	39
Total production	107	144
<i>Less</i> fish for non-food uses	33	30
Available for human consumption	74	114

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*Source:* Feidi (2000).

The contribution from capture fisheries will depend on the effectiveness of fisheries management and other developments. Improved management of currently overfished stocks could provide an increase of 5–10 million tonnes, whereas continued overfishing would lead to declining production.

Other factors that will influence future trade in aquaculture product include environmental and social concerns about aquaculture production, food safety and food security. Fish and fishery products are one of the most internationally traded of all foodstuffs, with 35–40 per cent of fisheries production traded annually.



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### *3. Factors influencing demand for seafood*

While the growth of world agriculture production is slowing down and real prices of agriculture products have generally declined over time, it is a different situation for the fisheries sector where production and real prices have increased over the past three decades (FAO 1999). This rise in prices has occurred in parallel with a slow increase in per person supplies, supporting the idea that fish generally fall into the category of preferred food items.

Factors influencing demand for seafood include the level and distribution of income, tastes and eating habits, population and other demographic factors and the relative prices of fisheries products and substitutes. Markets for fishery products have been influenced by government and nongovernment led efforts to influence consumption patterns. These groups have promoted the consumption of fish, both to promote healthy eating and boost sales.

As Australian fishery exports are directed to the APEC region, discussion in this section is focused on developments in this region. To help assess the prospects for demand growth over the next few years it is convenient to group countries into categories (box 1).

#### *1 Country consumption categories*

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**Category A** countries that are characterised by high income per person and high seafood consumption per person. Japan, Hong Kong and Singapore fall into this category.

**Category B** countries are characterised by high income per person, lower growth in income per person and a low to moderate level of seafood consumption per person. The United States, Australia, Canada and New Zealand are examples.

**Category C** countries have low income per person, a high rate of growth in aggregate income, and a moderately high level of seafood consumption per person. Chinese Taipei and Korea are examples of category C countries.

**Category D** countries are characterised by even lower income per person and a high rate of growth in aggregate income. Food consumption per person is moderately low but seafood provides a significant proportion of the animal protein consumed. Thailand, Indonesia, China, Malaysia and the Philippines are examples in this category.

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### *Economic growth and prices*

Economic growth is expected to have a major influence on the future demand for seafood. In this analysis it is assumed that world economic growth will be around 4.4 per cent in 2000 and 3.9 per cent in 2001, compared with the estimated 3.3 per cent in 1999. After 2001 economic growth is estimated to slow down slightly. (See table 6 for projections on economic growth in individual countries and regions.)

The relationship between income and the demand for food is influenced by many factors, including the level and distribution of income, the nutritional status of the population, and cultural and social attitudes. Generally, because a high proportion of income is already committed to food in developing countries, the demand for food is more responsive the changes in income in these countries than in developed countries. As basic nutritional needs are met, substitution between foods becomes more important. For countries with high consumption of seafood per person, higher income would be expected to have a small effect on consumption but a greater impact on expenditure on food, as higher valued fish would substitute for lower valued species.

### **6** *Projected economic growth rates* *Percentage change in real gross domestic product from previous year*

	1998	1999	2000	2001	2002	2003	2004	2005	2006
	%	%	%	%	%	%	%	%	%
<b>Selected APEC countries</b>									
Australia	5.2	4.4	4.2	3.1	4.0	3.5	3.5	3.5	3.5
China	7.8	7.1	8.0	7.8	7.8	7.5	7.5	7.0	7.0
Chinese Taipei	4.6	5.4	6.3	5.0	5.5	5.5	5.5	5.0	5.0
Hong Kong	-5.3	3.13	10.3	4.0	4.5	4.0	4.0	4.0	4.0
Indonesia	-13.0	0.3	4.5	4.0	4.2	4.5	5.0	5.5	5.5
Japan	-1.1	0.8	1.7	1.5	1.8	1.8	2.0	2.0	2.0
Korea, Rep. of	-6.7	10.7	9.2	5.0	5.5	5.5	5.0	5.0	5.0
Malaysia	-7.4	5.8	8.7	5.5	6.0	6.0	5.5	5.5	5.5
New Zealand	-0.6	3.9	4.2	3.0	3.0	3.0	3.0	3.0	3.0
Singapore	0.4	5.4	10.1	6.0	6.0	6.0	5.5	5.5	5.5
Thailand	-10.8	4.2	4.5	4.0	4.5	5.0	5.0	5.0	5.0
United States	4.4	4.2	5.0	2.3	3.2	3.0	3.03	3.0	3.0
<b>Selected European Union countries</b>									
Germany	2.1	1.6	3.1	2.7	3.0	3.0	2.8	2.8	2.8
France	3.2	3.0	3.2	3.0	3.0	3.0	2.8	2.8	2.8
United Kingdom	2.6	2.1	3.0	2.7	2.7	2.5	2.5	2.5	2.5
Italy	1.5	1.4	2.7	2.5	2.5	2.5	2.5	2.5	2.5
<b>World</b>	2.5	3.3	4.6	3.6	3.9	3.8	3.8	3.7	3.7

Source: International Monetary Fund (2000); ABARE.

## *DEMAND FOR AQUACULTURE PRODUCTS*

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In *category A* countries, growth in income per person is unlikely to result in a significant increase in consumption of seafood. The main change in demand is likely to be the substitution of higher valued seafood for the seafood products that currently form part of the diet but are less preferred by consumers.

In *category B* countries, such as Australia, seafood is not a major source of food. Seafood consumption provides variety in the diet, and is associated with eating away from home. Therefore, increases in income are likely to have a positive impact on seafood consumption. Health considerations are also expected to play a part in increasing the demand for seafood.

In *category C* countries, seafood is a preferred food, and given increasing discretionary incomes, growth in seafood consumption may follow a similar pattern to that experienced in Japan and Hong Kong. Demand for seafood in Korea is price inelastic but income elastic (that is, the amount of seafood demand is relatively insensitive to the price of seafood, but is relatively sensitive to income levels) (OECD 2000).

In *category D* countries, a high proportion of any increase in income is likely to be used to purchase food. Income changes may also alter the relative composition of foods eaten, with the demand for proteins likely to be more responsive to changes in income than the demand for carbohydrates. As fisheries products contribute significantly to meeting the nutritional requirements of a range of countries in category D, the demand for fish is likely to be highly responsive to income growth.

From Australia's trade perspective, a number of economies, notably Japan, Hong Kong and Korea, have historically relied on seafood as the primary source of protein, influenced by both cultural factors (Kingston, Battaglione, Smith and Beare 1991) and accessibility. However, the expansion in seafood demand that has occurred within the APEC region generally may be driven by a number of other factors. These include changes in the relative price of seafood, preference for seafood, income growth and demographic factors such as population growth and urbanisation (Smith, Dennis and Proctor 1996; Smith, Brown and McKelvie 1992).

A reduction in the price of seafood products, relative to other close substitute products such as beef or chicken, would be expected to increase the demand for seafood. A number of factors have combined to produce downward pressure on the price of seafood in recent times, including increases in production (primarily from aquaculture), increased competition and a reduction of import tariffs.

## *DEMAND FOR AQUACULTURE PRODUCTS*

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However, short term demand for fish in Europe and North America is likely to ease as competing livestock products, particularly poultry and pork, are expected to become relatively cheaper. This is expected because of continuing productivity gains in livestock production as well as modifications to the EU Common Agricultural Policy. These modifications are aimed at reducing grain prices and subsequently production costs for intensive livestock products such as pork and poultry. As a result, consumers in Europe and North America could well eat less fish. This shift in consumer demand is expected to occur gradually (Feidi 2000).

The responsiveness of the demand for seafood products to changes in prices varies considerably between products. For Japan, for example, a number of studies have demonstrated that the demand for high valued seafood, especially crustaceans, is more responsive to price changes than is demand for other seafood (Kingston et al. 1991; Wessells and Wilen 1994). This is also true for the United States (Cheng and Capps 1988; Wellman 1992) and Korea (Smith et al. 1996).

Increased urbanisation when associated with income growth results in a greater propensity to eat out, increasing the demand for seafood, particularly high value seafood. Access to seafood has also been helped as a result of lower transport costs to urban markets and an increase in the number of supermarkets and outlets selling fish products.

### *Trade barriers*

International rules and regulations play a major role in governing seafood trade, especially for developing countries. Two international agreements of significance are the Agreement on the Application of Sanitary and Phytosanitary Measures (SPS) and the Agreement on Technical Barriers to Trade (TBT). These agreements were concluded under the Uruguay Round of multi-lateral trade negotiations and are binding on all members of the World Trade Organisation.

The SPS agreement specifies when food safety concerns are a valid reason for exceptions to the principal of nondiscrimination in international trade. The TBT agreement sets out rules for the use of technical regulations that are not directly related to health (such as quality, labeling and method of analysis) to prevent any discrimination in favor of domestic products or between goods of different origin (FAO 1999).

Food safety has become an increasingly important international issue in recent years. Seafood has been regarded by consumers as a potential problem because of some well published problems with shellfish toxins and salmonella and, in

## *DEMAND FOR AQUACULTURE PRODUCTS*

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the case of aquaculture, the use of antibiotics in feed. Increasing efforts have been undertaken to improve the quality of aquaculture products. Recent examples have included the introduction of HACCP requirements for exports to the United States and the European Union in 1997, the FAO/WHO Food Standards Program and voluntary certification (ISO programs) for control as well as marketing purposes.

The issue of genetically modified organisms (GMOs) in human foods, apart from direct use, has also expanded to include the use of GMOs in feed for animals destined for human consumption. This is an important issue in the trade in aquaculture products as the use of genetically modified soybeans has been widespread in the production of feeds for fish and prawns.

Another factor affecting future trends in trade is the impact of tariff and non-tariff barriers. Despite steady reductions in tariffs on fish and aquaculture products in recent years, tariffs as well as import licences continue to represent barriers to trade in many countries. This is especially the case in many of the fast growing economies in Asia, but even the developed countries give competitive advantages to domestic producers of many species, especially in the case of processed products.

The potential effects of trade liberalisation, in the form of tariff reductions in the APEC region, were analysed by Hartmann, Klijn and Cox (2000). The results from this study indicated that significant increases in the volumes of seafood trade were available in the APEC region. The source of this growth would be expected to come from the creation of trade opportunities from tariff reductions and the diversion of some seafood from domestic consumption to export markets in response to changing relative prices.

A move toward free trade in fisheries products has important implications for fisheries management. The general expansion in seafood demand that is expected from a reduction in trade barriers will place greater pressures on existing fish stocks unless sustainable management regimes are implemented. There is likely to be a greater role for the aquaculture sector in providing sustainable seafood supplies.

Import tariff rates for seafood products in the APEC region are directly related to the level of processing, with higher tariffs for higher levels of processing (table 7). One consequence of higher import tariffs for further processed products, also known as tariff escalation, is that it provides an incentive for further processing in importing countries and a disincentive to exporting countries. Australian exporters of seafood face tariff escalation in many markets and, as

## *DEMAND FOR AQUACULTURE PRODUCTS*

a result, Australian seafood exports consist largely of unprocessed seafood products.

Nontariff barriers in the APEC region are diverse. They can be measures that affect trade directly or indirectly. These barriers are an issue for Australian seafood exporters when they distort trade to the detriment of Australian producers. Nontariff barriers are difficult to assess qualitatively, and quantitatively their effects are even more difficult. Frequently these barriers lack transparency. This lack of transparency creates uncertainty that further impedes trade. The majority of Australian seafood exports are subject to nontariff barriers, such as quantitative restrictions and/or sanitary or phytosanitary regulations. Given the relative elusiveness of nontariff barriers, it is difficult to estimate the extent to which Australian exports are impeded.

### *7 Ad valorem tariffs on seafood imports in selected APEC countries, 1998<sup>a,b</sup>*

	China	Hong Kong	Chinese Japan	Taipei	United Korea	States
	%	%	%	%	%	%
<b>Tuna</b>		0	3.5			0
Live, fresh or chilled	15–20			12.5–20 <sup>b</sup>	20	
Frozen	15			12.5–35	10	
Filletts	30			35	10–20	
<b>Rock lobster</b>	30	0			20	
Live, fresh or chilled			1	42.5		
Frozen			1	35		
Dried, salted or in brine				35		
<b>Prawns</b>	30	0	1		20	0
Live, fresh or chilled				22.5		
Frozen				22.5		
Dried, salted or in brine				37.5		
<b>Scallops</b>				15	20	0
Live, fresh or chilled	30	0	0			
Frozen						
Dried, salted or in brine						
<b>Abalone</b>	40–45		7		20	
Live, fresh or chilled			7			
Salted or in brine			5.3–15			
Dried		15	9–10.5			

<sup>a</sup> The rates presented in this table are on a most favored nation basis. <sup>b</sup> Tariffs can differ according to species.  
Source: APEC.

## DEMAND FOR AQUACULTURE PRODUCTS

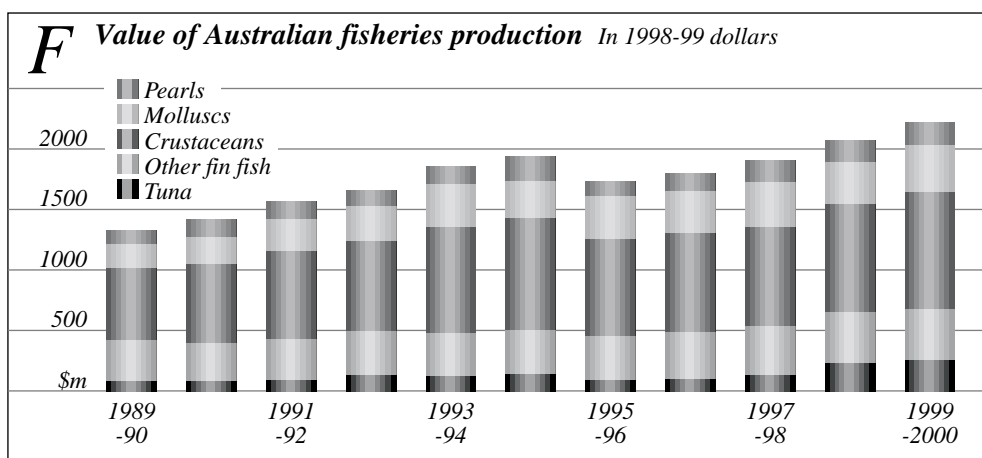
### 4. Australian seafood market

#### Domestic supplies

Even though Australia has the third largest fishing zone, by area, in the world, Australia is the only the world's fiftieth largest producer by weight. The value of the Australian catch is dominated by high value products such as rock lobster, prawns, abalone and tuna, most of which are exported. The domestic market is supplied by vessels operating in coastal waters close to their home port for finfish, which are sold fresh, or by imported products.

The value of Australian fisheries production has risen by 53 per cent from an estimated \$1.33 billion in 1989-90 to \$2.04 billion 1999-2000 (when measured in 1998-99 dollars) (figure F). During this period domestic landings of fisheries products peaked in 1991-92 at around 248 000 tonnes (ABARE 2001) when large catches of orange roughy were taken off south eastern Australia. In the late 1990s landings stabilised at around 230 000 tonnes (table 8). Fish (including tuna) have on average comprised 62 per cent of total recorded landings, crustaceans 22 per cent and molluscs 16 per cent over this period.

The volume of aquaculture production almost quadrupled over this ten year period to an estimated 40 600 tonnes in 1999-2000 (ABARE 2001) (table 9). Overall, the Australian aquaculture sector contributed 18 per cent of the total supply of Australian fisheries products in 1999-2000, up from 6 per cent in 1989-90.



## *DEMAND FOR AQUACULTURE PRODUCTS*

Australia's aquaculture industry currently produces a number of products that reflect the wide range of growing conditions in Australia: from tropical prawn and crab in northern Australia, to temperate finfish such as snapper and colder water production of Atlantic salmon off Tasmania.

The pearl industry is one of Australia's most valuable aquaculture industries, worth \$182 million in 1999-2000, or 30 per cent of the estimated value of aquaculture production in that year. Other highly valuable industries include southern bluefin tuna (\$202 million), Atlantic salmon (\$81 million), edible oysters (\$46 million), prawns (\$44 million), barramundi (\$9 million) and trout (\$8 million). Other species currently farmed include abalone, freshwater crayfish and mussels.

The degree of export orientation varies across species. For example, most pearls, farmed tuna and farmed kuruma prawns are exported. The main markets for these exports are Japan, Hong Kong and Chinese Taipei. Other

### *8 Australian fisheries production*

	1992 -93	1993 -94	1994 -95	1995 -96	1996 -97	1997 -98	1998 -99	1999 -2000
	t	t	t	t	t	t	t	t
<b>Fish</b>								
Tuna	10 220	7 703	8 682	9 245	13 026	11 890	16 728	16 218
Other	134 958	121 870	127 489	123 530	128 528	134 287	125 270	113 302
Total	145 179	129 573	136 171	132 775	141 555	146 177	141 998	129 520
<b>Crustaceans</b>								
Prawns	24 805	23 170	27 965	29 366	27 736	29 603	31 182	25 864
Rock lobster	18 434	16 793	16 266	15 784	15 815	16 616	19 224	20 264
Crabs <sup>a</sup>					6 685	6 749	5 750	6 488
Other	5 562	7 322	7 871	8 298	976	749	787	786
Total	48 800	47 284	52 102	53 449	51 212	53 717	56 943	53 403
<b>Molluscs</b>								
Abalone	4 668	4 673	5 204	5 408	5 236	5 226	5 614	5 508
Scallops	33 630	23 606	15 415	16 018	6 283	5 759	11 621	10 947
Oysters	8 561	8 717	9 426	10 061	10 396	10 499	10 731	12 969
Squid <sup>a</sup>					1 789	1 648	3 497	2 216
Other	4 940	5 148	7 464	6 484	5 585	5 946	5 984	6 504
Total	51 798	42 144	37 509	38 335	29 289	29 078	37 447	38 144
<b>Total</b>	245 777	219 001	225 781	224 559	222 055	229 351	236 800	221 405

<sup>a</sup> Crab and squid production not available separately prior to 1996-97.

Source: ABARE (2001).



## DEMAND FOR AQUACULTURE PRODUCTS

products such as farmed silver perch, edible oysters and yabbies are mainly sold domestically.

The mix of aquaculture and wild catch in total Australian production also varies across species. For some species, such as Atlantic salmon, all Australian production is derived from aquaculture. In the case of southern bluefin tuna, aquaculture's share of final production has increased rapidly in the past five years. In 1999-2000 around 98 per cent of the value of Australian southern bluefin tuna production was from aquaculture operations. For others, such as abalone, wild catch dominates. There are important links between the aquaculture and wild catch industries for some species. For example, southern bluefin tuna farming is influenced by the quota for tuna, which are caught as juveniles and grown out for sale.

### 9 Australian aquaculture production

	1992 -93	1993 -94	1994 -95	1995 -96	1996 -97	1997 -98	1998 -99	1999 -2000
	t	t	t	t	t	t	t	t
<b>Fish</b>								
Salmon	3 500	4 706	7 285	7 647	7 647	7 069	9 195	10 907
Tuna	535	1 275	1 927	2 018	2 123	5 140	6 365	7 803
Trout	2 015	11 819	1 779	2 333	2 093	1 438	1 646	1 942
Silver perch <sup>a</sup>					115	162	195	320
Barramundi <sup>a</sup>					555	627	775	814
Other	471	583	742	1 058	601	234	194	161
Total	6 521	8 383	11 733	13 056	13 134	14 670	18 370	21 947
<b>Crustaceans</b>								
Prawns	1 128	1 539	16 783	1 565	1 564	2 059	2 319	2 950
Yabbies	149	336	257	174	215	306	245	290
Marron	18	21	22	25	52	48	49	52
Red claw <sup>a</sup>					63	60	78	77
Other	45	38	66	95	44	0	0	0
Total	1 340	1 935	2 018	1 859	1 938	2 473	2 691	3 369
<b>Molluscs</b>								
Edible oysters	8 561	8 717	9 426	10 061	10 396	10 499	10 731	12 969
Mussels <sup>a</sup>					1 266	1 271	1 692	1 771
Other	414	823	832	1 375	350	185	332	239
Total	8 975	9 540	10 258	11 436	12 012	11 955	12 755	14 979
<b>Total</b>	16 835	19 858	24 009	26 351	27 084	29 477	34 228	40 632

<sup>a</sup> Individual species production not available separately prior to 1996-97; included in the 'Other' categories.  
Source: ABARE (2001).

## *DEMAND FOR AQUACULTURE PRODUCTS*

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The volume of farmed fish production has risen from an estimated 3000 tonnes in 1989-90 to almost 22 000 tonnes in 1999-2000. In this same period, production of farmed crustaceans rose from 620 tonnes to almost 3400 tonnes and farmed mollusc production increased from 7300 tonnes to nearly 15 000 tonnes.

Cultured finfish production in Australia is dominated by Atlantic salmon (50 per cent in 1999-2000), southern bluefin tuna (35 per cent) and trout (principally rainbow and brown trout, 9 per cent). Southern bluefin tuna and Atlantic salmon are both relatively new industries. Culture of native species is increasing, focusing on barramundi and silver perch. A number of other native freshwater finfish that are currently in commercial production include eels and Murray cod.

Mollusc culture is dominated by the pearl industry. Several species of pearl are found and cultured in Australia. The main pearl oyster cultured in Australia is the gold or silver lipped pearl oyster, *Pinctada maxima*, which produces the high quality south sea pearl and mother of pearl shell.

Species of edible oysters grown in Australia include the Sydney rock oyster, Pacific oyster and the native flat oyster. Historically, Sydney rock oyster has been the most important edible oyster produced in Australia. However, production has declined. Reasons for this include the introduction of the Pacific oyster, pollution, toxic algae blooms and disease. There has been a considerable increase in the production of Pacific oysters, mainly in Tasmania and South Australia.

Abalone culture is an emerging industry, and production is likely to expand substantially in the near future as production from recently established farms becomes available.

Black tiger prawns (*Penaeus mondon*) comprise the majority of cultured prawn production in Australia. Commercial production of kuruma prawns (*P. japonicus*) is increasing each year with some farms that previously produced black tiger prawns switching to kuruma production and more recently new farms have been set up especially for kuruma prawn production. Farming of penaeid prawns has grown rapidly in Australia but has stabilised in recent years.

Under consideration is the culture or on-growing of rock lobster and development of mud crab farming and Moreton Bay bugs.

## DEMAND FOR AQUACULTURE PRODUCTS

### 10 *Value of Australian exports of fisheries products*

	1990 -91	1994 -95	1995 -96	1996 -97	1997 -98	1998 -99	1999 -2000
	A\$m	A\$m	A\$m	A\$m	A\$m	A\$m	A\$m
Tuna	5	41	57	67	105	120	259
Salmon	17	25	29	17	15	11	9
Other fish	83	77	82	91	115	143	125
Rock lobster	256	475	418	453	424	451	578
Prawns	283	231	233	183	234	224	244
Abalone	115	168	147	170	191	185	223
Scallops	30	72	67	37	36	33	42
Crabs	2	28	37	28	27	20	23
Other crustaceans and molluscs	6	25	92	31	34	36	30
Marine fats and oils	1	2	2	2	3	3	1
Fish meal	A	2	4	5	8	7	9
Pearls	103	211	196	192	286	272	436
Ornamental fish	1	1	3	5	1	1	2
Other nonedible	7	9	11	16	9	5	3
<b>Total</b>	<b>831</b>	<b>1 367</b>	<b>1 328</b>	<b>1 305</b>	<b>1 489</b>	<b>1 511</b>	<b>1 988</b>

Source: ABARE (2001).

### *Export growth*

A significant portion of domestic fisheries production is exported, with total fisheries exports valued around \$2.0 billion in 1999-2000. Edible fisheries products comprise about 80 per cent of the value of exports (table 10). Australia's contribution to world trade in seafood products is small. Australia was ranked twenty-first in the world in 1998 in terms of value of fisheries exports.

Australian exports have been dominated by four countries — Japan (34 per cent of the total value of exports in 1999-2000), Chinese Taipei (11 per cent), Hong Kong (19 per cent) and the United States (9 per cent) (table 11).

Since the beginning of the 1990s there has been a diversification in the destinations of Australian fisheries exports. In 1990-91, just over half of the sales of fisheries products went to Japan. During the 1990s, China, Chinese Taipei, Hong Kong and the United States also became important destinations for Australian product. A description of these markets is provided in appendix A. Singapore has also become an important market for Australian seafood exports.

## *DEMAND FOR AQUACULTURE PRODUCTS*

### *11 Australian exports of fisheries products, by destination*

	<b>1990</b>	<b>1994</b>	<b>1995</b>	<b>1996</b>	<b>1997</b>	<b>1998</b>	<b>1999</b>
	<b>-91</b>	<b>-95</b>	<b>-96</b>	<b>-97</b>	<b>-98</b>	<b>-99</b>	<b>-2000</b>
	A\$m	A\$m	A\$m	A\$m	A\$m	A\$m	A\$m
China	4	6	21	53	120	104	42
Chinese Taipei	73	203	219	217	179	170	211
Hong Kong	78	269	234	236	245	248	368
Japan	426	556	491	447	483	462	680
Singapore	18	41	46	40	41	43	60
Spain	36	14	15	10	13	23	19
United States	142	74	64	76	110	144	187
Other	43	193	223	211	284	304	397

*Source:* ABARE (2001).

### *Key export species*

Rock lobster is Australia's highest value export product, accounting for an estimated 29 per cent of the 1999-2000 total export value, followed by pearls at 22 per cent, prawns at 12 per cent and abalone at 11 per cent. Hong Kong is the major market for whole live, fresh or chilled Australian rock lobster, accounting for 35 per cent of total value of Australian whole rock lobster exports. Australia's other markets for whole rock lobster are China, Chinese Taipei and Japan. The United States remains by far the major market for rock lobster tail exports.

Whole prawn exports are the major product form exported, accounting for around 85 per cent of the total value of prawn exports. Japan is the major market for prawns, accounting for 61 per cent of the total value of prawn exports in 1999-2000. Other major markets include China, Hong Kong and Chinese Taipei.

Abalone is also a significant Australian seafood export with an export value of \$243 million in 1999-2000. The major markets for Australian abalone are Japan, Hong Kong and Chinese Taipei, accounting for 27 per cent, 24 per cent and 20 per cent respectively of the value of Australian abalone exports.

Export sales of crabs and scallops rose in 1999-2000 to around \$23 million and \$42 million respectively. Hong Kong remains the largest export market for Australian scallops, accounting for 71 per cent of scallop exports. Chinese Taipei is the dominant market for crabs, accounting for 52 per cent of Australian crab exports in 1999-2000.

## DEMAND FOR AQUACULTURE PRODUCTS

The total value of fish exports (including tuna) rose 43 per cent to \$393 million in 1999-2000. Exports of tuna accounted for 66 per cent (\$259 million), most of which went to Japan. Tuna exports are dominated by sales of farmed southern bluefin. The other major fish species exported is farmed Atlantic salmon, valued at \$9 million in 1999-2000, with Japan again being the major market.

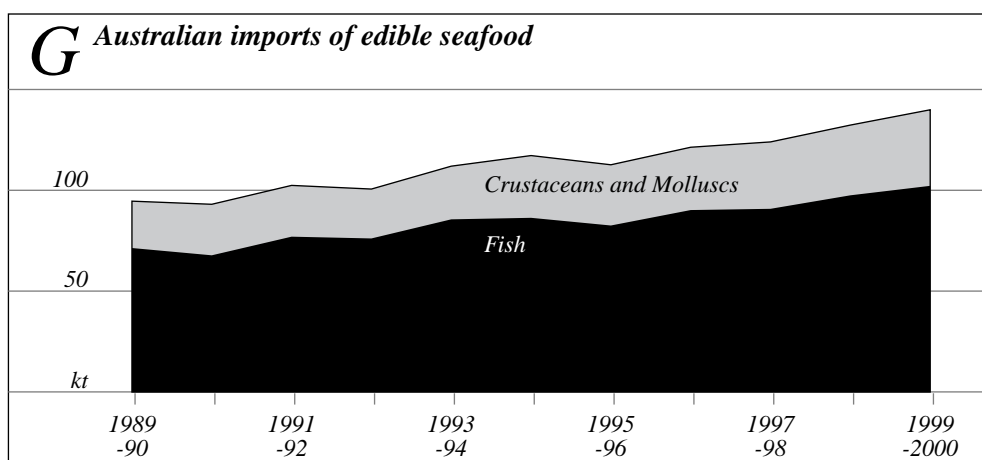
### Imports

Australia imports a range of seafood covering a variety of species and products and product forms. Imports of fisheries products supply around 60 per cent of all seafood consumed in Australia. Imported seafood products have mainly met demand from those segments of the Australian market that the domestic market could not supply because of resource constraints, but imports have increasingly been competitive in other market segments (Smith and Reid 1993).

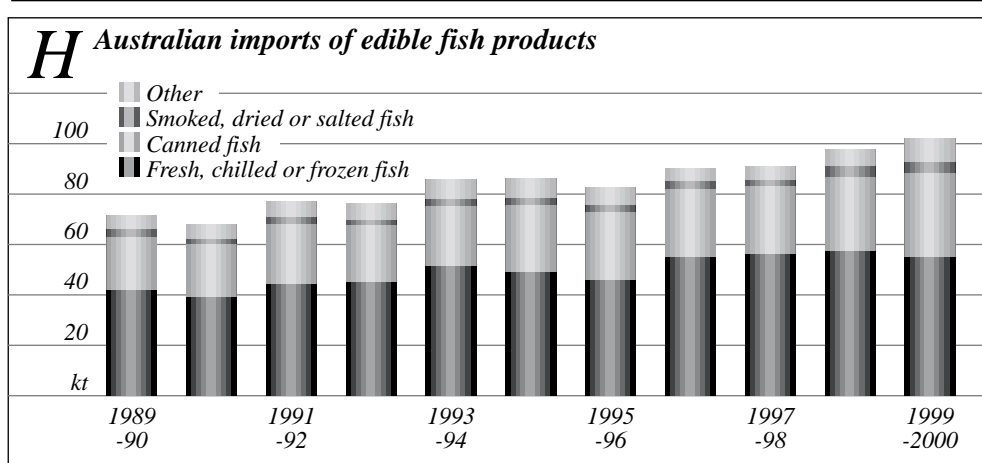
The total imported volume of edible fisheries products rose by 48 per cent between 1989-90 and 1999-2000, from around 94 700 tonnes to around 140 000 tonnes (ABARE 2001). Imports of crustaceans and molluscs increased by 50 per cent over this period, while imports of edible fish products increased by 37 per cent (figure G).

In 1999-2000 the total value of imports of edible fisheries products was about \$781 million. Around 59 per cent of this total value was edible fish products, valued at \$463 million, while crustaceans and molluscs imports were around \$317 million.

Between 1989-90 and 1999-2000, imports of edible fish products increased by 37 per cent to around 97 600 tonnes. Over that period there were no signif-



## DEMAND FOR AQUACULTURE PRODUCTS



ificant changes in the composition of imports by product type. Imports of fresh, chilled or frozen product comprised around 60 per cent of total imports, with canned products comprising about 30 per cent, and smoked dried or salted (3 per cent) and other fish preparations about 6 per cent (figure H).

A wide range of species are imported (box 2). The major single species or species group imported into Australia is tuna which in 1999-2000 constituted 17 per cent by volume of Australian edible fish imports. Hake is the next major species imported (12 per cent), while salmonids accounted for 8 per cent. Other species imported include eels, dogfish and other sharks, and cod.

As for edible fish imports, Australian imports of crustaceans and molluscs cover a variety of species and product forms. In 1999-2000 Australian imports of edible crustaceans and molluscs totaled around 37 718 tonnes (product

### 2 *Australian imports of edible fisheries products, by species*

#### **Tuna**

Australia imported around 17 400 tonnes (product weight) of tuna in 1999-2000, valued at around \$67.5 million. Of the total import volume, whole tuna (either fresh or frozen) accounted for 493 tonnes and canned products 16 900 tonnes. Nearly all frozen whole tuna was imported for canning purposes.

#### **Hake**

Imports of hake in all product forms totaled 12 344 tonnes in 1999-2000 valued at \$49.4 million. About 90 per cent of hake imports are in frozen fillet form, sourced from Chile and South Africa. Hake is imported as the standard for fish and chips, bulk catering, breaded fish products and the like.

## *DEMAND FOR AQUACULTURE PRODUCTS*

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### **Salmon**

In 1999-2000 Australia imported 622 tonnes of salmon (product weight), worth \$7.5 million, 87 per cent of which, by volume, was in smoked form. The major supplier was Denmark.

### **Flatfish**

Flatfish imports cover species such as sole, halibut, plaice and flounder. In 1999-2000, Australia imported around 961 tonnes (366 tonnes of sole), valued at about \$3.3 million. About 93 per cent of flatfish imports were sourced from New Zealand.

### **Herrings, sardines, mackerels and anchovies**

These species are imported in a wide variety of product forms — whole (fresh or frozen), canned, salted or in brine or other forms of prepared or preserved products. In 1999-2000, imports of these products totaled 7072 tonnes, valued at \$27.5 million; imports of canned product totaled 5819 tonnes.

### **Eels**

Australia imported \$0.43 million worth of eels in 1999-2000. Imports of fresh or chilled eels totaled 3783 kilograms, valued at \$20 773, while 40 322 kilograms of frozen eels worth \$408 899 were imported in 1999-2000. The major suppliers were Japan, Chinese Taipei, Viet Nam and New Zealand.

### **Prawns**

In 1999-2000 Australia imported 15 733 tonnes of prawn products, valued at \$191 million. Over half of these imports were as frozen product form (60 per cent), with prepared and preserved prawns (not canned) accounting for 36 per cent by volume. The major supplier of prawn imports (fresh, chilled or frozen product and other) to Australia has been Thailand. In 1999-2000 Australia imported 10 423 tonnes (product weight) of chilled or frozen prawns, valued at \$146 million.

### **Oysters**

Oyster imports are sourced mainly from New Zealand. In 1999-2000 Australia imported 660 tonnes (product weight) as live, fresh, chilled, dried, salted or in brine products. Oysters from New Zealand totaled 612 tonnes or 93 per cent of total oyster imports.

### **Mussels**

Australia imported 2284 tonnes of mussels in 1999-2000, valued at \$7.6 million, nearly all of which are from New Zealand. Of these imports, 81 per cent were frozen (29 per cent half shell, 23 per cent meat and 29 whole). Another 10 per cent were exported to Australia as prepared or marinated product. According to Australian quarantine regulations all mussel imports must be dead.

### **Scallops**

Imports of scallops in 1999-2000 totaled 1665 tonnes, valued at \$25.9 million. In 1999-2000, 79 tonnes were imported as chilled product, while the remainder was imported frozen, dried, salted or in brine. Japan and New Zealand have traditionally been the major suppliers of scallops to Australia.

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### **Cephalopods**

Imports of squid, octopus and cuttlefish made up 29 per cent of total imports of crustaceans and molluscs in 1999-2000. Total imports in 1999-2000 were 11 037 tonnes, valued at \$35.8 million. Major suppliers of these products have been Chinese Taipei, New Zealand and Thailand. Squid is the major item imported, with 7264 tonnes imported in 1999-2000.

### **Crabs**

Australia imported 669 tonnes of crab products in 1999-2000, valued at \$5.2 million. Of this, 475 tonnes were canned.

### **Lobster**

Australia imported 654 tonnes of lobster products in 1999-2000, valued at \$11.1 million.

weight) valued at \$317 million. Nearly 42 per cent of the total imports by volume was prawns at 15 733 tonnes, next were imports of cephalopods (squid, cuttlefish and octopus), which comprised 29 per cent of total imports, and mussels (6 per cent). Australia also imported small quantities of lobster, crabs, oysters and scallops.

### *Trends in Australian seafood consumption*

While average consumption of seafood in Australia is above the world average (see table 4), it is a relatively small part of the average Australian diet. In comparison to domestic consumption of other forms of meat, seafood ranks ahead only of mutton, offal, and bacon and ham (table 12).

## *12 Australian apparent consumption of meat and fish per person*

	1938	1948	1958	1968	1978	1988	1998
	-39	-49	-59	-69	-79	-89	-99
	kg	kg	kg	kg	kg	kg	kg
Beef <b>a</b>	63.6	49.5	56.2	40.0	64.8	40.0	36.4
Lamb <b>a</b>	6.8	11.4	13.3	20.5	14.4	14.9	11.8
Mutton <b>a</b>	27.2	20.5	23.1	18.8	3.6	7.3	4.5
Pig meat <b>a</b>	3.9	3.2	4.6	6.7	13.3	17.5	19.0
Poultry <b>b</b>	na	na	na	8.3	17.1	24.1	30.8
Offal and meat <b>nei</b>	3.8	4.0	5.2	5.1	5.9	3.1	na
Canned meat <b>c</b>	1.0	1.2	1.9	2.2	1.6	na	na
Bacon and ham <b>d</b>	4.6	5.3	3.2	3.6	6.0	6.9	8.7
Seafood <b>e</b>	4.9	4.1	4.5	5.6	6.4	8.3	10.9

**a** Carcass meat. **b** Dressed weight. **c** Canned meat. **d** Cured carcass weight. **e** Edible weight. Comprises fresh, frozen and otherwise prepared seafood. **na** Not available. **nei** Not elsewhere included.  
Source: ABS (2000a).



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Apparent per person consumption of seafood in Australia has risen over the past ten years from an average apparent consumption of 8.3 kilograms per person in 1988-89 to 10.9 kilograms per person in 1998-99 (product weight). This follows a longer term trend showing the consumption of seafood increasing dramatically since the late 1940s when intake was 4.1 kilograms per person. In 1996-97 (the last year when these figures were available), consumption of fresh or frozen products accounted for around 70 per cent of consumption, while the remainder was of seafood prepared in other forms such as dried, canned, smoked etc. (table 13).

Australian finfish sold for domestic consumption is mostly sold fresh through fishmongers. Imported frozen fish meets the needs of supermarkets, fast food outlets and caterers for fish fillets of low cost, consistent quality and continuous availability. Imported fish is also used as a feedstock to the few Australian based processors manufacturing frozen prepacked supermarket fish and seafood lines.

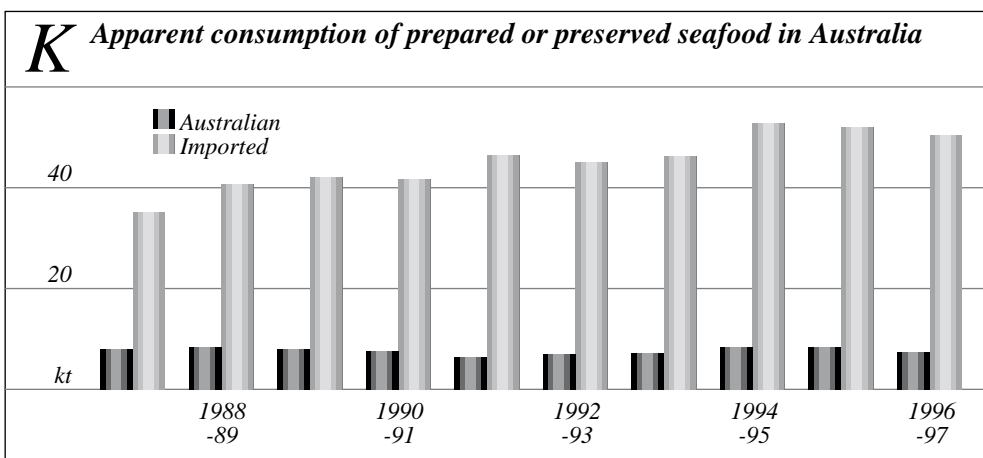
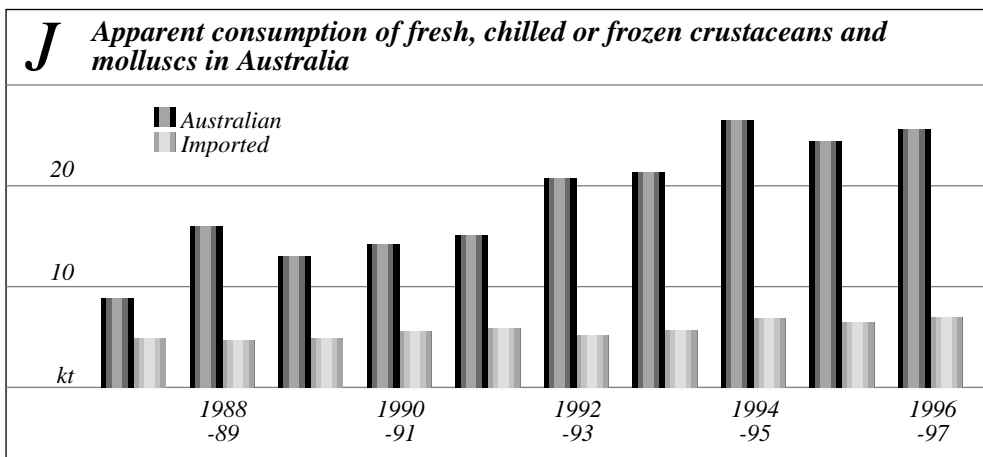
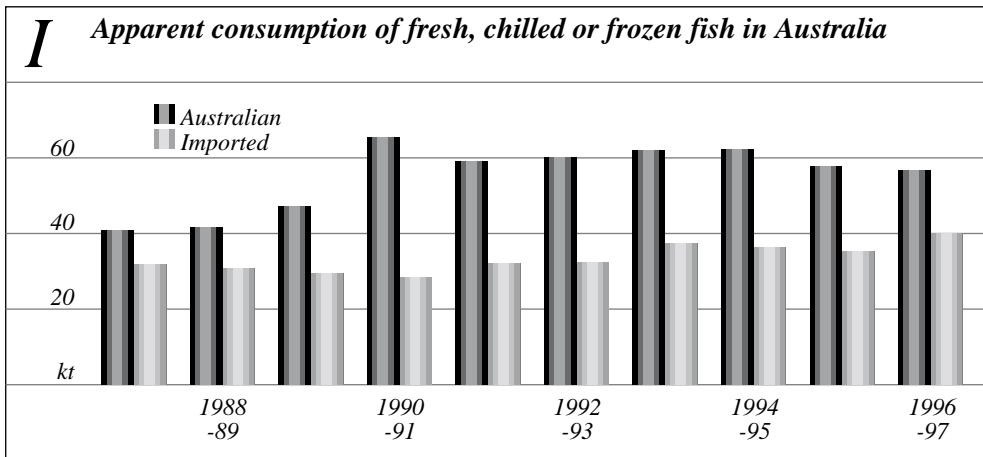
Between 1987-88 and 1996-97, apparent consumption of fresh, chilled or frozen fish in Australia rose by 13 per cent to 5.3 kilograms per person (product weight) in 1996-97. Australian fish products have contributed an average 62 per cent of total apparent consumption of fresh, chilled or frozen fish. This proportion has not been static, with Australia products supplying an increased proportion in the early 1990s as Australian catches of fish increased following the discovery of large supplies of orange roughy. Since then supplies of Australian product have declined and stabilised in the late 1990s so that an increased proportion of domestic consumption has been met by imported products (figure I).

### 13 Apparent consumption of seafood per person, by product form <sup>a</sup>

	1989 -90	1990 -91	1991 -92	1992 -93	1993 -94	1994 -95	1995 -96	1996 -97	1997 -98	1998 -99
	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg
Fish <sup>b</sup>	5.2	5.9	5.6	5.8						
– Australian					3.8	3.9	3.7	3.8	3.9	3.6
– imported					4.1	4.1	4.0	4.1	4.1	4.5
Crustaceans and molluscs	1.3	1.5	1.6	1.7	2.7	2.8	2.7	2.8	2.8	2.9
Other seafood <sup>c</sup>	2.9	2.9	3.1	3.0	na	na	na	na	na	na
Total	9.4	10.3	10.3	10.4	10.5	10.8	10.4	10.7	10.8	10.9

<sup>a</sup> Edible weight. <sup>b</sup> Prior to 1992-93 included fresh and frozen fish only. <sup>c</sup> After 1992-93, 'Other seafood', which included dried, canned and cured products, has been included in other categories. **na** Not available.  
Source: ABS (2000a).

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Consumption of fresh and frozen crustaceans and molluscs rose from 1.1 kilograms per person in 1987-88 to high of 1.9 kilograms per person in 1994-95 and to around 1.8 kilograms per person in 1995-96 and 1996-97 (figure J). The proportion of Australian product has risen from around two-thirds to around 80 per cent in the mid-1990s.

Consumption of 'other seafood' includes canned, smoked or dried fish, fishballs, and fishcake products derived from fish, crustaceans and molluscs. Estimated per person consumption of these products has ranged between 2.6 and 3.5 kilograms over the period 1987-88 to 1996-97 (edible weight). As a proportion of total seafood consumption per person, consumption of these other products has been relatively stable at about 30 per cent. Australian supplies contribute less than 20 per cent of consumption of these products (figure K).

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### 5. Factors influencing seafood demand in Australia

#### *Changing domestic purchasing behavior*

The last major study of Australia's consumption of fish and seafood was conducted in 1990-91, and was commissioned by the Fishing Industry Research and Development Council (FRDC 1992). The study was designed to assess the impact of various changes in seafood consumption since the previous study undertaken in 1977 (PA Consulting Services 1977), and to provide a basis on which the marketing of fish and seafood within Australia could be improved.

The results of the 1990-91 survey indicated consumption of seafood per person in Australia was relatively low but increasing, and a substantial proportion of consumption occurred 'away from home'. The authors attributed increasing seafood consumption to greater awareness of the health benefits of fish, increased disposable incomes, greater promotion and product innovations that allowed large scale distribution of seafood products through supermarkets (FRDC 1992).

The survey showed that Australians ate an average of 12 kilograms (edible weight) of fish and seafood per person in 1990-91 (table 14). This consisted of 9.3 kilograms of fish and over 2.7 kilograms of seafood (edible weight) (FRDC 1992). Estimated consumption in the earlier study was 10.1 kilograms per person (PA Consulting Services 1977).

#### **14** *Australian fish and seafood consumption per person*

	Fish		Seafood	
	1977	1990-91	1977	1990-91
	kg	kg	kg	kg
<b>At home</b>				
Fresh and frozen	2.90	4.26	0.8	0.68
Frozen packed	0.90	0.37	0.09	0.06
Canned	1.81	1.39	0.12	0.05
Other	0.34	0.92	0.02	0.32
Total	5.95	6.94	1.03	1.11
<b>Away from home</b>	1.84	2.38	1.24	1.64
<b>Total</b>	7.79	9.32	2.27	2.75

Source: PA Consulting Services (1977); Fisheries Industry Research and Development Corporation (1992).

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The 1992 study also included an analysis of attitudes toward seafood consumption both at the household level and of caterers. For the household sector, survey respondents were clustered into groups. The cluster with the highest average 'in-home' fish and seafood consumption tended to be of a younger age group (under 40 years), from a non-English speaking background, and had a moderate to high household income with two or more adult income earners in the household (FRDC 1992).

In comparison, households in the cluster with the lowest average 'in home' fish and seafood consumption were located in inland regions of Australia. Typically within these households a household member was either divorced, separated or widowed; household members came from an Australian or English speaking country; and households had lower household incomes, with only one or no adults earning income living in the household (FRDC 1992).

This is in line with overseas experience. Young, Brugere and Muir (1999) found that lower seafood consumption occurred in countries with larger interiors, with demand tending to decline away from the coast. Young et al. (1999) argued that even in large countries with developed infrastructures such as in north America, consumer choice for protein favored beef owing to its wide and cheap availability.

Within the overall increase in consumption between 1977 and 1990-91 were shifts in the types of fish and seafood consumed at home and the share of in-home versus away from home consumption. In-home consumption of fresh and frozen fish increased by 1.36 kilograms per person between 1977 and 1990-91, though most of this increase was matched by a decline in the consumption of fish fingers, other frozen packaged, canned and smoked forms of fish.

In the 1990-91 survey, consumers indicated that the major issues that influenced their attitudes toward buying seafood products were concerns about product freshness and handling, the potential impact of pollution, and the potential misrepresentation of seafood.

There was also a strong perception among buyers from the catering and restaurant sector that many attributes of seafood compare unfavorably with other substitute foods. The comparison with other foods highlighted a range of perceived deficiencies in seafood, including difficulties in obtaining supplies that met buyer requirements and value aspects.

Issues identified in the survey included that fresh and frozen fish were the most difficult of the major products for restaurateurs to buy and the most difficult

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food item to ensure ongoing supplies. Wide fluctuations in price were more apparent for fish than for other foods. Buyers believed that the quality of fresh and frozen fish was more variable than for other foods. It was also more difficult to obtain the right sized portion required for their business.

A more recent study conducted by Ruello and Associates (1999a,b) examined consumption patterns and habitats of consumers in Sydney and Perth. Results from this study indicated there had been notable changes in retail sales volumes, product range and eating patterns since the 1990-91 study but most of the major factors driving or constraining fish and seafood sales in 1990-91 were still evident in 1999.

Per person fish and seafood consumption in Sydney in 1999 had increased by 12.7 per cent since the corresponding survey period in 1990-91. In-home consumption had risen by 8.4 per cent while away from home consumption rose by 19 per cent (table 15).

In Perth overall consumption did not change significantly between 1990-91 and 1999 because a 27 per cent decline in in-home consumption was offset by a strong rise in away from home consumption of 37 per cent. The rise in away from home consumption was linked to increased frequency of eating out and innovation in the various types of eateries, foods and meals on offer. Ruello and Associates (1999a) suggested that the main factors for this outcome were declining household size, growing competition from a larger variety of convenience foods and meals and strong growth in casual away from home eating.

With this continued movement toward away from home consumption, aquaculture products are potentially more attractive to restaurateurs and caterers in meeting their needs compared with some wild capture products. The less variable price and potential for longer seasonal availability of aquaculture products versus wild caught species are factors making farmed products relatively more attractive. In addition, the aquaculture sector does have other attributes that make it attractive such as providing appropriate sized portions.

One of the objectives of the 1990-91 survey was to identify the potential market of then currently under-utilised species. From a market perspective, farmed species had greater potential than wild capture species, with the exception of squid and calamari. The major reasons for

### *15 Average weekly consumption of seafood per person in Sydney*

	<b>1990-91</b>	<b>1999</b>	<b>Change</b>
	grams	grams	%
In home	199.1	215.9	8.4
Away from home	135.9	161.7	19.0
Total	335.0	377.6	12.7

*Source:* Ruello and Associates (1999a).

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suggesting a species had a higher potential were that it was popular and in demand, always available and in constant supply, and was a good flavored product.

Ruello and Associates (1999b) found that the outlook for increasing sales of underutilised species and farmed products was generally better than in 1991, mostly because retailers of fresh fish and seafood in 1999 were generally confident that consumers were more prepared to try new species and products.

Of the underutilised species selected in both the 1991 and 1999 studies (FRDC 1992; Ruello and Associates 1999b), retailers were more confident about sales growth in the aquaculture species rather than the wild species, with the single exception of squid/calamari. The less variable price and longer seasonality of aquaculture product compared with wild caught species were the common attractive features of farmed products.

Another major change from the 1990-91 study was the point of purchase for fresh and frozen fish and seafood. In 1999 supermarkets accounted for 54 per cent of sales, fishmongers (shops and market outlets) for 32 per cent and fish and chip outlets 5 per cent. In 1991 the comparable figures were 8 per cent, 71 per cent and 4 per cent respectively. Ruello and Associates (1999b) concluded that the combination of a supermarket sector keen to market local produce and the growing output of farmed produce is likely to lead to further substantial growth in sales of fresh Australian fish.

### *Impact of demographic factors*

Demographic factors, such as population growth and changes in the age and sex composition of the population, also influence domestic demand for seafood. Australia's population is forecast to grow at around 1.5 per cent a year, which should result in a small but steady increase in seafood consumption.

A national nutrition survey undertaken by the Australian Bureau of Statistics and the Commonwealth Health Department in 1995 (ABS 1999) found seafood consumption in Australia varies between different age groups. Seafood consumption among older age groups is higher than consumption among the younger groups. For example, 16.9 per cent of the persons aged between 25 and 44 consumed fish and seafood products and dishes compared with 20.7 per cent of persons aged between 45 and 64.

Varying consumption patterns for differing gender, age groups and country of birth were also identified in Ruello and Associates (1999a). Average weekly consumption per person for all age groups had increased by 10–12 per cent

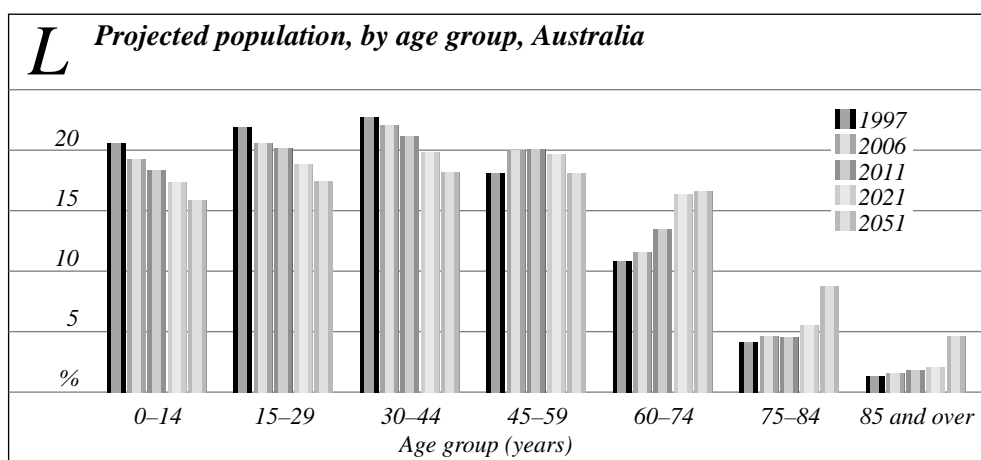
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compared with the results of the 1990-91 survey except for the 15–19 years age group where consumption had declined by 14 per cent over the period. Both in-home and away from home consumption had risen for all age groups except for the 15–19 year age group.

Average weekly consumption of seafood and fish increased for both males and females by 12.5 and 17.5 per cent respectively between 1990-91 and 1999 (Ruello and Associates 1999a). Average weekly consumption of residents born in Australia and those born overseas have both increased since the 1990-91 survey, with the increase being the most pronounced for Australian born Sydney residents. Away from home seafood consumption was lowest for households with an average income over \$80 000 and highest for households with an average annual income between \$25 000 and \$40 000. In-home consumption was highest for households with an average annual income of over \$60 000 and lowest for households with an average annual income of less than \$25 000.

The 1995 national nutrition survey also found that Australian children and teenagers have a significantly lower total fish and seafood consumption per person than adults (ABS 1999). These findings and the (unknown) attitudes of children and teenagers may be influential in future levels of consumption.

In Australia, the population at all age groups has grown over the past decade, but it has also aged, with the average family size declining. These trends are expected to continue (see ABS 2000b and figure L). Consequently, if existing consumption patterns for fish and seafood consumption continue, Australia's aging population points to a likely increase in seafood consumption as apparent consumption is higher among older groups.





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The racial composition of Australia's population can also influence the demand for seafood. Any increase in the proportion of the population originating from countries that are traditionally large consumers of seafood, such as south east and northern Asia, will affect the overall demand for seafood. Traditionally per person consumption of seafood in countries in south east and northern Asia are among the highest in the world and much higher than Australia's current level.

### *Tourism*

Tourism has been another major source of growth in demand for seafood. During the 1980s Australia experienced one of the fastest growth rates in the number of short term visitors of any OECD countries. This rate of growth continued in the 1990s, with the exception of 1998 when visitor numbers declined as a result of the impact of the Asian economic downturn. The number of visitors to Australia increased at 10 per cent a year between 1991 and 1999. The estimated number of tourists in 1999 was 4.3 million. The main countries of origin of these visitors were Japan (16.5 per cent of the total), New Zealand (16.9 per cent) and other Asian countries (26.0 per cent) (Tourism Forecasting Council 1999)

The overall outlook for the next decade is for a continuation in the increase in tourist numbers (Tourism Forecasting Council 1999). By 2008, around 8.4 million overseas visitors are forecast to come to Australia. Of these, 1.4 million are expected to be visitors from Japan and 3.2 million from other Asian countries. With tourists from these countries having a higher expenditure per person and a high propensity to consume seafood it is likely that the impact of increased tourism on Australian seafood demand will increase.

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### *6. Discussion*

Although not quantified in this report, domestic demand for fish and seafood products will continue to rise as a result of increasing population, changing demographics, migration and tourism. Potential marketing options could be based on:

- live fish
- chilled whole fish (drawn, dressed or headed and gutted)
- cooked prawns and yabbies – whole or peeled – frozen or chilled
- skinless and boneless chilled or frozen fillets – chunks, steaks, fillets, nuggets etc
- smoked (hot or cold smoking), pickled or other processed products.

Typically, consumer demand for a product is determined by factors such as relative prices, income, taste preferences, attitudes toward health and risks associated with consumption of a particular product and the convenience of purchasing and preparation. Findings of the Ruello and Associates (1999a,b) study indicated that fish and seafood are still not ‘top of mind’ with consumers when shopping and are most strongly associated with entertainment, entrees and adding variety to diet. Consumers reported that they wanted more information on how fish is caught/farmed and marketed, as well as simple cooking ideas that use common pantry ingredients.

Consumers favored fresh to frozen products and expressed concerns about food safety, reliability of fish names and whether fish labeled as fresh had been frozen previously. Ruello and Associates concluded that labeling issues and the general industry image should be addressed by all sectors of industry if they wanted to increase the demand for fish and seafood. Establishment and promotion of a clean green image has the potential to enhance demand for aquaculture products because of growing consumer concerns with the safety and health impact of food. Another finding of the survey was that seafood was considered to be overpriced and too expensive to be eaten more often. Both consumers and retailers felt that price remains a major barrier to increased fish and seafood sales. However, the real issue was not price but value. In summary consumers were seeking quality products that were convenient to prepare and were value for money.

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The live fish market in Australia is still developing, particularly for native freshwater species. There is still significant potential for expansion. However, once market niches that return very attractive prices have been filled, alternative higher volume markets are likely to return lower prices.

The size of the fish can be an important factor in market returns. Different market sectors exhibit a preference for certain sized fish. A most important segment in the domestic market is Asian restaurant and fish retailers. By contrast, the non-Asian retail trade is relatively small and more price sensitive. With market promotion to improve consumer awareness and with lower prices, the whole fish segment is capable of substantial growth. In the longer term it is considered that significant growth in the aquaculture fish market will result from producing fillets to meet the demand of the Australian consumers' preference in the home and in the restaurant trade for skinless boneless fillets.

The major supermarket chains are expected to play an increasingly important role in the marketing of seafood in Australia. This will have a major impact on increasing consumer access to seafood in general. The requirements of supermarket chains in increasing the seafood business focus on reliability of supply, large volumes of high quality and safe seafood and well functioning distribution channels. The main challenge for the supermarket chains lies in gauging the likely consumer response and obtaining the appropriate product at competitive prices.

It is most likely that future domestic market requirements will continue to be sourced from a combination of wild capture fisheries, aquaculture and imported products. Australians purchase more imported than locally caught or harvested seafood. Over half of the imported seafood products are in an 'as consumed' form — for example, fish fillets, cooked prawns, canned tuna. When all purchases are converted to an approximate edible weight, around 60 per cent of all purchased seafood is imported.

Aquaculture does have advantages over wild capture fisheries in terms of meeting consumer requirements and having the capacity to be able to supply product in a consistent form and regular basis. In addition, the low level of nutrients and biological productivity in Australia's marine environment means that it is unlikely that wild capture fisheries can be expanded sufficiently to meet future domestic requirements. There is some capacity to increase wild catch production through improved use of the existing wild catch and through increased take from several currently underexploited fisheries.

Australia relies on imports to provide consumers with high volume fish suited for processing (such as hake) that are not caught in Australian waters. It is

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unlikely that aquaculture, given current technologies and price structures, will be able to replace the large volumes of fish that Australia currently imports. The Australian aquaculture industry is focused on high value species for export markets, rather than lower valued products. Indeed, a recent study of Australian aquaculture found that based on current technologies and cost structures, production of higher valued species such as abalone had the potential for higher returns than lower valued species such as silver perch and Murray cod (Weston, Hardcastle and Davies 2001). In addition, production of the latter two species would only be feasible if supplying the higher value segments of the market, such as whole fresh fish for the restaurant trade.

Unless aquaculture industry costs can be sharply cut, a large proportion of domestic fish and seafood consumption will continue to be met through imports of low cost species rather than through domestic aquaculture production. It is more likely that Australian aquaculture will develop further to supply higher value markets. To achieve reasonable industry growth, export markets will need to be developed rather than relying on the small Australian market.

Like other primary industries, if the aquaculture industry is to be sustainable, it must constantly adapt to changing preferences and expectations of consumers, and to changing market conditions. To do this, the industry needs to focus on meeting market demands.

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### *Appendix A: Major Australian seafood export markets*

Australian export markets are dominated by five countries — Japan, Hong Kong, Chinese Taipei, the United States and China. In 1999-2000 these five markets took 75 per cent of Australia's fisheries product exports by value. Importantly these countries were major markets for high value products, taking over 95 per cent of lobster sales, nearly 100 per cent of crab exports, 90 per cent of abalone exports and 80 per cent of prawn shipments.

#### *Japan*

Japan remains Australia's major seafood export market, taking \$655 million, or 43 per cent, of Australia's edible seafood exports in 1999-2000. While prawns have generally been the major Australian seafood exported to Japan, exports of tuna and other fish products have been rising steadily so that in 1999-2000 they comprised 37 per cent and 5 per cent respectively of the value of total seafood exports to Japan (table 16). In comparison in 1990-91, these products comprised 14 per cent and 5 per cent respectively of the total value of Australian seafood exports to Japan.

Australia's share of Japan's total imports of fisheries products is relatively small. Japan is the largest importer of seafood products in the world. In 1998 the value of Japanese seafood imports was US\$12.8 billion, nearly 50 per cent higher than the next largest importer of seafood products, the United States. Japanese seafood products exports were US\$0.72 billion in 1998 (FAO 2000c).

#### **16** *Value of Australian fisheries exports to Japan*

	<b>1990</b>	<b>1994</b>	<b>1995</b>	<b>1996</b>	<b>1997</b>	<b>1998</b>	<b>1999</b>
	<b>-91</b>	<b>-95</b>	<b>-96</b>	<b>-97</b>	<b>-98</b>	<b>-99</b>	<b>-2000</b>
	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000
Tuna	48 708	39 547	74 885	65 054	126 461	112 195	244 001
Salmon	16 667	19 901	22 132	17 699	12 142	9 616	6 851
Rock lobster	119 894	111 797	134 148	125 997	92 690	97 947	155 769
Prawns	124 098	173 286	153 298	121 699	138 478	121 992	149 215
Crabs	434	3 817	6 330	2 880	4 446	4 689	4 832
Abalone	58 676	78 793	64 931	63 727	59 146	47 925	59 580
Other	17 269	18 276	8 538	25 708	7 947	53 919	35 099
Total edible	355 746	445 417	464 262	422 764	441 310	448 283	655 347
Pearls	79 132	107 594	22 949	18 764	36 132	12 099	23 653

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### *Hong Kong*

The 48 per cent increase in value of seafood exports to Hong Kong in 1999-2000 from 1998-99 was mainly a result of strong growth in the value of sales of rock lobster and abalone (table 17). Australia is only a minor exporter to the Hong Kong market. Hong Kong imported US\$1.6 billion of fisheries products in 1998 and exported US\$0.42 billion (FAO 2000c).

#### *17 Value of Australian fisheries exports to Hong Kong*

	<b>1990 -91</b>	<b>1994 -95</b>	<b>1995 -96</b>	<b>1996 -97</b>	<b>1997 -98</b>	<b>1998 -99</b>	<b>1999 -2000</b>
	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000
Scallop	24 361	43 587	34 398	23 631	25 155	21 065	29 697
Rock lobster	16 223	94 987	107 436	107 550	86 269	109 613	169 864
Prawns	2 488	12 332	22 285	18 020	27 786	19 572	19 552
Crabs	51	1 359	5 810	2 626	2 633	1 736	1 793
Abalone	23 599	33 980	31 039	51 856	62 273	70 699	90 164
Other	4 464	21 753	23 042	22 063	22 974	17 658	44 509
Total edible	71 186	207 998	224 010	225 743	227 090	240 343	355 579
Pearls	7 320	6 758	7 575	6 028	15 181	6 117	33 038

### *United States*

The strong growth in the value of exports to the United States in 1998-99 continued into 1999-2000, with the value of Australia exports reaching \$141 million (table 18). The main contributor to this growth was rock lobster (primarily tails) in 1999-2000. The United States is a major net importer of

#### *18 Value of Australian fisheries exports to the United States*

	<b>1990 -91</b>	<b>1994 -95</b>	<b>1995 -96</b>	<b>1996 -97</b>	<b>1997 -98</b>	<b>1998 -99</b>	<b>1999 -2000</b>
	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000
Scallop	115	346	221	3	234	290	0
Fish	52 161	15 237	8 737	13 105	29 282	48 211	43 681
Rock lobster	66 092	40 383	29 611	40 312	59 857	70 275	86 808
Prawns	6 568	1 151	138	285	266	192	1 587
Crabs	11	246	1 247	891	1 700	1 058	1 770
Abalone	2253	2425	2 715	2 634	3 998	4 061	3 622
Other	1 781	1 351	794	1 073	2 906	4 925	3 757
Total edible	128 981	61 139	43 463	58 303	98 243	129 012	141 225
Pearls	7 320	6 758	7 575	6 028	10 845	14 458	45 501

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seafood products. In 1998 the value of seafood imports into the United States was US\$8.6 billion in 1998, while exports were US\$2.4 billion.

### *China*

The value of Australia's seafood exports to China declined by 60 per cent in 1999-2000 to \$41 million, following an earlier decline in exports in 1998-99 (table 19). The declines in reported exports may be somewhat misleading, as other destinations, for example Hong Kong, are used as gateways to the Chinese market. Prawns accounted for 65 per cent of the total value of Australia seafood exports in 1999-2000. In 1998, China imported US\$0.99 billion worth of seafood products while exports totaled US\$2.66 billion (FAO 2000c).

### *19 Value of Australian fisheries exports to China*

	<b>1990</b>	<b>1994</b>	<b>1995</b>	<b>1996</b>	<b>1997</b>	<b>1998</b>	<b>1999</b>
	<b>-91</b>	<b>-95</b>	<b>-96</b>	<b>-97</b>	<b>-98</b>	<b>-99</b>	<b>-2000</b>
	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000
Scallop	5	4	934	0	134	1 008	1 031
Fish	723	582	1 563	557	2 486	5 445	3 116
Rock lobster	1 248	2 224	8 745	31 627	75 895	56 340	6 470
Prawns	1 757	2 620	8 002	19 503	34 437	34 982	26 453
Crabs	0	39	94	580	3 057	2 108	1 159
Abalone	0	233	59	159	859	1 679	1 560
Other	5	441	1 255	1 764	2 406	578	672
Total edible	3 738	6 143	20 652	53 190	119 274	102 140	40 461
Pearls	0	0	5	0	0	0	0

### *Chinese Taipei*

Australia exports to Chinese Taipei have doubled over the 1990s to reach \$0.21 billion in 1999-2000 (table 20). Rock lobster products dominate Australian seafood exports to Chinese Taipei, accounting for 64 per cent of sales in 1999-2000. Chinese Taipei is a net exporter of seafood products. In 1998, Chinese Taipei imported US\$0.48 billion worth of seafood products whereas exports were valued at \$1.58 billion (FAO 2000c).

## *DEMAND FOR AQUACULTURE PRODUCTS*

### **20** *Value of Australian fisheries exports to Chinese Taipei*

	<b>1990</b>	<b>1994</b>	<b>1995</b>	<b>1996</b>	<b>1997</b>	<b>1998</b>	<b>1999</b>
	<b>-91</b>	<b>-95</b>	<b>-96</b>	<b>-97</b>	<b>-98</b>	<b>-99</b>	<b>-2000</b>
	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000
Scallop	193	341	871	292	618	1 282	432
Fish	3 904	17 169	17 645	12 372	8 987	6 544	7 856
Rock lobster	45 553	111 110	129 651	140 778	104 090	103 822	134 498
Prawns	1 061	8 818	3 130	5 091	4 709	3 809	8 016
Crabs	21	20 772	22 469	18 897	1 700	9 634	12 284
Abalone	19 649	37 690	33 323	33 517	43 630	40 184	43 582
Other	2 212	5 821	10 228	4 507	14 655	3 825	2 248
Total edible	72 593	201 721	217 317	215 455	178 389	169 110	208 916
Pearls	0	2 510	1 961	1 621	930	481	1 534



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