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# Forestry and Fishing

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## FORESTRY

Forests are an important renewable natural resource providing a wide range of indispensable products and benefits to the community.

The cover of forest vegetation protects the soil from water and wind erosion, reduces flooding and siltation of water storages and maintains the quality of water. Forests provide habitat for a variety of native animals and plants.

Native and plantation forests contribute substantially to Australia's economy, especially to employment in rural areas. Forests also represent valuable ecosystems providing a gene pool of great diversity for scientific investigation; a source of honey, oils, gums, resins and medicines; and a resource base for education, tourism and recreation and other purposes. Forests cannot necessarily provide for all uses at the same time, yet careful management will ensure that the forests

provide multiple benefits in the long term for the Australian community.

### Existing forest estate

**Native forest** is defined in this report as land dominated by trees with an existing or potential mature height of twenty metres or more, as well as native stands of cypress pine in commercial use regardless of height. Based on this definition, the total area of native forest is estimated at 41 million hectares as at 30 June 1992 (about 5% of Australia's land area). (The National Forest Policy Statement defines a forest as an area dominated by trees having usually a single stem and a mature or potentially mature stand height exceeding five metres, and with existing or potential projective cover of overstorey strata about equal to or greater than 30%. The National Forest Inventory is presently revising the estimate of the total area of native forest according to the definition in the National Forest Policy Statement.)

#### 16.1 NATIVE FOREST AREAS, BY FOREST TYPE AND OWNERSHIP, AT 30 JUNE 1992 (<sup>'000 hectares</sup>)

Item	NSW	Vic.	Qld	SA	WA	Tas.	NT	ACT	Total
CLASSIFIED BY FOREST TYPE GROUP									
Rainforest	265	16	1,237	—	6	605	203	—	2,332
Eucalypt productivity(a)									
Class I	1,163	544	205	—	182	452	—	—	2,546
Class II	3,661	4,323	1,290	—	2,516	1,868	—	—	13,658
Class III	7,937	538	3,300	—	—	—	—	51	11,826
Tropical eucalypt and paperbark	—	—	4,078	—	—	—	2,450	—	6,528
Cypress pine	1,696	7	1,686	—	—	—	778	—	4,167
<b>Total</b>	<b>14,722</b>	<b>5,428</b>	<b>11,796</b>	<b>—</b>	<b>2,704</b>	<b>2,925</b>	<b>3,431</b>	<b>51</b>	<b>41,057</b>
CLASSIFIED BY OWNERSHIP									
Public ownership	9,530	4,768	10,304	—	2,212	2,066	850	51	29,781
Category 1(b)	3,255	3,127	3,071	—	1,788	1,146	—	—	12,387
Category 2(c)	3,705	—	6,412	—	53	295	511	—	10,976
Category 3(d)	2,570	1,641	(e)821	—	371	625	339	51	6,418
Private ownership	5,192	660	1,492	—	492	859	2,581	—	11,276
<b>Total</b>	<b>14,722</b>	<b>5,428</b>	<b>11,796</b>	<b>—</b>	<b>2,704</b>	<b>2,925</b>	<b>3,431</b>	<b>51</b>	<b>41,057</b>

(a) Eucalypt forests are grouped into productivity classes in descending order of productivity. No specific indexes of productivity have been developed for these classes and there can be some overlap, especially between States, in the relative productivity levels used to assign particular forest types to productivity classes. (b) Forest land managed for multiple use including wood production. (c) Crown land either vacant or occupied under lease on which wood harvesting is carried out under government control but is not reserved and managed for that purpose. (d) Land on which wood production is excluded (National Parks etc.). (e) Includes 101,500 hectares in World Heritage Area previously included in Category 1.

Source: State and Territory forest services.

Of the 41 million hectares, 29.8 million hectares (73%) are publicly owned and 11.3 million hectares (27%) are private land. Of the publicly owned forests, 6.4 million hectares (16%) are in National Parks or in World Heritage areas, 12.4 million hectares (30%) are managed by State forest authorities for various uses, including wood production and 11 million hectares (27%) are vacant or leasehold Crown land. A small but increasing area is covered by plantations. Australia has around 1.1 million hectares of plantations — 956,000 hectares of mostly radiata pine and 117,000 hectares of hardwood. Plantations are

expanding at approximately 30,000 hectares a year.

**Plantations.** The Commonwealth Government has supported the expansion of Australia's plantation resource base for many years. For instance, the National Afforestation Program (NAP) was established in 1987–88 as a three year grants program to stimulate an expansion in the commercial hardwood timber resource and to assist in land rehabilitation through broadacre commercial plantations (including farm forestry).

Table 16.2 shows total plantation areas in Australia classified by species.

**16.2 PLANTATION AREAS CLASSIFIED BY SPECIES, 31 MARCH 1992**  
(hectares)

<i>Species group</i>	<i>NSW(a)</i>	<i>Vic.</i>	<i>Qld</i>	<i>SA</i>	<i>WA</i>	<i>Tas.</i>	<i>NT(b)</i>	<i>ACT</i>	<i>Aust.</i>
<b>Coniferous</b>									
Pinus radiata	248,762	213,475	3,360	98,722	58,770	76,693	—	13,332	713,114
Pinus elliotii	5,216	8	75,092	—	—	270	—	—	80,586
Pinus pinaster	711	1,321	—	2,779	27,820	—	—	—	32,631
Pinus caribaea	113	3	54,403	—	—	—	2,386	—	56,905
Araucaria species	1,666	—	45,278	—	—	—	—	—	46,944
Other	9,745	2,017	10,496	364	670	334	1,801	444	25,871
<i>Total</i>	<i>266,213</i>	<i>216,825</i>	<i>188,629</i>	<i>101,865</i>	<i>87,530</i>	<i>77,027</i>	<i>4,187</i>	<i>13,776</i>	<i>956,051</i>
<b>Broadleaved</b>									
Eucalyptus species	27,250	20,374	1,489	1,204	23,830	38,196	—	—	112,343
Populus species	1,351	151	—	—	—	—	—	—	1,502
Other	1	126	220	—	—	2,700	—	—	3,047
<i>Total</i>	<i>28,602</i>	<i>20,651</i>	<i>1,709</i>	<i>1,204</i>	<i>23,830</i>	<i>40,896</i>	<i>—</i>	<i>—</i>	<i>116,892</i>
<b>Total</b>	<b>294,815</b>	<b>237,476</b>	<b>190,332</b>	<b>103,069</b>	<b>111,370</b>	<b>117,923</b>	<b>4,187</b>	<b>13,776</b>	<b>1,072,948</b>

(a) Eucalypt plantation areas previously classified as native forest in table 16.1 are now recorded separately in table 16.2. (b) Since 31 March 1986, plantations on Aboriginal land have been transferred to private ownership and publicly owned plantations are no longer managed for wood production.

Sources: National Forest Inventory, and State and Territory forest agencies.

## Wood and wood products

Australia's wood and wood products industries are important components of Australia's primary industry and manufacturing sectors. They are particularly important in providing economic development and employment in many regions of rural Australia. The industry includes the hardwood and softwood sawmilling, plywood and panels, woodchip export and the pulp and paper sectors. Over 60,000 people are directly employed in growing and harvesting of wood and the manufacture and processing of wood and paper products. The wood and wood products

industries contribute about one per cent to gross domestic product.

In 1989–90, value added for wood and wood products industry was \$2.9 billion, representing 4.2 per cent of value added by the total manufacturing sector. In 1992–93, exports of forest products totalled \$777 million, of which 54 per cent were woodchips and 25 per cent paper and paperboard products. In the same year, imports were \$2,437 million, of which 45 per cent was paper and 21 per cent sawnwood. This indicates that the trade deficit in forest products is \$1,660 million. Australia produces 70 per cent of its sawn timber needs, of which native forests provide

approximately 40 per cent, with the balance coming from softwood plantations. Imported sawn timber is mostly Douglas Fir from North America, and Radiata Pine from New Zealand.

The hardwood and softwood sawmilling sectors comprise mills of various sizes which process timber into sawn timber and other products such as veneers, mouldings and floorings. The hardwood mills are generally small scale and scattered. The softwood mills are generally larger and more highly integrated with other wood processing facilities. Australia's production of sawn timber increased by 4.8 per cent in 1992-93 to 3,081,000 cubic metres, of which 47 per cent was hardwood and 53 per cent was softwood.

Other value added timber products include plywood, wood-based panels and reconstituted wood products. Australian wood-based panels include particle board, medium density fibreboard and hardboard made from softwood or hardwood pulp logs, sawmill residues or thinnings. Australia has 18 panelboard mills, 10 producing particle board, 4 producing medium density fibreboard, 3 producing hardboard and 1 producing softboard.

Australia has 22 pulp and paper mills, which utilise roundwood thinnings, low quality logs, harvesting residues and sawmill waste and recycled paper and paperboard to produce a broad range of pulp and paper products. Around a third of domestically consumed paper is imported. The four major types of paper products produced domestically are packaging and industrial papers, newsprint, printing and writing papers, and tissue paper. Each requires different inputs and technologies.

The woodchip export industry uses timber which is unsuitable for sawmilling and not required by the Australian pulp, paper and reconstituted board industries. Before the advent of the woodchip export industry, much of this material was left in the forest after logging. Considerable quantities of sawmill waste material, which would otherwise be burnt, are also chipped for local pulpwood-using industries and for export. Until recently, at least 95 per cent of woodchips exported from Australia have been eucalypt but increasing quantities of softwood woodchips are now becoming available from pine plantations.

### 16.3 SUMMARY OF OPERATIONS OF WOOD PROCESSING ESTABLISHMENTS, 1991-92

<i>Industry description</i>	<i>Establish- ments at 30 June</i>	<i>Employment at 30 June(a)</i>	<i>Wages and salaries(b)</i>	<i>Turnover</i>
	no.	'000	\$m	\$m
Log sawmilling	583	9.8	232.0	1,010.4
Veneers and manufactured boards of wood	85	4.4	142.2	766.2
Hardwood wood chips	19	0.6	24.9	341.1

(a) Includes working proprietors. (b) Excludes the drawings of working proprietors.

Source: *Manufacturing Industry, Australia (8221.0)*.

## 16.4 PRODUCTION OF WOOD AND SELECTED WOOD PRODUCTS(a)

Item	Quantity	1989-90	1990-91	1991-92	1992-93
Sawn Australian grown timber(b)	'000 cu m	3,172	2,774	2,921	3,081
Woodchips (green weight)					
Hardwood (broad leaved)	'000 tonnes	5,169	5,042	4,870	5,078
Softwood	'000 tonnes	718	960	1,307	1,242
Particle board(c)	'000 cu m	768	625	643	660
Wood pulp					
Mechanical	'000 cu m	430,665	459,078	459,832	436,026
Other	'000 cu m	599,711	562,760	559,687	560,467
Paper and paperboard					
Newsprint	tonnes	383,657	394,990	403,728	433,476
Tissue and sanitary papers	tonnes	163,072	133,800	n.p.	n.p.
Graphic	tonnes	n.p.	n.p.	231,541	} 1,392,661
Other paper and paperboard	tonnes	766,690	963,574	n.p.	

(a) Excludes production of small single establishment enterprises with fewer than four persons employed and establishments engaged in non-manufacturing activities but which may carry on, in a minor way, some manufacturing. (b) Source: Australian Bureau of Agricultural and Resource Economics. (c) Particle boards and similar boards of wood or other ligneous material. Excludes laminated. Source: *Manufacturing Production, Australia: Building Materials and Fittings (8361.0)* and *Manufacturing Production, Australia: Wood and Wood Products (8369.0)*.

### Government administration

Land management is primarily the responsibility of State and Territory Governments. Each State has a forest authority responsible for the management and control of publicly-owned forests, in accordance with the Forestry Acts and Regulations of the State or Territory concerned.

The Department of Primary Industries and Energy (DPIE) and the Department of the Environment, Sport and Territories (DEST) are the two key agencies which have responsibilities relating to forest management at the national level. Close liaison is maintained between the two agencies on relevant issues. DPIE's main responsibilities are the development of a national approach to forest management; providing advice to the Commonwealth Minister responsible for forest matters; administration of export licensing responsibilities in relation to unprocessed timber; liaison with State, national and international organisations concerned with forestry; provision of a Secretariat for the Ministerial Council on Forestry, Fisheries and Aquaculture (MCFFA); and management of policy and program initiatives.

DEST has responsibilities for environmental matters relating to forests. DEST provides policy advice to its Minister and the Government on conservation and environmental matters pertaining to Australia's forests, including biological diversity and

climate change. The Australian Heritage Commission, the Australian Nature Conservation Agency and the Commonwealth Environment Protection Agency within DEST have assessment, management and monitoring roles in respect of the national estate, endangered species and environmental impacts in Australia's forests.

DPIE and DEST, in close cooperation with the States, Territories and Ministerial Councils, were extensively involved in the development of the National Forest Policy Statement, the National Forest Inventory.

The MCFFA consists of Commonwealth, State, Territory, and New Zealand Ministers responsible for forests. It is the successor of the Australian Forestry Council formed in 1964, and works to provide leadership and facilitate cooperation at the national level. Initiatives fostered by the MCFFA are aimed at promoting the enhanced management of the nation's forest resources in the general interest of the community. Most recently it has been involved in the development and implementation of initiatives under the National Forest Policy Statement in cooperation with the Australian and New Zealand Environment and Conservation Council.

### Commonwealth government initiatives

#### The National Forest Policy Statement

was signed by the Commonwealth Government and all mainland State and Territory

Governments, at the Council of Australian Governments' meeting in Perth in December 1992. The Statement was developed jointly by the Commonwealth, States and Territories through the Australian Forestry Council (now the Ministerial Council on Forestry, Fisheries and Aquaculture) and the Australian and New Zealand Environment and Conservation Council in consultation with other relevant government agencies, the Australian Local Government Association, unions, industry, conservation organisations and the general community. The Statement is the joint response of the Commonwealth Government, State and Territory Governments to three major reports on forest issues — those of the Ecologically Sustainable Development Working Group on Forest Use, the National Plantations Advisory Committee, and the Resource Assessment Commission's Forest and Timber Inquiry.

The Statement provides a policy framework for the future management of Australia's public and private forests and outlines a vision for the ecologically sustainable management of Australia's forests comprising broad national goals in the following eleven areas:

- *Conservation* — to maintain an extensive and permanent native forest estate in Australia and to manage that estate in an ecologically sustainable manner so as to conserve the full suite of values that forests can provide for current and future generations. These values include biological diversity, and heritage, Aboriginal and other cultural values.
- *Wood production and industry development* — to develop internationally competitive and ecologically sustainable wood production and wood products industries. Efficient industries based on maximising value-adding opportunities and efficient use of wood resources will provide the basis for expansion in wood products manufacturing, which in turn will provide national and regional economic benefits.
- *Integrated and coordinated decision making and management* — to reduce fragmentation and duplication in the land use decision-making process between the States and the Commonwealth and to improve interaction between forest management agencies in order to achieve agreed and durable land use decisions.
- *Private native forests* — to ensure that private native forests are maintained and managed in

an ecologically sustainable manner, as part of the permanent native forest estate, as a resource in their own right, and to compliment the commercial and nature conservation values of public native forests.

- *Plantations* — to expand Australia's commercial plantations of softwoods and hardwoods so as to provide an additional, economically viable, reliable and high-quality wood resource for industry; and to increase plantings to rehabilitate cleared agricultural land, to improve water quality, and to meet other environmental, economic and aesthetic objectives.
- *Water supply and catchment management* — to ensure the availability of reliable, high-quality water supplies from forested land and to protect catchment values.
- *Tourism and other economic and social opportunities* — to manage Australia's forests in an ecologically sustainable manner for a range of uses, including tourism, recreation and production of non-wood products.
- *Employment, work force education and training* — to expand employment opportunities and the skills base of people working in forest management and forest-based industries.
- *Public awareness, education and involvement* — to foster community understanding of, and support for, ecologically sustainable forest management in Australia and to provide opportunities for effective public participation in decision making.
- *Research and development* — to increase Australia's national forest research and development effort and to ensure that it is well coordinated, efficiently undertaken and effectively applied.
- *International responsibilities* — to promote nature conservation and sustainable use of forests outside Australia and to ensure that Australia fulfils its obligations under relevant international agreements.

The Commonwealth has established two plantations initiatives under the Statement, the Farm Forestry Program (FFP) and the North Queensland Community Rainforest Reforestation Program (CRRP).

Commonwealth funding of \$3.7 million has been allocated to FFP projects and \$4.2 million to the CRRP over the years 1992–93 to 1995–96. The CRRP funding is being matched by the Queensland Government



while grantee contributions are substantial in the case of the FFP projects.

An objective of both the FFP and the CRRP is to promote commercial wood production on cleared agricultural land so as to provide an additional, reliable, high-quality wood resource for sustainable regional industries, as well as diversify farm incomes. The programs aim to encourage the integration of farm forestry with agricultural activities and promote appropriate linkages between tree growers and wood processing industries. Other objectives of the programs are to address problems of land degradation and provide for improved water quality, and in the case of the CRRP, to train a work force and landowners to support the long-term practice of rainforest plantation establishment and management.

**The One Billion Trees (OBT) Program** was initiated by the Commonwealth Government in 1989 to encourage community participation and involvement in vegetation establishment and retention projects.

It is the Commonwealth Government's principal vegetation management program with the primary aim of having a billion more trees established around Australia by the year 2000.

The Commonwealth, through the Australian Nature Conservation Agency, provided \$4.3 million for 1993-94 to Greening Australia, a non-profit community-based organisation to continue the OBT Program. State and Territory Greening Australia staff provide technical information, advice and practical support to help individuals and groups to develop community-based landcare and conservation activities.

Greening Australia conducts school-based and community education projects to develop a knowledge and understanding of the processes of vegetation decline, land degradation and remedial vegetation management.

The Australia-wide network of Greening Australia staff and volunteers conduct trials and demonstrations on how to establish and sustain vegetation, how to develop seed banks and collect seed from local species, conduct species trials, and coordinate major revegetation projects.

To provide a further incentive for community groups to become involved in the OBT Program, the Commonwealth provided

\$905,600 for 1993-94 for cooperative projects involving revegetation for land and nature conservation. Projects that may attract assistance include wildlife habitats and corridors, shelterbelts and livestock havens, species trials, seed collection, preservation of remnant vegetation, beautification and amenity planting, and land degradation control and prevention. Emphasis is placed on community involvement and self-help, and on maximising the extent of community benefit. The Program is closely linked to the Save the Bush Program with a number of projects attracting funding from both programs.

**National forest inventory.** In many of the debates over forest management, the information base on forest attributes, such as timber, fauna and flora, has been found to be incomplete. Accordingly, a National Forest Inventory will be completed by 1995. A comprehensive information base, it will lead to more informed discussion and decision making about the future of Australia's forests by identifying and describing forest communities and their current conservation status, and information to enable the planning of efficient sustainable forest utilisation.

**Tropical forests.** Over half of the world's known plant and animal species are found in rainforests. Rainforests are the traditional home of many tribal peoples and also play an important role in contributing to global climatic stability. However, destruction of tropical forests in developing countries is occurring because of activities largely associated with population pressures and poverty.

Australia has only a relatively small area of tropical forest (an estimated 1.4 million hectares out of a total forested area of 41 million hectares), confined to northern and eastern Queensland, the Northern Territory and Western Australia. Much of this forest is already under various forms of protection. For example, the Queensland Wet Tropics World Heritage Area covers almost 890,000 hectares, including most of the tropical forest in North Queensland.

As a developed country with considerable experience and expertise in sustainable forest management, Australia can make a positive contribution to the improvement of forest management practices in developing countries, by providing education, training and technical expertise.

In June 1992 the Commonwealth Government announced its policy on international trade in tropical timber. A key aspect of the policy is a commitment to the year 2000 target set by the International Tropical Timber Organisation (ITTO), by which date all tropical timber products entering international trade should be derived from sustainably managed forests. Other aspects of the policy include support for the conservation of biodiversity, reforestation through agroforestry and plantations, and the provision of technical and scientific assistance to other countries — largely in the Asia-Pacific region — to promote better forest management practices. These policy measures complement initiatives arising from the Rio Earth Summit including the Conventions on Climate Change and Biodiversity, Agenda 21 and The Statement of Principles on Forests.

**Pulp mill guidelines.** The Commonwealth has established environmental guidelines for the development of new bleached eucalypt kraft pulp mills. To ensure the effective implementation of the Commonwealth guidelines and to streamline approval processes, the Commonwealth has concluded agreements with Tasmania, Western Australia and Victoria. These agreements make provision for the review of the guidelines if there have been commercially proven major new advances in pulping and bleaching technology.

A National Pulp Mills Research Program (NPMRP) exists to ensure that the Commonwealth guidelines remain current with international developments in pulping and bleaching technologies. The NPMRP is a cooperative venture involving the Commonwealth Government and State Governments, community interest groups, industry and the CSIRO. The Program has as its principal objectives: expansion of basic knowledge in pulping of eucalypt woods and bleaching of the pulps; improving the currently available technology; and developing more relevant and superior biological monitoring systems for the receiving waters.

The Commonwealth has commenced a review of the guidelines in the light of recent international pulp and paper research and developments in the wood pulping industry. It is envisaged that the review will be completed by December 1994.

## Research

A Forest and Wood Products Research and Development Corporation has been established as a key initiative under the National Forest Policy Statement to assist the forest industries to improve their international competitiveness and to realise their growth potential. Its charter is to identify priorities and to commission, administer and subsequently evaluate research into a broad range of issues relating to wood production, extraction, processing, economics and marketing. The Corporation will be jointly funded by the industry and the Commonwealth.

### Commonwealth Scientific and Industrial Research Organisation (CSIRO).

Forestry research is conducted primarily within the Division of Forestry and the Division of Forest Products. The emphasis is on strategic research concerned with commercial production and processing of wood from native eucalypt forests and plantations of eucalypts and softwoods.

The Division of Forestry has its headquarters in Canberra with other laboratories in Hobart, Mount Gambier and Perth. The Cooperative Research Centre for Temperate Hardwood Forestry is co-located with the Division on the campus of the University of Tasmania. The Division of Forest Products is based at Clayton, Melbourne. The Cooperative Research Centre for Hardwood Fibre and Paper Science operates from the CSIRO-Monash University site at Clayton.

Research is conducted in programs closely aligned to major forest resources and industry sectors: Softwood Plantations, Hardwood Plantations, Regrowth Forest Management, Australian Tree Resources, Fibres and Chemicals, and Wood Science and Technology. Prominent disciplines are tree physiology, nutrition, genetics, chemistry and engineering. CSIRO scientists have contributed to guidelines for new bleached kraft eucalypt pulp mills.

Australia's trade deficit in forest products is \$1.7 billion per year; reducing this deficit is a major target of governments, industry and research organisations. Sustained high production has long been a major goal of forestry research, and thus plantations and better native eucalypt forests are a focus of attention. Forests of both types will remain

important sources of wood for national production of pulp and paper as well as sawn timber.

## **FISHING**

### **Fisheries resources**

Australia's fisheries stocks are extremely diverse but, by world standards, its marine ecosystem is relatively unproductive. The Australian Fishing Zone covers an area 16 per cent larger than the Australian land mass and is the third largest fishing zone in the world. However, Australia's fish production is insignificant by world standards. This reflects low productivity of the oceans rather than under-exploitation of the resource.

Over 3,000 species of marine and freshwater fish and at least an equal number of crustacean and mollusc species occur in and around Australia. Despite this, less than 100 of these are commercially exploited. Australia's major commercially exploited species are prawns, rock lobster, abalone, tuna, other fin fish, scallops, oysters and pearls. Australian fishing operators concentrate their efforts on estuarine, coastal, pelagic (surface) species and demersal (bottom living) species that occur on the continental shelf.

In 1991-92, Australians consumed 3.4 kilograms of edible weight fresh and frozen fish per person, sourced from Australian waters, and 1.9 kilograms of imported fish. The consumption per person of crustaceans and molluscs (such as prawns, lobsters, crabs and oysters) was 1.2 kilograms. A further 3.1 kilograms per head was consumed in the form of prepared seafood products.

The level of fishing effort exerted by the fishing fleet has increased rapidly over the last decade to the point where almost all the major known fish, crustacean and mollusc resources are fully exploited. Some major fisheries such as southern bluefin tuna, gemfish and shark have suffered serious biological depletion.

Australia has enjoyed a relatively long history of success in the farming of the Sydney rock oyster. Pearl culture operations and ornamental fish farming are well established. The production of juveniles of several species of fin fish, molluscs and crustaceans has been

undertaken for some years, initially for restocking wild populations and subsequently for grow-out operations. As in many other developed countries, there has been a surge of interest and investment in many types of aquatic farms over the last decade. Notable successes are the salmon industry in Tasmania and commercial cultivation of the Pacific oyster, blue mussel and rainbow trout.

Aquaculture, or 'fish farming', is an alternative to harvesting the naturally occurring fish stocks and has considerable potential as a means of ensuring sustainability of harvesting yields. Aquaculture industries are established in all States, with species involved ranging from pearl oysters, to freshwater trout, to crocodiles. Aquaculture has experienced rapid growth during the past four years with the value of production rising from \$188 million in 1989-90 to \$259 million in 1992-93.

Developmental work is active in a number of areas such as barramundi, freshwater crayfish (yabbies and marron), prawns, mussels and algae and research is continuing into the hatchery rearing of species such as abalone, scallops, giant clams, flat and pearl oysters. Over half of the established aquaculture output by value goes to markets other than for direct consumption. However, the newer emerging industries are producing mainly food. A strategy for the development of Australian aquaculture is being formulated by a Working Group of Commonwealth and State fisheries agencies.

### **Production, processing and exports and imports of fisheries products**

**Value of fisheries production.** Table 16.5 shows the gross value of the Australian commercial fishing industry. As the value of materials used in the course of production is not available, it is not possible to show net values. Gross value of production is the value placed on recorded production at the wholesale price realised in the principal markets. In general, the principal markets are the metropolitan markets in each State, although, in cases where commodities are consumed locally or where they become raw material for a secondary industry, these points are treated as the principal markets.

The gross value of fisheries production in 1992-93 is estimated to have been \$1,374 million, a five per cent rise on the production of the previous year. The types of seafood which have increased substantially in

value include abalone, tuna and prawns. The main factor behind the increase in the value of tuna was the increase in the proportion of tuna caught by long-lining for the high value Japanese sashimi market.

#### 16.5 GROSS VALUE OF FISHERIES PRODUCTION (\$ million)

<i>Period</i>	<i>Value</i>	<i>Period</i>	<i>Value</i>
1975-76	146	1984-85	522
1976-77	206	1985-86	635
1977-78	233	1986-87	702
1978-79	279	1987-88	828
1979-80	326	1988-89	1,022
1980-81	330	1989-90	1,092
1981-82	344	1990-91	1,223
1982-83	423	1991-92	1,307
1983-84	449	1992-93	1,374

*Source: Australian Bureau of Agricultural and Resource Economics and the Australian Fisheries Service.*

#### 16.6 GROSS VALUE OF SELECTED MAJOR SPECIES (\$ million)

	<i>1990-91</i>	<i>1991-92</i>	<i>1992-93p</i>
Prawns	263	252	259
Rock lobster	287	362	328
Tuna	66	75	106
Other fin fish	270	281	294
Abalone	92	97	125
Scallops	42	80	58
Oysters	43	44	45
Pearls	129	79	121
Other(a)	31	37	38
<b>Total</b>	<b>1,223</b>	<b>1,307</b>	<b>1,374</b>

(a) Other aquaculture not elsewhere included.

*Source: Australian Bureau of Agricultural and Resource Economics.*

**16.7 AUSTRALIAN FISHERIES PRODUCTION(a) BY CATEGORY**  
(tonnes)

	1990-91	1991-92	1992-93p
<b>Fish</b>			
Tuna	11,666	13,088	12,762
Other	145,435	126,202	117,464
<b>Total</b>	<b>157,102</b>	<b>139,289</b>	<b>130,226</b>
<b>Crustaceans</b>			
Prawns	29,118	24,700	23,615
Rock lobster	14,717	18,356	17,934
Other	3,741	4,337	4,282
<b>Total</b>	<b>47,576</b>	<b>47,393</b>	<b>45,832</b>
<b>Molluscs</b>			
Abalone	5,154	5,079	4,927
Scallops	14,540	28,826	24,366
Oysters	9,267	9,072	9,039
Other	3,611	4,240	3,950
<b>Total</b>	<b>32,572</b>	<b>47,217</b>	<b>42,282</b>
<b>Total quantity</b>	<b>237,250</b>	<b>233,899</b>	<b>218,340</b>

(a) Includes estimated value of aquaculture production but excludes inland commercial fisheries.

Source: Australian Bureau of Agricultural and Resource Economics.

**16.8 AUSTRALIAN FISHERIES PRODUCTION BY FISHERY AND CATEGORY**  
(tonnes)

	1990-91	1991-92	1992-93p
<b>Northern prawn</b>			
Prawn			
Tiger	3,364	4,142	2,837
Banana	6,987	2,508	4,166
Endeavour	727	1,054	794
King	109	78	47
<b>Total</b>	<b>11,187</b>	<b>7,781</b>	<b>7,844</b>
<b>Torres Strait</b>			
Prawn			
Tiger	674	764	816
Endeavour	933	989	1,008
King	57	58	50
Other	9	6	4
<b>Total</b>	<b>1,673</b>	<b>1,816</b>	<b>1,879</b>
Tropical rock lobster	171	147	175
Spanish mackerel	106	100	110
<b>Total</b>	<b>1,950</b>	<b>2,063</b>	<b>2,164</b>
<b>Other fisheries(a)</b>	<b>486</b>	<b>292</b>	<b>329</b>
<b>South east</b>			
Orange roughy	33,111	19,082	12,351
Morwong	1,053	833	920
Tiger flathead	2,120	2,202	1,555
Gemfish	1,120	375	739
Blue grenadier	3,347	3,061	3,174
Ocean perch	156	179	270
School whiting	1,840	988	898
Ling	720	615	776
Redfish	1,007	1,516	879
Mirror dory	297	237	236
Tasmanian trevalley	1,043	1,254	1,264
Other	6,522	7,390	8,143
<b>Total</b>	<b>52,337</b>	<b>37,732</b>	<b>31,205</b>

For footnotes see end of table.

**16.8 AUSTRALIAN FISHERIES PRODUCTION BY FISHERY AND CATEGORY— *continued***  
(tonnes)

	1990-91	1991-92	1992-93 <sup>p</sup>
Great Australian Bight			
Orange roughy	959	627	458
King flathead	365	621	508
Gemfish	172	274	132
Bight redfish	40	131	44
Jackass morwong	53	81	68
King dory	12	63	27
Blue grenadier	32	50	45
Spiky oreo	23	46	21
Ling	28	33	17
Squid	27	32	5
Other	433	178	173
<i>Total</i>	<i>2,144</i>	<i>2,136</i>	<i>1,499</i>
Southern shark			
School and gummy	2,361	2,134	2,003
Other shark	368	613	583
<i>Total</i>	<i>2,729</i>	<i>2,747</i>	<i>2,586</i>
East coast tuna			
Yellowfin	569	628	626
Southern bluefin	8	—	—
Albacore	86	177	174
Bigeye	14	26	26
Billfish	36	62	60
Skipjack	—	208	212
Other fish	283	143	149
<i>Total</i>	<i>997</i>	<i>1,244</i>	<i>1,246</i>
East coast purse seine			
Yellowfin	40	—	—
Skipjack	6,000	6,633	6,630
<i>Total</i>	<i>6,040</i>	<i>6,633</i>	<i>6,630</i>
Southern bluefin tuna			
Domestic	3,059	2,142	1,741
Joint venture	941	2,073	2,450
Other	344	800	650
<i>Total</i>	<i>4,343</i>	<i>5,015</i>	<i>4,841</i>
<b>Total production</b>	<b>82,213</b>	<b>65,643</b>	<b>58,344</b>

(a) Includes North West Slope and Kimberley Coast prawn fisheries.

Source: Australian Bureau of Agricultural and Resource Economics.

**Processing of fish, crustaceans and molluscs.** There is very little value added processing of fish products in Australia. Processing establishments vary in size, scope of operations and sophistication of technologies employed. The majority of establishments undertake only the most basic cleaning, filleting, packing and freezing processes, but others have the capacity for significant product transformation.

Fish, crustaceans and molluscs intended for export are processed in establishments registered under the Export (Fish) Regulations. Edible fish for local consumption is mainly dispatched fresh-chilled to markets.

**Exports and imports.** Exports of fisheries products comes under Commonwealth jurisdiction, while domestic market activity comes under that of the corresponding State or Territory.

A significant proportion of Australian fisheries production is exported. In 1992-93 the value of exports was \$951 million which amounted to approximately 69 per cent of the total value of Australian production. The Australian fisheries export industry depends on a limited range of products sold on a few major

markets and in 1992-93 exports to Japan and Taiwan accounted for about 60 per cent of the value of all exports. In 1992-93 the most valuable exports included rock lobster (\$384 million), abalone (\$168 million) and prawns (\$155 million).

#### 16.9 DESTINATION OF AUSTRALIAN FISHERIES EXPORTS

Country	1990-91		1991-92		1992-93	
	\$m	%	\$m	%	\$m	%
Japan	356	49.4	347	41.9	406	42.7
USA	129	18.0	161	19.4	139	14.6
Taiwan	73	10.1	141	16.9	160	16.8
Hong Kong	71	9.9	91	10.9	143	15.0
Spain	35	4.9	21	2.5	12	1.3
Singapore	18	2.4	21	2.5	27	2.8
France	3	0.5	10	1.1	22	2.3
Thailand	8	1.2	6	0.7	5	0.5
Saudi Arabia	1	0.1	6	0.7	2	0.2
Malaysia	1	0.2	5	0.6	7	0.7
Other	24	3.4	22	2.7	28	2.9
<b>Total</b>	<b>720</b>	<b>100.0</b>	<b>832</b>	<b>100.0</b>	<b>951</b>	<b>100.0</b>

Source: ABS Foreign Trade statistics.

In the same period, Australia imported \$500 million of seafood, 21 per cent of which came from Thailand and 18 per cent from New Zealand. The most valuable categories of seafood imported included prawns

from Thailand (\$48 million), canned fish from Canada and Thailand (\$33 million each) and frozen fish fillets from New Zealand (\$28 million).

#### 16.10 SOURCE OF AUSTRALIAN FISHERIES IMPORTS

Country	1990-91		1991-92		1992-93	
	\$m	%	\$m	%	\$m	%
Thailand	83	18.6	92	19.4	107	21.4
New Zealand	70	15.6	82	17.3	90	18.0
Canada	35	7.8	36	7.6	36	7.2
Malaysia	39	8.8	32	6.8	35	7.0
USA	22	4.8	25	5.3	28	5.6
Japan	25	5.6	22	4.6	17	3.4
Chile	16	3.5	16	3.3	13	2.6
Vietnam	13	2.8	15	3.2	19	3.8
Korea, Republic of	12	2.7	14	2.9	14	2.8
Indonesia	15	3.4	13	2.8	9	1.8
Other	118	26.4	127	26.7	132	26.4
<b>Total</b>	<b>447</b>	<b>100.0</b>	<b>475</b>	<b>100.0</b>	<b>500</b>	<b>100.0</b>

Source: ABS Foreign Trade statistics.

## Fisheries legislation and territorial arrangements

The Commonwealth Parliament has enacted a number of laws dealing with fisheries in Australian waters beyond territorial limits, and has fishing agreements and arrangements with a number of other countries.

The fisheries laws of the States and the Northern Territory apply to all kinds of fishing within the territorial sea and inland waters. These laws require the licensing of persons and boats in the commercial fisheries and provide a range of other regulatory powers.

In July 1992 Australia ratified the Convention on Prevention of Fishing with Long Driftnets in the South Pacific Region.

**The Australian Fishing Zone and foreign fishing.** Establishment of a 200 nautical mile Australian Fishing Zone (AFZ) in 1979 covering a total of 8.9 million square kilometres, brought portions of oceanic tuna stocks, and demersal and pelagic fish stocks previously exploited by foreign fishing vessels, under Australian control.

Australia has an international obligation under the Law of the Sea Convention, to allow foreign nations access to resources within the AFZ that are surplus to domestic fisheries requirements and where such access does not conflict with Australian management and development objectives.

Licensed vessels are currently permitted to operate in Australian waters either under bilateral agreements or joint venture arrangements with foreign governments or fishing companies/organisations. As at December 1993, up to 250 licences are available under the Bilateral access agreement.

Following the introduction of controls on the length of gillnets which can be used, foreign pelagic gillnet operations have ceased. Japan is permitted, under agreement, to long-line, principally for tuna, off certain areas of Australia. Negotiations between Australia, New Zealand and Japan have resulted in an agreed total quota for southern bluefin tuna for 1993-94.

In February 1990 the Governments of Australia and the Soviet Union signed a fisheries cooperation agreement which provides a framework for fishing to take place under

subsidiary agreements. The agreement also established principles under which port access by Soviet trawlers for repairs, revictualling, refuelling and landing of catch might be authorised.

Whales are a protected species in the Australian Fishing Zone.

**Fisheries Act 1952.** This Act applies to commercial fishing for swimming species by Australians in waters extending from 3 to 200 nautical miles seaward of the territorial sea baseline of Australia and external territories excluding the territorial sea of another country, and by foreign boats in the 200 nautical mile AFZ. The AFZ extends 200 nautical miles seaward of the territorial sea baseline of Australia and the external Territories but does not include waters adjacent to Australia's Antarctic Territory or waters exempted from the AFZ by proclamation under section 7A of the Act.

Australia has made maritime delimitation agreements with Indonesia, Papua New Guinea, the Solomon Islands and France. Australia has yet to make a marine delimitation with New Zealand. There are proclamations in force under section 7A of the Act for all overlappings of the AFZ with neighbours' exclusive fishing zones, whether or not Australia has made a delimitation agreement with the country concerned.

This Act requires the holding of licences and empowers the Minister to prohibit fishing activities as necessary for the conservation of resources and the management of the fisheries. The Fisheries Act authorises the publication of management plans having the force of law in relation to particular fisheries.

In recent years, most domestic fisheries have been subject to biological and economic pressure due to increased effort. In 1985 the Commonwealth Fisheries Act was amended to allow formal management of Commonwealth fisheries. Since then major elements in management policy have included:

- quotas;
- catch restrictions;
- limited entry arrangements;
- boat replacement policy;
- seasonal and periodic closures and gear restrictions;



- voluntary unit buy-back schemes;
- permanent closure of nursery grounds;
- long-term freeze on licence transfers;
- research into sustaining long-term biologically viable fisheries; and
- international management agreements.

The *Fisheries Management Act 1991* was introduced to implement new management controls. It provides a simpler and more legislative base for management. Management will concentrate on the use of individual transferable quotas (ITQ) as the preferred tool to achieve a reduction in fishing levels. A particular fishery is assigned a total allowable catch and the market for ITQs will determine the most efficient allocation of quotas and the most economically efficient use of resources. The Australian Fisheries Management Authority (AFMA) was established in February 1992 as part of the new management system.

Refer to *Year Book Australia 1990* for a detailed account of the following Acts: *Continental Shelf (Living Natural Resources) Act 1968*; *Torres Strait Fisheries Act 1984*; *Foreign Fishing Boats Levy Act 1981*; *Fisheries Agreements (Payments) Act 1981*; and *Fisheries Levy Act 1984*.

## Research

The main aim of fisheries research in Australia is to provide a background of biological, technical and economic information which will provide guidance for the efficient and sustainable utilisation of fisheries resources. To this end much of the research already undertaken has been directed at formulating recommendations for management of various fisheries. Research work, including feasibility fishing projects involving foreign fishing vessels, is also carried out and is expected to lead to the development of new fisheries, the expansion of under-exploited fisheries, greater economy in operations and the use of more efficient equipment and methods.

The Fisheries Development Trust Account (established under the *Fishing Industry Act 1956*) and the Fishing Industry Research and Development Trust Fund (established under the

*Fishing Industry Research and Development Act 1987*) are available to support, financially, projects for the development and management of the fisheries and fishing industry is funded by annual Commonwealth appropriation. The latter is a matching fund into which is paid each year an appropriation from Commonwealth government revenue. Total Commonwealth funds are linked to amounts collected from the fishing industry by the State Fisheries Authorities and paid into appropriate State research accounts for the same purpose. Priority areas for research and development include resource assessments, fish diseases and toxins, post-harvest activities, economics and marketing and management of the environment.

Organisations in Australia at present engaged in research into fisheries matters are:

- CSIRO Division of Fisheries Research, which has its headquarters and main laboratory at Hobart, Tasmania, and regional laboratories in Western Australia and Queensland (fisheries science);
- CSIRO Division of Oceanography, which has its headquarters and laboratory at Hobart, Tasmania;
- CSIRO Division of Food Research, conducts research into handling, storage, processing and transportation of fish at its laboratory in Hobart, Tasmania;
- The Australian Fisheries Management Authority, Department of Primary Industries and Energy, Canberra;
- Bureau of Resource Sciences, Department of Primary Industries and Energy, Canberra;
- Australian Bureau of Agricultural and Resource Economics, Department of Primary Industries and Energy, Canberra;
- State fisheries departments (research vessels are operated by all States);
- Great Barrier Reef Marine Park Authority (GBRMPA) located in Townsville and Canberra universities; and
- Private fishing companies (surveys of fisheries resources, research into handling, processing and marketing).

## RECREATIONAL FISHING

People fishing for recreation and pleasure reported an estimated catch of 23,152 tonnes of fish, 2,800 tonnes of crabs and 1,400 tonnes of yabbies/marron in the year ending April 1992. On average, every Australian household casting a line or net caught 27.1 kilograms of seafood.

The pastime of recreational fishing was most popular in New South Wales with 296,900

households reporting that a member had caught fish for home consumption, followed by 245,900 households in Queensland and 235,500 households in Victoria.

Queensland anglers had the most success by landing nearly 7,300 tonnes (23.5% of the total fish catch) of seafood, compared with just under 6,600 tonnes (21.3%) caught in New South Wales and 5,200 (16.8%) in Western Australia.

### 16.11 RECREATIONAL FISHING CATCH BY TYPE OF SEAFOOD, YEAR ENDED APRIL 1992 (tonnes)

	NSW	Vic.	Qld	SA	WA	Tas.	NT	ACT	Aust.
Abalone	20.8	36.4	0.2	8.1	32.3	25.1	—	3.3	126.0
Crabs	335.8	51.9	869.6	865.6	648.1	10.2	54.5	5.9	2,841.5
Fish	5,046.9	4,164.4	5,732.1	3,184.7	3,371.8	1,014.7	388.2	248.8	23,151.7
Lobster, crayfish	127.4	46.1	50.0	53.3	357.7	56.9	4.3	3.3	698.9
Mussels	9.9	20.5	2.7	15.6	48.1	21.6	3.9	1.6	123.9
Octopus	79.9	18.6	3.4	10.5	56.3	2.3	—	0.6	171.5
Oysters	132.2	4.8	129.7	11.8	29.3	16.5	2.7	3.0	330.0
Prawns	251.6	119.8	316.0	14.4	117.0	0.9	11.0	4.7	835.6
Scallops	—	149.6	19.5	17.3	3.2	7.5	0.4	0.3	197.7
Squid	96.7	148.6	53.0	330.1	142.5	32.1	2.8	5.7	811.4
Yabbies, marron	399.6	339.6	78.6	215.1	351.2	0.2	3.2	11.0	1,398.5
Other seafood	85.5	72.7	29.5	29.0	35.4	3.2	0.5	0.6	256.3
<b>Total seafood</b>	<b>6,586.3</b>	<b>5,173.1</b>	<b>7,284.3</b>	<b>4,755.5</b>	<b>5,192.9</b>	<b>1,191.1</b>	<b>471.4</b>	<b>288.6</b>	<b>30,943.2</b>

Source: Home Production of Selected Foodstuffs, Australia (7110.0).

## BIBLIOGRAPHY

### ABS Publications

There are no ABS publications devoted to forestry and fishery statistics for Australia as a whole. Forestry and fishery statistics are available in publications on broader subjects or in unpublished ABS data, which can be obtained on request.

*Apparent Consumption of Foodstuff and Nutrients, Australia (4306.0)*

*Home Production of Selected Foodstuffs, Australia (7110.0)*

*Manufacturing Industry, Australia (8221.0)*

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### Other Publications

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AUSTRALIAN BUREAU OF AGRICULTURAL AND RESOURCE ECONOMICS. *Australian Fisheries Statistics, 1993*

DEPARTMENT OF PRIMARY INDUSTRIES AND ENERGY. AUSTRALIAN FISHERIES SERVICE, *Australian Fisheries*

### FOR MORE INFORMATION

The ABS has a far wider range of information on Australia than that contained in the *Year Book*. Information is available in the form of regular publications, electronic data services, special tables and from investigations of published and unpublished data.

For further information contact ABS Information Services at one of the addresses listed on the page facing the Introduction to the *Year Book*.

# Bushfires — an integral part of Australia's environment

*(This article has been contributed by Mr N. P. Cheney, CSIRO Division of Forestry.)*

## Introduction

The January 1994 bushfires in New South Wales have renewed, once again, the public awareness of the susceptibility of Australia to fire. However, our history suggests that this awareness will be short-lived for the majority of the population. One of the consequences of improved bushfire control is that fewer and fewer people have a regular association with fire. This is reflected in changes in community attitudes towards fire and their own ability to live with what is a very natural and very Australian phenomenon. A better understanding of fire principles, better equipment and better communication by fire authorities will continue to reduce the average area of countryside burnt each year. However, it is because of this that the general public will be less prepared and more reliant on external services and perhaps more prone to disasters in the future.

The bushfires in New South Wales were extensive but mostly confined to the coastal strip between Batemans Bay in the south to the New South Wales/Queensland border and generally less than 100 kilometres inland from the coast. Many of the fires burnt in rugged and largely uninhabited country managed for national parks or nature reserves and did little quantifiable damage. The most damaging fire of the period was one of the smallest. The Como/Jannali fire burnt only 476 hectares, yet the fire destroyed 101 houses, which was more than half of the total house losses for all of New South Wales during the January bushfire emergency period. Our history, and the experience of countries overseas with similar fire climates, are that disasters on the urban bushland interface are likely to be more serious in the future.

## Fire climate

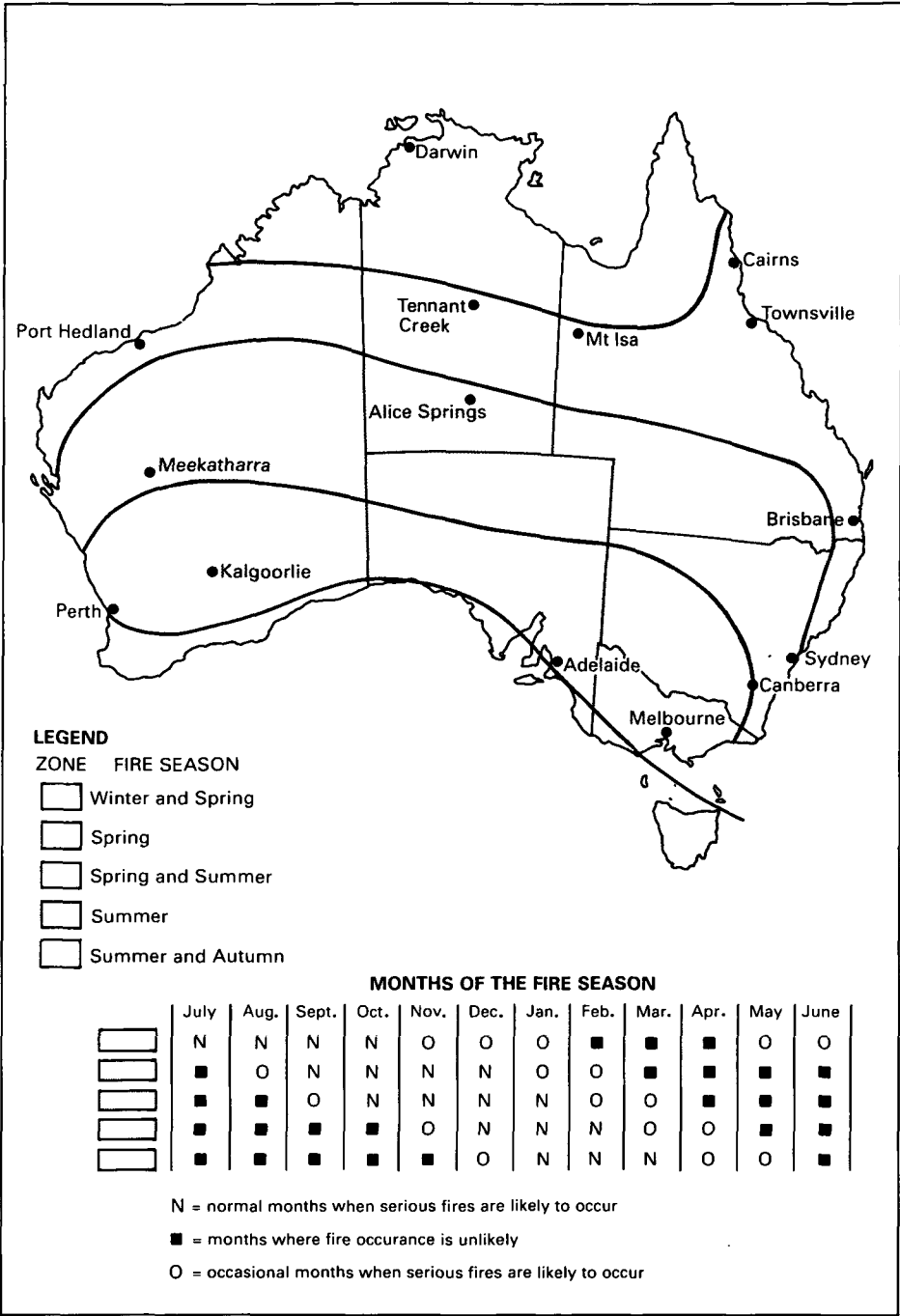
The geographic location and the topography of Australia mean that almost all vegetation types in the country are fire prone. There are few

high mountains and no truly alpine regions. Only the tropical rainforests of north Queensland can be said to be virtually fire-free. Even the normally arid interior of the country is capable of carrying extensive fires. In 1974–75, lush growth of grasses and forbs following exceptionally heavy rainfall in the previous two years provided continuous fuels through much of central Australia and in this season fires burnt over 117 million hectares or 15 per cent of the total land area of this continent.

The fire season in different regions of Australia depends primarily on latitude. In northern Australia the main fire season is winter and spring (the dry season of wet-dry tropics) and when the prevailing wind direction is from the south-east. The fire season in southern Australia is predominantly summer and autumn (see Figure 1). The most severe fire weather occurs in the south-eastern corner of Australia south of a line between Adelaide and Sydney. This is where high pressure systems located in the Tasman Sea can force hot, dry air from the centre of the continent and where low pressure troughs travelling across the southern ocean can form very strong pressure gradients and produce very strong, dry winds. In other parts of the country strong winds during the dry season are rare; they are generally associated with the tropical cyclones and are mostly heavily moisture laden, though, on occasions, cyclonic winds have caused havoc during the fire season in Western Australia.

The south-eastern areas of Australia and Tasmania along with the south-west corner of Western Australia also produce the tallest forests and associated heavy fuel loads. These wet forests occasionally dry out and under extreme fire weather, these heavy fuels produce the most intense and devastating bushfires. So the greatest potential for a bushfire disaster is where people have built in close proximity to the tall, wet forests of southern Australia.

FIGURE 1 BUSHFIRE SEASONS IN AUSTRALIA



Source: R.H. Luke and A.G. McArthur, *Bushfires in Australia*.

## Bushfires in pre-European times

Historical accounts record that Aborigines burnt extensively and often. Although they had little capacity for fire suppression there seems little doubt that they had a very extensive knowledge about when and where particular areas would burn and the biological consequences of their burning. They burnt some areas early in the fire season, before fires would spread extensively, to protect them from fires later in the season. When the weather conditions were appropriate they burnt to promote the flowering and fruiting of certain edible plants. They used fire extensively for warfare, for providing access through thick vegetation, for hunting, for warmth, and for protection against snakes and insects. Their traditions, it seems, did not value areas that were left unburnt for a long time, for much of the burning was done with no specific objective in mind other than 'to clean up the country'; an attitude and practice that still remains with Aboriginal people living in inland Australia today.

While they appeared to manage fire by burning early in the dry season to create green pick and to protect special areas, Aborigines also burnt late in the season with little apparent concern for the downwind consequences of the fire. For example, fires for hunting drives were reported to be lit during hot, dry windy weather when grasses were fully cured. Fires were lit in a horseshoe shape into the wind and, although some control was exercised on the backing fire to force animals out through the opening in the horseshoe as the fire encircled them, the head fires were allowed to run with the wind.

The repeated observation of the first explorers were of open forests and woodlands with a grassy understorey and the impression of an annual conflagration during the fire season. In May 1770, Captain James Cook described the vegetation and country on Botany Bay's southern shore as '... the country which we found diversified with woods, lawns and marshes; the woods are free from underwood of every kind and the trees are such a distance from one another that the whole country might be cultivated without being obliged to cut down a single tree ...' and elsewhere '... the moors looked like our moors in England and as no trees grow upon it but everything is covered with a thin brush

of plants about as high as the knees.' This description fits a vegetation which is burnt annually, or in the case of heathlands, every two to three years. These observations were repeated by other explorers that pushed further inland from the coast up until about 1850.

Annual burning is only possible in vegetation types such as the tropical and subtropical woodlands where there is a substantial proportion of grassy fuels. The temperate woodlands may or may not burn every summer depending on the distribution of summer (dry season) rainfall and the extent of perennial grasses. It is obvious that much of the tall, dry forests and heathlands of today were originally of more open character and carried a substantial sward of grassy fuels that did permit annual or biennial burning.

Historically, it also seems that the Aborigines did not favour the tall, wet forests of southern Australia and these, being naturally moist, even in summer, burnt only under extreme fire weather conditions when the forest fuels dried out and were ignited by fires from the open woodlands and dry forests. These conditions occurred every 50 to 200 years and the resulting fires were very intense and extensive, regenerating tracts of even-aged forest.

It seems likely that most of the dry forests and woodlands of Australia had a fire regime perpetuated by Aboriginal Australians that was similar in many respects to the annual burning regime in northern Australia today. Fires were lit frequently throughout the year and in the dry season when grasses were fully cured, and burnt unchecked until they ran into an area that had been burnt some time previously. Fires were not particularly intense even on days of extreme fire weather because the fuels were light.

## After European settlement

As soon as the Europeans established permanent towns and farms, there was pressure to reduce the number and frequency of Aboriginal ignitions. This started a change in the fire regimes over much of the country from one of annual burning to regimes of somewhat longer frequencies. As soon as Aboriginal burning ceased, the regrowth of the vegetation was extremely rapid and within a few years the grass was 'choked by underwood' and by the regeneration of young trees. Major Mitchell describes 'the omission

of the annual periodical burning by natives, of the grass and young saplings has already produced in the open forest lands nearest to Sydney, thick forests of young trees, where, formally, a man might gallop without impediment and see whole miles before him.' This regeneration of forests around Sydney was repeated in other parts of Australia and is still happening today in areas of north Queensland. The cessation of annual burning by graziers in lands newly reserved for national parks is allowing open forests and woodlands to develop into closed forests. In other areas, the open eucalypt woodlands on the rainforest fringes, which had been maintained by periodic burning, are now being invaded by rainforest species.

Despite the popular view that European settlement increased the frequency of fire in the country, it is clear from the historical evidence that as European settlement increased, fire frequency decreased. As fire frequency decreased, however, the fuels built up and when fires did occur they were more intense than fires under the Aboriginal annual burning regime.

For a period around 1850 to 1900, there was deliberate firing of the vegetation by Europeans associated with minerals prospecting. Burning was widely used to clear scrub and litter and expose the underlying rocks. Where this was carried out in dry forests carrying substantial regeneration and heavy fuel build up after the cessation of annual Aboriginal burning some years earlier, the fire intensities were dramatically increased. The prospectors did extend burning into wet forests which were not regularly frequented by Aborigines but this effect was probably relatively localised.

Burning was undertaken by graziers to clear land of rough shrub and coarse grasses and to produce green pick for cattle on rough bush leases. This burning differed from Aboriginal burning both in timing and in frequency. The frequency of graziers burning has been progressively decreasing over the past 200 years. Several observers quoted graziers firing parts of the country as often as every three to four years up until the 1920s but for most of southern Australia the frequency now is very much less than this.

## Legislation and management

Legislation to specifically limit the lighting and spread of bushfires was established at different times in different States around the 1880s. The first ordinance 'to diminish the dangers from bushfires' was established in Western Australia in 1847 followed by the Bushfires Acts in South Australia and Tasmania. Organised protection from fire was not possible until much later. In the early 1900s forestry departments were established and advocated complete protection from fire caused by the miners and the graziers. Still, legislation lacked any impact until after the disastrous fires of February 1926 when sweeping changes were made in almost every State. Lighting of fires during the fire season was prohibited, forestry departments were strengthened and volunteer bushfire brigades were formed to control fires in rural areas.

From 1926 to 1970, every major change in fire management followed a major fire disaster and in this period most of the disasters resulted when graziers' fires burning during an extended spring drought continued into summer. The year of change was different in each State: 1939 and 1944 in Victoria, 1952 and 1968 in New South Wales, 1961 in Western Australia and 1967 in Tasmania. Along with the increasing tide of legislative restrictions and control, was the progressive reservation of vacant crown lands — initially for forestry and later for national parks — and progressive improvement in agricultural grazing land. Increasingly there were assets such as homesteads, stock, crops and fencing that demanded protection from wildfires and, more recently, the threat of litigation from neighbours burnt out by escaped fire has made graziers more circumspect with their burning.

## Fire ecology

Eucalypts appeared in the fossil record around 80 million years ago. With them were charcoal fragments, and indication of the long association of fire with Australian flora. Although there have been substantial changes in the vegetation associated with change in climate, the fossil record shows that whenever there was a change to a drier environment with associated sclerophyll vegetation, there is also an increase in the frequency of fire. For example, in the Lake George area of New South Wales, whenever there was a shift from

plants favoured by a cool temperate climate to plants which were favoured by a dry arid climate (for example, the eucalypts), there was an increase in charcoal associated with the plant pollen. There was a substantial increase in the amount of charcoal present between 200,000 and 250,000 years before present which is well before Aborigines were considered to be within the area. Since then, the presence of natural ignition from lightning and the extensive burning practices of the Aborigines have influenced the development of our forests and heathlands and resulted in a natural mosaic of plant community ages throughout Australia.

Although wildfire is detrimental to our rural production and the built environment, it should be considered to be as much a part of the natural environmental of our forests and heathland ecosystems as the sun and the rain. Some Australian plants are stimulated to flower by the presence of fire or smoke, while others have seeds which require some heat treatment before they will germinate. There is a suite of specific plants and animals which are associated with each fire regime. Annual burning favours communities of grasses and herbs, which in turn are preferred by kangaroos and larger wallabies. The tall eucalypts of the mountain forests of Victoria and Tasmania have seeds which are so small that they will not survive in the deep litter beds that accumulate beneath them. These species require an intense fire under dry conditions to remove the accumulated organic matter on the forest floor so that the tiny eucalypt seedlings can grow and regenerate the forests. If these forests do not receive a fire within their life span, (which is about 250 to 350 years), they will die out and be replaced by temperate rainforest species. In between these two extremes are other plants which have the capacity to produce abundant shoots from stems or lignotubers after fire and so can withstand frequent and repeated firing at regular intervals.

Similarly, some species of our native fauna are favoured by burning at regular intervals, others prefer intermediate intervals between fire, while yet others require long periods without fire for their optimum development. When considering fire in relation to fauna, it is important not to confuse temporary impacts on individual animals with longer term trends which often have a net beneficial effect.

During any fire some animals will perish. However, in the absence of fire, changes in vegetation may cause the decline and disappearance of some species. The interdependence of plants and animals with a particular fire frequency can be quite complex. For example, the small rat kangaroo or woylie of Western Australia has a diet which consists mainly of the underground fruiting bodies of a fungus. The fruiting of the fungus is related to the amount of nitrogen in the soil which is, in turn, related to the vigour of understorey plants which are capable of fixing nitrogen. Thus, the optimum conditions for this animal requires a fire frequency which regenerates the understorey shrubs (in the absence of fire the shrubs die out) and yet provides other areas where the shrubs are intact with shelter from predators.

Introduced animals have had a huge impact on the smaller native fauna whose interaction with fire is complicated further by the grazing of native vegetation by rabbits and the predation by foxes and feral cats. It is considered by many that these influences are having a much greater impact on our fauna than the changed frequency of fire.

### **The nature of bushfire disasters — past and future**

A natural disaster occurs when a natural phenomenon impacts on a vulnerable population. The severity and magnitude of a bushfire depend upon both the severity of the prevailing weather conditions and the amount of fuel available for combustion. Under a frequent burning regime, heavy fuel loads do not accumulate and so extreme fire intensities cannot occur even though fires may spread rapidly in grassy fuels. The most intense conflagrations will occur in those locations where there is the potential for extreme fire weather and the accumulation of heavy fuel loads. In Australia, these locations are the tall, wet forests of the temperate zones of Victoria, south-western Western Australia and southern Tasmania.

For a conflagration to be a disaster depends on the vulnerability of the population and their level of preparedness. The historic fire disasters of the past occurred when numerous fires left to burn by graziers burnt huge areas under extreme conditions. In 1939, 71 lost their lives, mostly from timber towns in the



forest lands of Victoria. In 1967, on 7 February, there were 110 fires burning within a 25 mile radius of Hobart in southern Tasmania before the onset of extreme fire weather. These fires converged together over a period of seven hours and devastated the suburban fringes of Hobart and towns in the channel districts to the south of Hobart. These fires burned 264,000 hectares, 61 lives were lost and more than 1,700 homes destroyed. On 16 February 1983 (Ash Wednesday), 15 major fires in South Australia burnt out 160,000 hectares, killed 28 people and destroyed 383 homes. On the same day, eight major fires in Victoria burnt out 183,000 hectares, wiped out several towns and seaside resorts, 47 people perished and 2,186 homes were destroyed. In 1994, in New South Wales, between 21 December and 16 January, more than 800 fires burnt more than 800,000 hectares and totally destroyed 287 residential properties and other premises. Four people were killed.

However, in each of the recent fire disasters, the major losses have occurred when a single fire burnt into a residential area, either a major town or on one of the city fringes as shown in Table 1. The total area burnt by the Como/Jannali fire, which burnt entirely within the suburban development of greater Sydney, was only 476 hectares, yet this was responsible for more than half the residential house losses in the recent New South Wales fires. Similarly, in the Tasmanian disaster, very substantial losses occurred from a relatively few fires; one of the major ones being the Hobart fire which burnt only 6,660 hectares, killed 20 people and destroyed 310 homes and other buildings.

Historically, major disasters have occurred where severe fires are least frequent. In the future it is likely that the frequency of burning per se is likely to decrease and, as a consequence of this, the vulnerability of the population to fire is likely to increase. In the past, the perimeter of major cities between the urban area and the bushland was often well defined with a substantial fire break or fuel-modified area which separated the town

from the rural vegetation. Residential sites were substantially cleared of bush before development and the size of normal residential blocks gave little scope for regeneration of natural bush. There is now an increasing tendency for people on the outskirts of major cities and towns to purchase larger blocks of from one to 20 hectares and build their homes without substantial clearing of the native vegetation or, where this land had previously been pastoral land, regrowth and regeneration of the native vegetation has been encouraged.

In addition to living more intimately with the fuels, the people living in these areas have little understanding of bushfires or fire behaviour. They have often urban-based employment and many expect fire protection to be provided as a service and seem reluctant to join a volunteer bushfire brigade to provide fire protection as a cooperative self-help operation. Without the experience of regular fires under mild conditions, the residents of these areas can be totally unprepared for the occasional wildfire burning under extreme fire weather conditions. Fewer precautions will be taken to clear fuels around individual houses and the concentration of house losses is likely to be greater than in the past.

The overseas experience in areas with a similar fire climate to Australia follow the same trends set out above. People are building houses on larger blocks with more wildland fuels being retained in an undisturbed state. The East Bay Hills fire of 20 October 1991 burnt through an urban/rural residential area in Oakland and Berkeley Hills, California. The total area of the fire was only 615 hectares, yet 25 people were killed, 2,777 separate family residences and more than 400 apartments were destroyed. Because of its urbanisation, the area had a relatively low frequency of fire but when severe weather conditions prevailed, the intermix of houses, forest and scrub fuels on steep slopes produced a wildfire that was impossible to contain until the weather conditions moderated. Ironically, some 20 per cent of the vegetation was Australian eucalypts.

**TABLE 1 MOST SIGNIFICANT SINGLE FIRES IN URBAN/RURAL WILDFIRE DISASTERS IN AUSTRALIA AND CALIFORNIA**

<i>Year</i>	<i>Date</i>	<i>Location</i>	<i>Area burnt (ha)</i>	<i>Fatalities</i>	<i>Homes destroyed</i>
<b>AUSTRALIA</b>					
1964	14 January	Dandenong Ranges, Victoria	2,000	8	454
1967	7 February	Hobart, Tasmania	6,600	20	310
1983	16 February	Upper Beaconsfield, Victoria	9,200	21	238
1983	16 February	Macedon, Victoria	29,500	7	628
1983	16 February	Mt Osmond, South Australia	3,885	9	9,100+
1994	8 January	Como/Jannali, New South Wales	476	1	101
<b>CALIFORNIA, UNITED STATES OF AMERICA</b>					
1961	n.a.	Bel-Air, Los Angeles	2,500	n.a.	484
1977	n.a.	Santa Barbara	325	n.a.	234
1990	n.a.	Santa Barbara	2,000	n.a.	641
1991	20 October	Oakland/Berkeley	615	25	2,777

*Source: CSIRO Division of Forestry.*

The comparatively minor losses of the Como/Jannali fire reflects different town planning where most of the housing was sharply separated from the bushland by a perimeter road or fire trail. The trend for housing intermixed with bushland fuels like the East Bay Hills area is increasing in Australia. However, where people demand residential homes on large bushland blocks, the management of fuels on these blocks to minimise the bushfire threat must become the

responsibility of each and every individual. Improved building standards will help but solves only part of the problem. Unless individuals band together to maintain low fuel levels within the urban/rural residential areas, then this type of urban wildfire demonstrated within the Sydney suburbs is going to be repeated elsewhere in Australia in the future with increasing levels of property damage and disruption.

