The Size, Distribution and Tenure of the Forest Estate





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The biogeography of Australia's forests

The availability of water and the suitability of temperatures control the broad distribution of forests across the Australian continent. At the local scale, the distribution of soils, slope and aspect also helps determine whether forests occur and what type of forest predominates. Through time, the kind of forest present in an area depends not only on the above factors, but also on others such as disturbance history and the way the forest has responded to such disturbances. Human use of the forests or their removal of entire forests also impacts strongly on the modern distribution of forests.

When viewed at the continental scale, the forests fall into two climatic categories: tropical and temperate. The tropical region across the north of the continent has two broad gradients that affect the kinds of forests to be found: one of increasing rainfall and slightly decreasing temperatures from west to east, and another of the same factors from south to north. One result of these gradients is that the tallest and densest forests occur in north-east Queensland – including Australia's main areas of tropical rainforest.

The temperate regions of the central eastern, south-east and south-west coasts support a great variety of forests that also respond to climate. Cool climate forests occur in the tropical north-east, but there they are restricted to the tops of mountains. In the south-east of the continent, cool climate forests are very extensive, only disappearing where temperatures are too cold in winter, such as in the alpine regions where a tree line determined by cold temperatures can be found, or where water becomes limiting inland. The patterns of rainfall are also generally more complex in the south-east, where relatively high mountains interact with winter rainfall from southerly directions and summer rainfall from northerly directions.

The Great Dividing Range of eastern Australia tends to mark a major divide between forest types, especially where the steep escarpment marks the eastern edge of the inland plateau. To the inland, the climate is distinctly drier and warmer than to the east and south-east of the divide and escarpment. This is partly due to the effects of increased altitude, but also to the general flow of rain-bearing weather. Thus, tall to very tall forests occur towards the coast, and low to medium height forests occur inland. A similar variation in forest types occurs in the south-west of the continent, where Eucalyptus marginata (jarrah) forests occur on the hills at the edge of the inland plateau, giving way to a great diversity of woodland types on the generally flat inland.

The large stature of the mature E. marginata forests in the south-west appears out of proportion to the duration of the summer drought they experience. Forest trees near Kalgoorlie also have a much greater stature than the climate of less than 250 millimetres of annual rainfall would suggest. Both these forested areas appear to depend on supplies of water from deep in the soil, rather than solely on direct rainfall. Another biogeographically noteworthy forest is the E. camaldulensis (river red gum) forest of the Murray and Darling river systems. Here again, the stature of the forests is greater than may be expected given the rainfall, but groundwater and periodic flooding maintain them.

Forests of considerable biogeographic interest are those bearing a strong resemblance to their Gondwanan predecessors. They are found primarily in the south-east, especially in Tasmania and in scattered locations in generally cool sites on mountains along the east coast, and in the tropical rainforests. Some of the plants and animals are modern descendants of those that lived when these forests were widespread and dominated the vegetation of Australia some 60 million years ago. They are noteworthy in the primitive characteristics they have, compared to those of more recently evolved species.

Forest types

Most of Australia's trees are hardwoods like the eucalypts, rather than softwoods (conifers). *Araucaria cunninghamii* (hoop pine), *A. bidwillii* (bunya pine) and *Athrotaxis selaginoides* (King Billy pine) dominate some native forests (although the total area of such forests is insufficient to constitute a major forest type in this report) and there are extensive areas of slow-growing callitris forests, but the few conifers elsewhere are found scattered through other forest types.

Specht and his co-authors produced a conservation atlas of Australian native plant communities in 1995. Using existing vegetation data at the time, they recognised 910 plant communities defined by dominant species and structure across the entire continent; this probably underestimates the total number of communities because of the incompleteness of the information. Of these, 457 are considered to be forest communities under the current definition.

For the purposes of this report, these communities have been grouped into eight broad native forest types. The first seven are eucalypt, acacia, melaleuca, rainforest, casuarina, mangrove and callitris. There is a long list of other forest types that are locally important (and occasionally widespread), though none cover significantly large areas. Together with forests for which information is limited for a variety of reasons, such types form the eighth native forest category – 'other forest'. Plantation forests are treated in two additional categories: hardwood and softwood.

This chapter examines the size, distribution and tenure of Australia's forest estate as a whole, and then by each of the eight native forest types and two plantation types.

The size of the forest estate: summary

The most recent inventory of the forest estate, undertaken for this report, shows that Australia has a total forest area of close to 157 million hectares, made up of almost 156 million hectares of native forests and just over 1 million hectares of plantations. With a land area of almost 769 million hectares, this means that about 20 per cent of the continent is forested. The estimate of forest cover given here is dramatically different from some previous estimates, but well within others; this is due almost entirely to the definition of forest used. As described in Chapter 1, a forest is defined in this report as:

An area, incorporating all living and nonliving components, that is dominated by trees having usually a single stem and a mature or potentially mature stand height exceeding 2 metres and with existing or potential crown cover of overstorey strata about equal to or greater than 20 per cent. This definition includes Australia's diverse native forests and plantations, regardless of age. It is also sufficiently broad to encompass areas of trees that are sometimes described as woodlands.

Table 1 and Figure 2 show the total distribution of native forests by State and Territory. Queensland has the greatest area of forest, but the position of the Northern Territory as the second most forested region may come as a surprise. Almost 28 million hectares of the Territory's total forest area is woodland that has not fallen within many previous definitions of forest.

Distribution by crown cover category

Crown cover is determined by estimating or measuring the area of ground covered by tree canopies, ignoring overlap and gaps within individual canopies. A line around the outer edge defines the limits of an individual canopy, and all the area within is treated as 'canopy', irrespective of gaps and overlaps.

The native forests can be divided into three classes by the density of their crown cover. Thus, there are:

- 112 million hectares of woodland (tree crowns cover 20–50 per cent of the land area when viewed from above), including just under 8 million hectares of woodland mallee;
- 39 million hectares of open forest (51–80 per cent crown cover), made up of 35 million hectares of what are commonly called wet and dry sclerophyll forests and 4 million hectares of open forest mallee; and
- 4.6 million hectares of closed forest (81–100 per cent crown cover), made up of 3.6 million hectares of rainforest and 1 million hectares of mangroves.

Map 1 (see colour section in back of book) shows the distribution of these three broad canopy cover categories across the country. There are a number of anomalies in these data, even though they represent the best that are currently available. For example, the larger areas of forest mapped in northern Australia are known to be less extensive than shown. In addition, the sharp border across the south of Cape York is an artefact of mapping, rather than of forest distribution.

Figure 2: The distribution of native forest, by State and Territory



Source: National Forest Inventory (1997).

					('000 ha)				
Forest type	ACT	NSW	NT	Qld	SA	Tas	Vic	WA	Australia
Eucalypt	120	17 929	31 138	31 984	4 820	2 237	6 845	29 390	124 463
tall	72	2 097	0	1 126	2	250	2 825	171	6 543
medium	48	12 842	23 849	28 511	497	1 901	2 986	20 815	91 450
low	0	1 163	7 288	2 340	316	86	76	3 431	14 700
mallee	0	1 827	0	0	4 005	0	958	4 973	11 764
unknown	0	0	0	6	0	0	0	0	6
Acacia	0	944	2 439	4 603	307	3	17	3 986	12 298
Melaleuca	0	202	1 072	2 643	2	0	18	155	4 093
Rainforest	0	209	252	2 567	0	545	3	7	3 583
Casuarina	0	802	0	62	147	0	0	40	1 052
Mangrove	0	7	442	398	20	0	5	173	1 045
Callitris	0	382	0	309	139	0	37	0	867
Other	0	312	43	6 490	63	118	360	1 048	8 435
Total native forest	120	20 787	35 385	49 056	5 499	2 904	7 285	34 800	155 835
Plantation ⁽¹⁾	15	270	4	170	103	134	215	131	1 043
Total forest	135	21 057	35 389	49 226	5 602	3 038	7 501	34 930	156 877
(% of land area)	56%	26%	26%	29%	6%	45%	33%	14%	20%
Land area ⁽²⁾	240	80 160	134 620	172 720	98 400	6 780	22 760	252 550	768 230

Table 1: The distribution of forest types, by State and Territory

Note: Column or row total may not add up due to rounding.

⁽¹⁾ Australian Forest Products Statistics (September 1997).

⁽²⁾ Year Book Australia (1997).

Sources: National Forest Inventory (1997).

Tree height

Currently there is no national standard used for mapping tree height: mapping compiled for this report used nearly 150 different height classes. Height data have been grouped into three categories, as follows:

- low: 2–10 metres
- medium: 11–30 metres
- tall: greater than 30 metres.

Composition

Table 2 shows the area of forest for each of the eight native forest types used in this report, subdivided by crown cover (Figure 3 shows this graphically), and Table 1 shows the distribution of native forest types by State and Territory.

The distribution of forest types across the continent is given in Map 2 (see colour section in back of book).

Growth stages

For some forest types it is possible to describe the growth stages of stands. Three stages are generally recognised: regrowth, mature and senescent. Additionally, some categorisations subdivide regrowth into establishment and juvenile, and mature into early and late mature. Growth stages data are available for some forests with multiple-use and conservation reserve tenure, and these are presented in Table 4. Overall, data are available for more than 26 per cent of these tenure categories, amounting to about 4 per cent of all forests. The amount of information on growth stages will increase with completion of the regional forest agreement process (see Chapter 5).

The tenure of Australian native forests

Land tenure is crucial to our understanding of the state of the forests, since it determines the uses to which the forests may be put. This report recognises five tenure categories:

 conservation reserves: publicly owned forests reserved for conservation, including national parks and flora reserves;

	Cro	wn cover category		
Forest type	Closed forest	Open forest	Woodland	Total
Eucalypt	nil	32 703	91 759	124 463
tall	nil	5 475	1 068	6 543
medium	nil	22 656	68 794	91 450
low	nil	385	14 315	14 700
mallee	nil	4 187	7 577	11 764
unknown	nil	nil	6	6
Acacia	nil	1 695	10 603	12 299
Melaleuca	nil	878	3 215	4 093
Rainforest	3 583	nil	nil	3 583
Casuarina	nil	83	968	1 052
Mangrove	1 045	nil	nil	1 045
Callitris	nil	136	731	867
Other	nil	3 679	4 756	8 435
Total forest	4 628	39 174	112 032	155 835

Table 2: Areas of forest types within crown cover categories ('000 ha)

Note: Column or row total may not add up due to rounding. Source: National Forest Inventory (1997).

					Multip	le-use forests b	/ growth stage (h	(F			
Rentreest 33000 13900 14995 77.56 80.000 80.000 80.000 60.000 </th <th>Forest type</th> <th>Total area 1 which grow stage is kno</th> <th>or Establish wn (1–10 ye</th> <th>nent Juve ars) (11–30</th> <th>nile years)</th> <th>Immature (31–100 years)</th> <th>Mature (100–200 years)</th> <th>Senescent (> 200 years)</th> <th>Two growth stages</th> <th>Three or more growth stages</th>	Forest type	Total area 1 which grow stage is kno	or Establish wn (1–10 ye	nent Juve ars) (11–30	nile years)	Immature (31–100 years)	Mature (100–200 years)	Senescent (> 200 years)	Two growth stages	Three or more growth stages	
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	Medium open eucalypt forests	2 951 757	22 058	149 (619	147 340	646 540	266 000	171 000	1 568 400	
	Low open eucalypt forests	0	0		0	0	0	0	0	0	
	Tall eucalypt woodlands	0	0		0	0	0	0	0	0	
	Medium eucalypt woodlands	1 354 000	0		0	0	0	546 000	0	814 000	
Interfaces and woodlants 1 0 <td>Low eucalypt woodlands</td> <td>0</td> <td>0</td> <td></td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td>	Low eucalypt woodlands	0	0		0	0	0	0	0	0	
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The Size, Distribution and Tenure of the Forest Estate



Figure 3: Area of crown cover categories within each forest type

- multiple-use forests: publicly owned forests set aside for timber production, including State forest and timber reserves, in which timber production and mining are permitted, together with a range of other commercial and non-commercial activities;
- leasehold land: publicly owned forests on land leased from the crown;
- other crown land: forests on crown (public) land not covered by the previous three categories – this grouping includes such tenures as Aboriginal reserves, defence land, mining reserves and sundry others; and
- private forests: forests owned privately.

The *Native Title Act 1993* recognises the customary right to land of Indigenous peoples. The complex issues flowing from this Act are being worked through; at the time of publication of this report it was not possible to gauge how much of Australia's forests will come under native title following application of the Act.

Table 5 shows the tenure of native forest by crown cover category, and Map 3 (see colour section in back of book) shows the distribution of native forests by tenure across the continent. The tenure of plantation forests is dealt with more fully in another section of this chapter.

The ratio of public to private ownership for native forests mirrors the general pattern of land ownership in Australia. Approximately 27 per cent of native forests are privately owned and 72 per cent are publicly owned. Just under 1 per cent are of unclear ownership due to shortcomings in the databases used for this calculation.

The private forest category is the second largest tenure class: about 42 per cent of the native forest estate is on public land held under lease by the private sector, predominantly the pastoral industry.

The right to use land conferred by a lease does not automatically confer a right to use forest on the land; nevertheless, the forest may be affected by the uses to which the land is put, such as grazing. Relevant State and Territory governments set conditions for the use of leasehold land, and these conditions vary. For instance, pastoral leases usually only confer rights for small-scale timber use such as fencing and similar utilitarian purposes. In contrast, some leaseholders in New South Wales have entitlements similar to those of private owners. A wide range of various conditions relating to the use of forests on leasehold land also apply in other States and Territories.

Taking private and leasehold native forests together, almost 70 per cent are on land managed by the private sector.

The remaining 30 per cent are public forests, which are defined in the National Forest Policy Statement as any forest on crown land for which management responsibility has been delegated to government agencies, local governments or other instrumentalities. Public forests are divided fairly equally across three public tenure types – conservation reserves, multiple-use forests and other crown land.

About 11 per cent of the total native forest estate is in conservation reserves; 10 per cent is on other crown land; and about 9 per cent is on land with multiple-use tenure.

The influence of tenure on the management regime imposed on any given forest is discussed in later chapters.

Tenure of native forests within States and Territories

Table 5 shows native forest tenure for each State and Territory. Some significant variations from the averages for the total native forest area are:

- forests on leasehold land are concentrated in Queensland and the Northern Territory, which between them have about 54 per cent of all native forests in the country and 67 per cent of all native forests on leased land;
- most of the privately owned forests are in the Northern Territory and Queensland;
- Western Australia has 22 per cent of the native forest estate, of which less than 4 per cent is owned privately;
- almost 85 per cent of native forests on other types of crown land are in Western Australia. Of these, more than 10 million hectares are on vacant public land and 2.5 million hectares are on Aboriginal reserves;

				State/Ter	ritory ('00	0 ha)			
Crown cover and tenure class	АСТ	NSW	NT	Qld	SA	Tas	Vic	WA	Australia
Closed forest									
Leasehold	0	0	61	451	0	0	0	20	532
Private	0	41	417	945	15	17	1	4	1 439
Conservation reserve	0	103	108	608	1	187	6	29	1 043
Other	0	4	1	111	(1)	145	(2)	106	366
Multiple-use	0	69	0	828	0	196	(4)	0	1 095
Unresolved tenure	0	(4)	106	21	4	0	(1)	21	153
Total	0	217	693	2 964	20	545	8	180	4 627
Open forest									
Leasehold	10	279	1 208	2 271	323	0	0	127	4 219
Private	6	3 811	4 729	4 524	1 336	783	665	270	16 124
Conservation reserve	80	1 768	750	729	613	336	2 179	870	7 324
Other	1	333	57	289	5	151	118	350	1 304
Multiple-use	5	2 166	0	2 161	24	1 088	3 054	1 385	9 883
Unresolved tenure	0	7	276	15	8	(1)	14	(3)	320
Total	102	8 364	7 020	9 989	2 309	2 359	6 029	3 003	39 175
Woodland									
Leasehold	3	5 687	18 967	21 274	1 543	0	0	13 877	61 352
Private	(3)	4 194	6 040	11 643	977	0	372	1 228	24 454
Conservation reserve	13	1 189	1 851	1 532	638	0	525	3 465	9 214
Other	(4)	269	200	651	8	0	47	12 750	13 926
Multiple-use	(3)	859	0	994	2	0	291	226	2 373
Unresolved tenure	0	8	613	8	2	0	13	69	713
Total	17	12 206	27 671	36 102	3 170	0	1 248	31 617	112 033
Plantation ⁽⁵⁾									
All tenures	15	270	4	170	103	134	215	131	1 043
All forest									
Leasehold	13	5 966	20 236	23 996	1 866	0	0	14 025	66 103
Private	7	8 046	11 187	17 111	2 327	801	1 038	1 502	42 018
Conservation reserve	93	3 060	2 709	2 870	1 252	523	2 710	4 364	17 580
Other	2	605	258	1 051	12	296	165	13 206	15 597
Multiple-use	5	3 095	0	3 983	27	1 285	3 346	1 612	13 351
Unresolved tenure	0	15	995	44	15	(1)	26	90	1 186
Plantation ⁽¹⁾	15	270	4	170	103	134	215	131	1 043
Total	135	21 057	35 389	49 226	5 602	3 038	7 501	34 930	156 877

Table 5: Forest area, by crown cover and tenure category, by State and Territory

Note: Column or row total may not add up due to rounding. ⁽¹⁾ Area smaller than 50 hectares.

⁽²⁾ Area of 51–100 hectares.
 ⁽³⁾ Area of 101–500 hectares.

⁽⁴⁾ Area of 501–999 hectares.

Sources: National Forest Inventory (1997). ⁽⁵⁾ Australian Forest Products Statistics (September 1997).

- almost 30 per cent of multiple-use native forests are in Queensland;
- Victoria, with less than 5 per cent of the total forest estate, has 25 per cent of all native forests in the multiple-use category, but also by far the highest percentage in the conservation reserve tenure category; and
- the Northern Territory has no multiple-use native forests and the Australian Capital Territory and South Australia have negligible areas in this tenure.

Tenure of native forests by crown cover type

Table 5 also shows the amount of forest crown cover type in each tenure category. Points of interest include:

- woodlands make up almost 93 per cent of all native forests held under lease, reflecting their extensive distribution across the pastoral lands of the Northern Territory, Queensland and Western Australia;
- about 8 per cent of all woodlands are in the conservation reserve tenure, compared to 22 per cent of closed forests and nearly 19 per cent of open forests. Nevertheless, because the woodland estate is much larger than the closed and open forest estate, the gross area of woodland in conservation reserves constitutes almost 52 per cent of the total area of forest in conservation reserves;
- of the 4.4 million hectares of forest in conservation reserves in Western Australia, 80 per cent are woodlands, reflecting the large areas of woodland in that State;
- open forests occur largely on private land or in the multiple-use or conserved categories; and
- about 19 per cent of open forests are in conservation reserves, compared to 11 per cent for the entire national forest area.

Closed forests are proportionally more highly reserved for conservation purposes than is the native forest estate nationally. Even so, the figure does not represent the true level of conservation of closed forest. Much of the rainforest in the wet tropics of north-east Queensland – representing about 31 per cent of the national rainforest area – occurs within the multiple-use tenure but has full conservation protection under legislation. The true level of conservation of closed forests is therefore more than 40 per cent.

Tenure of major native forest types

Table 6 shows the tenure of the eight native forest types across Australia. About half the tall eucalypt forests occur in multiple-use tenures, just over one-fifth in conservation reserves and nearly 30 per cent on private or leasehold land. In total, about two-thirds of all eucalypt forests occur on private or leasehold land. Over 90 per cent of acacia forests, virtually all casuarina forests and more than half of all mangrove and callitris forests occur on private or leasehold land. Just over half of all rainforests are found on land designated as conservation reserve or multiple-use; most of the rest (40 per cent) occur on private or leasehold land.

National and international listings

There are several agreements and processes at the international and national levels that serve to identify forests of particular merit for the conservation of natural or cultural values. Two such agreements and processes are discussed here: World Heritage listing, and the Register of the National Estate. Areas within these categories overlap.

World heritage areas

The World Heritage Convention encourages the protection and conservation of internationally important sites of natural and cultural heritage worldwide. One hundred and fifty countries including Australia have ratified the Convention since it came into force in 1975. More than 550 sites from 113 countries are on the World Heritage list.

Under the terms of the convention, Australia is obligated to conserve and protect particular natural and cultural sites of worldwide importance. The Commonwealth's *World* *Heritage Properties Conservation Act 1983* provides the legal basis for fulfilling this international commitment.

Australia has 13 World Heritage sites. Six contain forest; forests were specifically mentioned in the listing purposes for several. Those containing forests are:

- Kakadu National Park (listed in three stages: 1981, 1987 and 1992);
- Lord Howe Island Group (1982);
- Tasmanian Wilderness (listed in two stages: 1982 and 1989);
- Central Eastern Australian Rainforest Reserves (1987);
- Wet Tropics of Queensland (1988); and
- Fraser Island (1992).

Table 7 shows the area of native forest by crown cover class occurring in World Heritage listed places. Table 8 shows the tenure of those native forests, and Table 9 shows the proportion of the total native forest area (by crown cover class) occurring in World Heritage or National Estate listed places. Table 10 shows the percentage of each forest type occurring in World Heritage or National Estate listed places. Map 4 (see colour section in back of book) shows the location of forested World Heritage places.

The effects of listing

The Commonwealth has responsibility for fulfilling Australia's international obligations under the World Heritage Convention. In practice, the Commonwealth and individual States and Territories work jointly to manage World Heritage listed places. The nature of the joint arrangements is periodically reviewed.

Register of the national estate

The Register of the National Estate encompasses natural and cultural places that have aesthetic, historic, scientific or social significance for the present community and future generations. It was established in 1975 under the *Australian Heritage Commission Act 1975*.

The Register lists both areas of forest and sites within them, including places of intrinsic aesthetic value, pre-colonial and current Indigenous sites and early settler history. Currently, 71 per cent of National Estate places containing forests are within the conservation reserve tenure.

In 1994 there were over 2200 forest areas or forest sites on the Register of the National Estate. As can be seen in Tables 7, 8, 9 and 10, registered areas cover almost 16 million

Table 6: Tenure of major native forest types

	Tenure area ('000 ha)					Australia	
Forest type	Private	Leasehold	Conserved	Other	Multiple	No data	('000 ha)
Eucalypt	33 178	50 681	14 961	13 940	10 728	974	124 463
tall	1 372	583	1 469	110	3 006	4	6 5 4 3
medium	28 640	35 121	9 232	10 178	7 391	888	91 450
low	988	12 056	658	787	139	72	14 700
mallee	2 174	2 920	3 602	2 864	193	11	11 764
unknown	5	(1)	0	(1)	(1)	0	6
Acacia	2 784	8 525	276	608	99	7	12 298
Melaleuca	949	2 560	424	86	45	29	4 093
Rainforest	1 017	414	812	220	1 093	26	3 583
Casuarina	81	919	39	6	6	(1)	1 052
Mangrove	422	118	231	146	1	126	1 045
Callitris	197	300	69	8	292	(1)	867
Other	3 390	2 586	770	582	1 086	22	8 435
Total	42 018	66 103	17 580	15 597	13 351	1 186	155 835

Note: Column or row total may not add up due to rounding.

⁽¹⁾ Area less than one thousand hectares. Source: National Forest Inventory (1997).

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Table 7: The area of native forest, by crown cover class, in World Heritage or National Estate listed places⁽¹⁾

		Area (mi	llion ha)
Crown cover category	Total forest area (million ha)	World Heritage area	National Estate
Closed forest	4.6	1.1	1.6
Open forest	39.2	1.1	6.1
Woodland	112.0	1.5	8.1
Total	155.8	3.7	15.8

⁽¹⁾ World Heritage areas and National Estate areas overlap. Source: National Forest Inventory (1997).

Table 8: The tenure of native forest in
World heritage or National
Estate listed places(1)

	% of total forested listed area			
Tenure class	World Heritage	National Estate		
Private	4	10		
Leasehold	7	8		
Conservation reserve	75	71		
Other	1	4		
Multiple-use	14	6		
Unknown	<1	<1		

Note: Column or row may not add up due to rounding.

⁽¹⁾ World Heritage areas and National Estate areas overlap.

Source: National Forest Inventory (1997).

Table 10: The proportion of each
forest type in World Heritage or
National Estate listed places⁽⁷⁾

Forest type	World Heritage area (%)	National Estate (%)
Eucalypt	2	10
tall	2	19
medium	<1	9
low	<1	2
mallee	0	20
unknown	0	0
Acacia	0	2
Melaleuca	2	13
Rainforest	28	38
Casuarina	4	7
Mangrove	7	21
Callitris	0	7
Other	3	12
All forest	2	10

⁽¹⁾ Expressed as a percentage of total area of each forest type. World Heritage areas and National Estate areas overlap. Source: National Forest Inventory (1997). Table 9: The proportion of eachcrown cover category of native forestoccurring in World Heritage orNational Estate listed places⁽¹⁾

Crown cover category	World Heritage area (%)	National Estate (%)
Closed	23	34
Open	3	15
Woodland	1	7
All native forest	2	10

⁽¹⁾ World Heritage areas and National Estate areas overlap.

Source: National Forest Inventory (1997).

hectares of forest, about 10 per cent of the total native forest estate. These are largely made up of 12 million hectares of eucalypt forest and 1 million hectares of rainforest. Map 5 (see colour section in back of book) shows the distribution of those forests occurring within places listed on the register.

The implications of listing

An entry in the register is public recognition of the importance of a place but does not give the Commonwealth or a State or Territory any right to acquire the place or the public any right to visit it if it is private property. Nevertheless, there may be practical consequences to listing. In Tasmania, for instance, a consequence of listing some forests on the Register of the National Estate was a reduction in the volume of wood produced from those forests.

		10		1	P	2		(1)	
	Total forest	% of	% of	% of	% of	% of	% of	% of	% of
Forest type	(ha)	forest type	category	forest type	category	forest type	category	forest type	category
Rainforests	3 582 535	0.05	0.16	0.01	0.06	21.70	6.61	0.06	1.38
Tall open eucalypt forests	5 475 108	0.61	2.86	3.38	22.19	21.14	9.84	0.61	20.07
Medium open eucalypt forests	22 655 994	0.27	5.21	0.64	17.49	11.96	23.05	0.27	36.50
Low open eucalypt forests	384 890	0.35	0.12	0.02	00.0	3.33	0.11	0.27	0 <u>.</u> 63
Tall eucalypt woodlands	1 067 985	0.00	00.0	00.00	00.0	3.15	0.29	00.00	00.00
Medium eucalypt woodlands	898 662 89	0.06	3.58	0.02	1.68	6.17	36.10	0.03	14.13
Low eucalypt woodlands	14 314 958	0.00	0.08	0.15	2.52	2.24	2.73	0 <u>.04</u>	3.04
Eucalypt mallee forests	11 763 798	8.25	83.26	3.80	53.66	9.75	9.75	0.21	14.84
Callitris forests	866 667	0.07	0.05	0.80	0.83	6.95	0.51	00.00	00.0
Acacia forests	12 298 104	0.06	0.58	00.00	0.03	1.37	1.43	0.04	3.25
Other forests	14 624 742	0.33	4.10	60.0	1.53	7.71	9.59	0.07	6.15
Total	155 834 648	0.75	100.00	0.53	100.00	7.55	100.00	0.11	100.00
		4		10	10	0		Total co	Iserved
	Total forest	% of	% of	% of	% of	% of	% of	% of	% of
Forest type	(ha)	forest type	category	forest type	category	forest type	category	forest type	category
Rainforest	3 582 535	0.36	0.43	0.17	0.23	0.11	06.0	22.47	4.02
Tall open eucalypt forests	5 475 108	0.28	0.50	0.12	0.26	0.36	4.55	26.50	7.24
Medium open eucalypt forests	22 655 994	1.05	7.83	0.24	2.03	0.36	18.65	14.79	16.71
Low open eucalypt forests	384 890	0.39	0.05	00.00	00.0	0.01	00 [.] 0	4.37	0.08
Tall eucalypt woodlands	1 067 985	0.00	00.0	00.00	00.0	00.00	00 [.] 0	3.15	0.17
Medium eucalypt woodlands	68 799 868	1.90	42.83	3.47	90.40	0.24	38.35	11.89	40.81
Low eucalypt woodlands	14 314 958	1.96	9.22	0.19	1.02	0.08	2.70	4.66	3.33
Eucalypt mallee	11 763 798	7.73	29.82	0.42	1.89	0.86	23.16	31.02	18.20
Callitris forests	866 667	0.11	0.03	00.00	00.0	0.02	0.04	7.95	0.34
Acacia forests	12 298 104	0.71	2.88	0.10	0.49	<u>60.0</u>	2.65	2.38	1.46
Other forests	14 624 742	1.34	6.41	0.66	3.68	0.27	8.99	10.46	7.63
Total	155 834 648	1.96	100.00	1.69	100.00	0.28	100.00	12.87	100.00
Notes: IUCN classes are as follows: 1a – Strict nature reserve: prot 1b – Wilderness area: protecte 2 – National park: protected a 3 – Natural monument: protec 4 – Habitat/species managem 5 – Protected landscape/season 6 – Managed resource protected	tected area managed main tected area managed mainly fo urea managed mainly for e ted area managed mainly edted area mana tape: protected area ma ted area: protected area ma	If for science. or wildemess protectio cosystem protection a for conservation of s nanaged mainly for lands co seed mainly for fands co anaeed mainly for the	on. Ind recreation. Secific natural feat nservation through the seascape conse sustainable use of	ures. maragement interv evation and recreati instural ecosstems.	ention.				
Sources: National Forest Inventory (1: Environment Australia	(266)								

Listing on the Register of the National Estate imposes no legal obligations on private individuals or bodies, or on local, State or Territory governments. Commonwealth ministers are required, under Section 30 of the Australian Heritage Commission Act, to refrain from taking action that adversely affects a site on the register unless there is 'no feasible and prudent alternative' and the Australian Heritage Commission has been given the opportunity to comment.

Classification of protected areas

The International Union for the Conservation of Nature and Natural Resources (IUCN) has developed a simplified classification system for protected areas to provide a basis for international comparison. There are six classes that are distinguished by the degree of protection afforded to the site. They offer a standardised way of grouping conservation reserves in Australia (of which there are more than 40 types). The six classes are:

- strict protection (1a nature reserve; 1b wilderness area – protected areas managed either mainly for science or wilderness protection);
- 2. managed for ecosystem protection and recreation (for example, national parks);
- managed for conservation of specific natural features (for example, natural monuments);
- managed actively for conservation of habitat or species;
- 5. managed for conservation of landscape/seascape; and
- managed mainly for the sustainable use of natural ecosystems (managed resource protected area).

Within Australia there are divergent views about what land should be included in Class 6. At issue is whether multiple-use forest that is reserved under legislation to protect and maintain forests for harvesting and conservation should be included in this class. The total area reported for multiple-use forests designated by States as falling within Class 6 is 3.6 million hectares.

Table 12: Extent of native forest in conservationreserves and in other classification systemswith conservation value using a broadapplication of IUCN Class 6⁽¹⁾

Tenure	Area (ha)
Conservation reserve	17 580 191
Other crown land	2 595 146
Multiple-use forest ⁽²⁾	3 605 100
Total	23 780 437
Total	23 780 437

(1) 'Conservation reserve' and 'Other crown land' categories show areas in IUCN Classes 1–6. Multiple-use forest category shows the area placed in Class 6 by some agencies.

⁽²⁾ No data available for the ACT, NT, Qld or SA.

Source: National Forest Inventory (1997).

Table 11 shows forest area by forest type against the six standard IUCN classes using a narrow definition of Class 6, and Table 12 provides information for a wider application of Class 6. Map 6 (see colour section in back of book) shows the location of forests classified as falling within any of the six (narrowly defined) IUCN conservation reserve classes.

Size, distribution and tenure by forest type

Eucalypt forest

Eucalypts dominate 124 million hectares of open forest, woodland and mallee and share the canopy with other species in a further 10 million hectares. According to the classification by Specht and his co-authors, eucalypts are the most dominant species in 270 forest communities in Australia (these constitute the eucalypt forest type described here) and occur as co-dominants in a further 15 forest communities. Table 13 lists 101 common forest-dominant eucalypt species and the regions in which they occur naturally.

Table 13: 101 common forest-dominant eucalypt species

Species	Common name	Range
E. accedens	Powderbark wandoo	Sw WA
E. acmenoides	White mahogany, yellow stringybark (parts of Qld)	Nth coast NSW, coastal Qld
E. agglomerata	(Blue-leaved) stringybark	Coastal NSW & ne Vic
E. alba	White gum, poplar gum	Nth WA, NT, east coast Nth Qld
E. albens	White box	Vic, NSW, sth Qld, SA
E. andrewsii	New England blackbutt	Ne NSW & se Qld, isolated occurrences in Qld
E. argophloia	(Queensland western) white gum, lapunya, scrub gum	Sth Qld
E. astringens	Brown mallet	Sw WA
E. baileyana	Bailey's stringybark	Nth NSW & se Qld
E. baxteri	Brown stringybark	SA, NSW & Vic
E. blakelyi	Blakely's red gum	East NSW, ACT, nth & se Vic
E. bosistoana	Coast grey box, Gippsland grey box (Vic)	Coastal east Vic & sth NSW
E. botryoides	Southern mahogany, Bangalay	Coastal se Vic to central NSW coast.
E. brevifolia	Northern white gum	WA, NT
E brevistylis	Rates tingle	Southern sw WA
E. calophylla = Corymbia calophylla	Marri, red gum	WA
E. camaldulensis	River red gum, red gum, Murray red gum, river gum (WA)	WA, NSW, NT, Qld, Vic, ACT, SA
E. citriodora = Corymbia citriodora	Lemon-scented (iron) gum, spotted gum	East Qld
E. cladocalyx	Sugar gum	Sth SA
E. coccifera	Tasmanian snow gum	Tas
E. consideniana	Yerchuk	East Vic, se NSW
E. crebra	Narrow-leaved (red) ironbark, ironbark	NSW, Qld
E. cypellocarpa	(Spotted) mountain (grey) gum, monkey gum	Vic, east NSW
E. dalrympleana	Mountain gum, white gum, broad-leaved ribbon gum	Sth Qld, se & ne NSW, parts of Vic & Tas
E dealbata	Tumbledown red gum	East NSW to se Qld
E. deanei	Round-leaved gum, mountain blue gum, Deane's gum	East central NSW, nth NSW, sth Qld
E. decorticans	Gum-top ironbark	Se Qld
E. delegatensis	Alpine ash (Vic, NSW), woollybutt (Vic), gum-topped stringybark (Tas), white-top (Tas), blue leaf (Tas)	Vic. NSW. ACT. Tas
E. diversicolor	Karri	Sw WA
E. dives	(Broad-leaved) peppermint, blue peppermint (Vic)	East NSW, central & south Vic
E. drepanophylla	Queensland grey ironbark	Qld
E. dundasii	Dundas blackbutt	Sth WA
E. dunnii	Dunn's white gum, white gum	Ne NSW, se Old
E. elata	River peppermint, river white gum	Se NSW, east Vic
E. fastigata	Brown barrel, cut-tail	East NSW into ne Vic
E. fibrosa	(Broad-leaved) (red) ironbark, blue-leaved ironbark	Sth coast NSW to mid-coast Old
E. ficifolia = Corymbia ficifolia	Red flowering gum	WA

Table 13 (continued): 101 common forest-dominant eucalypt species

Species	Common name	Range
E. globoidea	White stringybark	Central & south NSW coast & east Vic
E. globulus	Tasmanian blue gum, (southern) blue gum	East coast of Tas, sth coast Vic
E. gomphocephala	Tuart	Sw WA
E. grandis	Flooded gum (NSW), rose gum (Qld)	Coastal NSW & Qld
E. guilfoylei	Yellow tingle	Southern sw WA
E. gummifera =		
Corymbia gummifera	Red bloodwood	Ne coastal Vic, NSW coast, Sth Qld
E. intermedia = Corymbia intermedia	Pink/red bloodwood	Nth Coast NSW, coastal Old
E. jacksonii	Red tingle, red tingle tingle	Southern sw WA
E. jensenii	Wandii ironbark	WA, NT
E. laevopinea	Silvertop, stringybark	East NSW to south Qld
E. largiflorens	Black box	NSW, south Qld, east SA & Vic
E. leptophleba	Molloy red box	Nth Qld
E. leucoxylon	Yellow gum (Vic), South Australian blue gum (SA), water gum (Eyre Peninsula, SA), white ironbark	Central west Vic, se SA, sth NSW
E. macrocarpa	Mottlecah	WA
E. macrorhyncha	Red stringybark	Vic, NSW, isolated patch in se SA
E. maculata = Corymbia maculata	Spotted gum	Coastal NSW, isolated in Vic
E. mannifera	Brittle gum	Central & sth NSW, east Vic
E. marginata	Jarrah	Sw WA
E. melanophloia	Silver-leaved ironbark	Inland NSW & Qld, coastal sth & central Qld
E. melliodora	Yellow box, honey box (Qld), yellow ironbark (Qld)	Vic, NSW, se Qld
E. microcarpa	Grey box, narrow-leaved box, inland grey box	Vic, NSW & Qld wheatbelt area
E. microcorys	Tallowwood	Coastal nth NSW & se Qld
E. miniata	Darwin woollybutt, woollybutt	Nth WA, NT & Qld
E. moluccana	Grey box, gum-topped box (Qld)	Central & nth coastal NSW, east Qld
E. muelleriana	Yellow stringybark	Se NSW & coastal east Vic
E. nitens	Shining gum, silvertop (NSW)	Scattered distribution in NSW & Vic
E. nitida	Smithton peppermint, peppermint (Tas)	Tas, sth Vic, se SA
E. obliqua	Messmate stringybark, messmate, stringybark	Vic, Tas, east NSW just into Qld, se SA
E. oreades	Blue mountains ash, smooth-barked mountain ash, white ash	East NSW & se Qld
E. ovata	Swamp gum, black gum (southern Tas), white gum	Tas, sth SA, sth Vic, se NSW
E. paniculata	Grey ironbark	Coastal NSW
E. pauciflora	Snow gum, cabbage gum (Tas), weeping gum (Tas), white salee (Australian standard name for the timber)	Mountainous & tableland areas of NSW, Vic, Tas & se Qld, some coastal areas of SA, NSW & Tas
E. phoenicea	Scarlet gum, Ngainggar	Nth NT, WA, ne Qld
E. pilularis	Blackbutt	Coastal NSW, se Qld coast
E. polyanthemos	Red box	Vic & NSW
E. polycarpa = Corymbia polycarpa	Long-fruited bloodwood	Nth NSW, Qld, nth NT, nth WA

Table 13 (continued): 101 common forest-dominant eucalypt species

Species	Common name	Range
E. populnea	Poplar box, bimble box	Qld, NSW
E. propinqua	Grey gum, small-fruited grey gum	Coastal nth NSW & sth Qld
E. pulchella	White peppermint	Tas
E. punctata	Grey gum	East NSW, se Qld
E. radiata	Narrow-leaved peppermint, peppermint	East Vic & NSW
E. regnans	Mountain ash, swamp gum (Tas), stringy gum (Nth Tas)	Vic & Tas
E. resinifera	Red mahogany	East NSW, se Qld, ne Qld (coastal)
E. robusta	Swamp mahogany, swamp messmate (Qld)	Sth coast of Qld to sth coast of NSW
E. rossii	Scribbly gum, snappy gum, white gum	Inland east NSW
E. rubida	Candlebark, ribbon gum, white gum	Inland east NSW, Vic, east Tas, isolated in sth SA
E. saligna	Sydney blue gum, blue gum	Coastal NSW & sth Qld, few isolated in central coastal Qld
E. salmonophloia	Salmon gum	Sth WA
E. sideroxylon	Red ironbark, mugga, mugga ironbark	Nth Vic, NSW, se Qld
E. sieberi	Silvertop ash, coastash (NSW, Vic), ironbark (Tas), silvertop, black ash (NSW)	East Vic, sth coast NSW, ne Tas
E. similis	Yellow jacket	Qld
E. smithii	Gully gum, gully peppermint (NSW), blackbutt peppermint (NSW)	East Vic, coastal sth NSW
E. staigeriana	Lemon-scented ironbark	Nth Qld
E. stellulata	Black sally	East NSW, east Vic
E. tereticornis	Forest red gum, blue gum (Qld), red iron gum (Qld)	Coastal se Vic, NSW & Qld
E. terminalis = Corymbia terminalis	Desert bloodwood	Nth WA, NT, Qld & nth NSW & SA
E. tessellaris = Corymbia tessellaris	Carbeen, Moreton Bay ash	East & nth Qld, ne NSW
E. tetrodonta	Darwin stringybark, stringybark (NT & WA), messmate (Nth Old & WA)	Nth WA, NT & Qld
E. torelliana = Corymbia torelliana	Cadaga, Cadaghi	East coast nth Qld
E. torquata	Coral gum	Sth WA
E. viminalis	Manna gum, ribbon gum (NSW), white gum (NSW & Tas)	Tas, Vic, se SA, east NSW, se Qld
E. viminalis subsp. cygnetensis	Boomsma (formerly E. huberana)	Parts of SA & sw Vic
E. wandoo	Wandoo	Sw WA
E. woodwardii	Lemon-flowered mallee	Sth WA

Source: Bureau of Resource Sciences, unpublished data (1997).

Box 1: The genus Eucalyptus

The genus *Eucalyptus* was named in 1788 by Charles-Louis L'Heritier de Brutelle, a Frenchman living in London, who named a specimen collected in 1777 as *Eucalyptus obliqua* (messmate stringybark). Since then over 700 eucalypt species have been recognised, most of which are trees and only four of which are not endemic to Australia.

Three closely related genera exhibit *Eucalyptus*like qualities: *Eucalyptus, Corymbia* and *Angophora.* The genus *Corymbia* has been identified recently by taxonomists; it includes a number of species, broadly known as the bloodwoods, which were previously classified as *Eucalyptus* species. Most State agencies accept this division of the eucalypts into three distinct genera. The Department of Conservation and Land Management in Western Australia uses the alternative classification, which does not recognise *Corymbia*. In this report, 'eucalypt forest' encompasses the genera *Eucalyptus* and *Corymbia* (communities dominated by *Angophora* species fall into the 'other forest' type).

Some groups of eucalypt species are characterised by their bark and their common names derive from this attribute – gum (smooth bark), box (bark fragmented into small patches), stringybark (bark fissured into long strips), ironbark (similar to stringybark but very hard) and minniritchi (raised hairy appearance). Bloodwoods are named for the presence of red kino in veins or pockets in the timber. Some names derive from the similarity of the timber to overseas timbers (ash, mahogany and oak), from leaf colour (blue gum) or the oils in the leaves (peppermints, lemon-scented gum).

Distribution

Some eucalypts have highly specific environmental conditions that control their distribution, while others are less sensitive and occur over a wide range of environmental gradients. Many of the widely distributed species may also occur in different forms, depending on the environment. An example of this is *E. microcarpa* (known as grey box in Victoria, narrow-leaved box in New South Wales and inland grey box in Queensland), which occurs as a tree of medium height in the core of its range and as a multi-stemmed mallee in harsher environments. Figure 4 shows the broad distribution of eucalypt forests across the continent. To briefly describe the distribution of Australia's more common eucalypt forests in this report, they have been divided into three height groups – tall, medium and low. Mallees, which occur as both medium and low forests, are considered separately. The data referred to below are contained in Table 1; Map 7 (see colour section in back of book) shows the distribution of eucalypt forest by structure.



Figure 4: Thumbprint of regions in which eucalypt forests occur

Tall eucalypt forests

Tall eucalypt forests are those that exceed 30 metres in height. There are 6.5 million hectares of these forests, constituting 4 per cent of the total native forest estate. Most of them occur in Victoria, New South Wales, Queensland and Tasmania, although there are small areas in all other States and Territories except the Northern Territory.

These forests are often referred to as wet sclerophyll forests: 'wet' reflecting the moist, lush understorey vegetation that generally occurs in them, 'sclerophyll' from the botanical term for the tough leaves characteristic of eucalypts. In some areas the understorey contains conspicuous tree ferns, or palms in the tropics and sub-tropics. The best examples of these forests are the *E. diversicolor* (karri) forests of south-western Australia and the *E. regnans* (mountain ash or swamp gum) forests of Victoria and Tasmania. Specimens of *E.* *regnans* have been known to reach heights in excess of 100 metres, making them the tallest flowering plants in the world.

A distinctive characteristic of many tall eucalypt forests is the predominantly even age of the canopy trees. This may be due to the suppression of new growth by the mature trees, to wildfires that in moist forests tend to be less frequent but occasionally are severe enough to wipe out the mature stand and stimulate regrowth of an even age, or a combination of the two. In the prolonged absence of fire, some understorey plants in the tall eucalypt forests may live as long as the eucalypts or longer.

The crown cover densities of tall eucalypt forests are predominantly classified as open forest or woodland (Table 2). Those classified as woodland often occur in relict stands that are in transition to rainforest. In such forests, widely spaced individual eucalypt trees emerge above the lower rainforest canopy, and are called emergents. There is debate as to whether such forest should be classified as eucalypt with rainforest understorey or rainforest with eucalypt emergents, or as dynamic ecotones between the eucalypt forest and rainforest. In Tasmania, for instance, such forests are often called 'mixed forests', unless eucalypts make up less than 5 per cent of the crown cover, in which case they are called rainforests.

Apart from the transitional forests just mentioned, there are three principal forms of tall eucalypt forest, all characterised by the understorey:

- the *E. diversicolor* forests of Western Australia, with their understorey of sclerophyllous shrubs and small trees;
- the temperate east coast forests, where the understorey is often taller than 10 metres and may include tree ferns; and
- the warmer northern tall forests, where the understorey consists of palms, vines and small trees.

Medium height eucalypt forests

Medium height eucalypt forests are those ranging between 11 metres and 30 metres in height. There are 91 million hectares of such forests, excluding mallee, amounting to more than half (58 per cent) of the country's total native forest cover. These forests constitute 81 per cent of all non-mallee eucalypt forests and occur in every State and Territory, although most are in the Northern Territory, Queensland and Western Australia, which each have 20 million hectares or more. New South Wales has comparatively less and the Australian Capital Territory, South Australia, Tasmania and Victoria collectively have just over 5 million hectares.

The boundary between open forest and woodland is sometimes difficult to distinguish and these forests often share the same overstorey species. About three-quarters of the medium height eucalypt forests are woodland: in some cases, such as in the E. melliodora (yellow box) woodlands, this may be due to partial clearing. They constitute close to half of Australia's total native forest cover, contain about 80 per cent of all eucalypt species, and occur in a variety of forms in transitional zones between humid and arid regions. They can be divided into three subgroups, depending on their understorey:

- Medium height eucalypt woodlands with tall understorey extend across northern Australia and occur inland in the east and south-east of the continent. Depending on whether the forests are in the northern or temperate regions, the understorey includes palms and cycads or sclerophyllous shrubs such as banksias, acacias and casuarinas. In the temperate regions, the natural distribution of these woodlands coincides with the core of Australia's agricultural regions: as a consequence, most exist as remnant patches in an agricultural landscape. In southern Queensland, central New South Wales and northern Victoria, such woodlands occur in dry areas (400-600 millimetres of annual rainfall). They are often referred to as box and ironbark woodlands and contain species such as Corymbia polycarpa (bloodwood), E. populnea (poplar box), E. crebra (narrowleaf iron bark), E. melanophloia (silver-leaf ironbark), E. microcarpa (grey box) and, in Western Australia, E. gomphocephala (tuart).
- Medium height eucalypt woodlands with low understorey occur in the wheatbelt of Western Australia, where the E. marginata (jarrah) forest gives way to E. wandoo (wandoo) and E. salmonophloia (salmon gum) woodlands. This latter species may grow up to 30 metres in height in areas that receive little more than 200-300 millimetres of rainfall annually. Another example of this category of forests occurs on the eastern side of the continent, where E. largiflorens (black box) often dominates the areas bordering the floodplains of the Murray-Darling Basin. Box and ironbark woodlands similar to those referred to as 'medium height woodlands with tall understorey' also occur with a low understorey. Medium height eucalypt woodlands with low understoreys often have a succulent understorey of Chenopodiaceae (bluebush, saltbush), in addition to sclerophyllous shrubs.
- Medium height eucalypt woodlands with grassy understorey such as the *E. albens* (white box) and *E. melliodora* woodlands are found on the fertile western slopes of Queensland, New South Wales and Victoria. They also occur as stands

dominated by *E. similis* (yellow jacket), *E. brevifolia* (northern white gum) and *E. jensenii* (wandi ironbark) in low rainfall, relatively infertile regions of northern Australia, with hummock grasses such as *Triodia mitchellii* in the understorey. Communities of this type only reach heights greater than 10 metres under favourable conditions.

About one-quarter of the medium height forests are classed as open forest. Like their woodland counterparts, these forests occur in three types, depending on the height and nature of the understorey:

- Medium height open eucalypt forests with a tall sclerophyllous understorey occur where annual rainfall is 600-1000 millimetres, often adjacent to taller forests but on less fertile soils. Some of the more dominant species in the temperate zone include C. maculata (spotted gum) and C. gummifera (bloodwood) in Queensland and eastern New South Wales, E. radiata (narrowleaved peppermint) and E. sieberi (silvertop ash) in southern New South Wales and Victoria, E. viminalis (manna gum) and E. obliqua (browntop or messmate stringybark) in Tasmania, Victoria and New South Wales, and C. calophylla (marri) and E. marginata in Western Australia. About 100 000 hectares of these forests also occur in South Australia, where they are dominated by species such as E. viminalis, E. baxteri (brown stringybark), E. obliqua and E. camaldulensis (river red gum). In the tropics of north Queensland and the Northern Territory, such forests are dominated by E. tetrodonta (Darwin stringybark or messmate) and E. miniata (Darwin woollybutt), with understoreys of Livistona (palms) and Cycas (cycads), along with dense grasses.
- *Medium height open eucalypt forests with a low understorey* (often called dry sclerophyll to differentiate them from wetter, taller forests) usually occur in areas receiving less than 600 millimetres of rain a year or on very infertile soils in wetter regions. These forests are widespread throughout temperate South Australia, Victoria, New South Wales and south-eastern Queensland. Common species include

C. intermedia (pink bloodwood) in southeastern Queensland, *E. crebra* and *C. gummifera* in northern New South Wales, *E. macrorhyncha* (red stringybark) and *E. mannifera* (brittle gum) in southern New South Wales and Victoria, and *E. baxteri* and *E. leucoxylon* (South Australian blue gum or yellow gum) in South Australia and Victoria. Small areas of this type of forest dominated by *E. tetrodonta* also occur in the tropics.

Medium height open eucalypt forests with a grassy understorey occur predominantly in north-east New South Wales and eastern Queensland, where the dominant species include E. tereticornis (forest red gum), C. intermedia and E. drepanophylla (Queensland grey ironbark). Patches occur in Tasmania, where E. delegatensis (alpine ash) often occurs with a grassy understorey, and in tropical Australia, where large areas of E. tetrodonta and E. miniata forests have an understorey consisting of grasses like annual sorghum. Medium height open forests also occur on the flood plains of the Murray River in New South Wales and Victoria, where E. camaldulensis forms large stands.

Low height eucalypt forests

About 15 million hectares, or 9 per cent, of total native forest cover is non-mallee eucalypt open forest and woodland less than 10 metres tall. Most of these forests occur in semi-arid regions in association with Acacia species. Generally they contain a range of eucalypt species similar to that in adjacent medium height forests: species include *E. baxteri* in South Australia, *E. populnea* and *E. largiflorens* in western New South Wales, *E. populnea* in southern Queensland, and *E. tetrodonta, E. miniata, E. alba* (white or poplar gum) and *E. brevifolia* in northern Queensland, the Northern Territory and the Kimberley region of Western Australia.

Low eucalypt forests also occur in the subalpine regions of New South Wales, Tasmania and Victoria. The best known of these are the snow-gum forests of Tasmania's sub-alpine areas (*E. coccifera*) and the Snowy Mountains of south-east Australia (*E. pauciflora*).

Box 2: Large river red gum

One of the largest specimens of *E. camaldulensis* (river red gum) known is on private property in the Mount Gambier area of South Australia. The tree is estimated to be at least 800 years old, is about 50 metres high and has a circumference of 11.6 metres at 1.3 metres above the ground.

Mallee forest

Mallee trees are low-growing eucalypts distinguished from non-mallee eucalypts by the occurrence of multiple stems arising at ground level from a large, bulbous woody structure called a lignotuber or 'mallee root'. Over 100 species of eucalypt have a mallee form. Not all are forest; non-forest mallee vegetation is not included in this report.

Mallee forests are generally 2–10 metres tall but can reach 18 metres. Maps compiled for this report establish that about 12 million hectares or almost 8 per cent of Australia's native forests are mallee. These forests occur across the south of the continent, primarily in regions with 250–400 millimetres of annual rainfall. In more arid areas mallee forest is usually replaced by acacias and at the upper rainfall limit by single-stemmed forms, sometimes of the same species. Map 7 shows the distribution of mallee forest across the continent. Western Australia has 42 per cent of Australia's mallee forests (Table 1). A further 34 per cent are found in southern South Australia and the remainder occur in south-west New South Wales and north-west Victoria. Although Table 1 shows no mallee forests in the Northern Territory, Queensland and Tasmania, malleeform tree eucalypts are known from each: current records do not show whether they form open forest or woodland. In other areas, such as parts of the high sub-alpine E. pauciflora forests, the trees are, in fact, mallee form, but are not mapped as such.

Tenure

The 124 million hectares of eucalypt forest in Australia are divided by tenure (Table 14) as follows:

- multiple-use forests: 9 per cent;
- conservation reserves: 12 per cent;
- 'other' crown land: 11 per cent;
- leasehold land: 41 per cent;
- private: 27 per cent.

Tenure varies significantly from State to State and Territory to Territory. In Victoria, for example, 48 per cent of eucalypt forests are multiple-use, 38 per cent are designated as conservation reserves, and 12 per cent are privately owned. This contrasts with Queensland, where about 6 per cent are multiple-use forests, 4 per cent are within conservation reserves, 55 per cent are

		Tenure area ('000 ha)								
State/ Territory	Private	Lease- hold	Conservation reserve	Other	Multiple -use	Un- resolved	Total			
ACT	7	13	93	2	5	0	120			
NSW	7 714	4 039	2 824	564	2 776	12	17 929			
NT	10 037	17 525	2 483	241	0	852	31 138			
Qld	10 315	17 590	1 393	644	2 029	12	31 984			
SA	2 271	1 279	1 222	11	27	11	4 820			
Tas	779	0	306	135	1 016	(1)	2 237			
Vic	825	0	2 577	148	3 279	18	6 845			
WA	1 231	10 236	4 063	12 195	1 597	69	29 390			
Australia	33 178	50 681	14 961	13 940	10 728	974	124 463			

Table 14: Tenure of eucalypt forests, by State and Territory

Note: Column or row total may not add up due to rounding.

⁽¹⁾ Area less than 1000 ha.

designated leasehold and 32 per cent are privately owned. There are also significant variations in the ownership and level of conservation of different eucalypt forest types (Table 5).

Acacia forest

Acacias occur on all continents except Antarctica, predominantly in tropical and warm temperate regions. Worldwide, there are more than 1200 species. In Australia, they are almost as important as eucalypts in creating the character of the landscape, forming the second most extensive forest type. As with eucalypts, acacias occur as open forests and woodlands. According to the classification by Specht and his co-authors, acacias are the most dominant species in 36 Australian forest communities (these constitute the acacia forest type described here) and are co-dominants in a further 11 communities.

There are 12 million hectares of acacia forests in Australia (8 per cent of the total native forest area) and a further 9 million hectares (6 per cent of the total native forest area) in which *Acacia* species occur in the canopy but are not the dominant species. Fifty-four *Acacia* species are known to occur as dominant or sub-dominant forest canopy species.

Acacia forests may occur in pure stands dominated by a single canopy species – the *Acacia harpophylla* (brigalow) forests of western Queensland are an example of this – or stands in which the canopy is shared by eucalypts, casuarinas or other acacias. *A. shirleyii* (lancewood), for example, may occur as a single species forest or in association with eucalypts.

Other extensive acacia forests are *A. cambagei* (gidgee), *A. aneura* (mulga), *A. pendula* (myall) and *A. papyrocarpa* (western myall). The tallest forest-forming acacia, *A. melanoxylon* (blackwood), can grow to more than 30 metres in height.

Some *Acacia* species may occur as either trees or shrubs, depending on the site. For instance, *A. aneura* is a medium-sized, forest-forming tree on favourable sites; such occurrences are therefore included in the forest inventory. In arid areas where it is a low-growing shrub, it has been excluded.

Distribution

Acacia forests occur in all States and the Northern Territory (Table 15). In northern Australia, acacia forests are generally found in regions with less than 750 millimetres of rain a year and most occur in areas with less than 500 millimetres a year. In the wetter end of their range they form medium-to-tall open forests; as aridity increases, the density of trees and their height decrease and they form low woodlands. Figure 5 shows the regions of the continent in which acacia forests are found.

Both *A. shirleyii* and *A. harpophylla* forests occur in regions with 500–700 millimetres of annual rainfall, the former on sandstone soils, the latter on clay soil plains.

Lancewood is the most widespread of the northern acacia forests; the largest occurrence is in the central north of the Northern Territory. *A. shirleyii* forms low woodland in the drier parts of its range. As available water increases, it forms tall, open forest.

A. harpophylla forests are found mainly from northern Queensland through to northern New South Wales, the species growing as tall as 20 metres, depending on rainfall and other site conditions. These forests have largely been cleared in recent years to make way for agriculture.

In either woodland or open forest form, *A. pendula* and *A. aneura* forests are found from southern Queensland through New South Wales to South Australia; *A. aneura* forests continue westwards into Western Australia. These forests occur in regions generally receiving 350–500 millimetres of rain per year.

Tenure

Table 15 shows tenure for acacia forests across all States and Territories. Nationally, less than 1 per cent are found within multiple-use forests, about 2 per cent fall within conservation reserves, 5 per cent are on other crown land, 69 per cent are on leasehold land, and 23 per cent are privately owned. There is a similar division by tenure at the State and Territory level: most occur on private and leasehold land, although about 85 per cent of the tall, dense, *A. melanoxylon*-dominated forests of Victoria and Tasmania have a multiple-use tenure and 5 per cent are in conservation reserves.



Figure 5: Thumbprint of regions in which acacia forests occur

			Tenure a	rea ('000	ha)		
State/ Territory	Private	Lease- hold	Conservation reserve	Other	Multiple -use	Un- resolved	Total
ACT	0	0	0	0	0	0	0
NSW	27	897	4	4	11	(1)	944
NT	313	2 108	2	10	0	6	2 439
Qld	2 269	2 103	118	46	66	(1)	4 603
SA	6	296	5	(1)	0	0	307
Tas	3	0	0	0	0	0	3
Vic	4	0	2	(1)	10	(1)	17
WA	162	3 120	144	547	12	0	3 986
Australia	2 784	8 525	276	608	99	7	12 298

Note: Column or row total may not add up due to rounding. ⁽¹⁾ Area less than 1000 ha. Source: National Forest Inventory (1997).

Box 3: More on the acacias

Acacias are commonly referred to as wattles, a term coined by early settlers who recognised the similarity between the acacia twigs and branches and the materials used in England for wattle-anddaub construction of ancient buildings and roofs. In England, these materials were cut from coppiced stands of oak, chestnut or hazel.

Acacias are so widespread and some flower so spectacularly that one species, A. pycnantha (golden wattle), is the national floral emblem, forming part of the Australian coat of arms. Wattles are common to both natural landscapes and urban gardens, and some Australians celebrate national wattle day.

Melaleuca forest

The genus Melaleuca is predominantly Australian, although some species occur in Indonesia, Malaysia, New Caledonia, New Guinea and the Pacific Islands. In Australia, Specht and his co-authors identified 51 Melaleuca plant communities. Of these, 15 form forests in which Melaleuca species are considered the most dominant canopy species;

these constitute the melaleuca forests described below. The most extensive melaleuca forests are dominated by M. dealbata (blue-leaved paperbark), M. leucadendra (long-leaved paperbark), M. minutifolia and M. viridiflora (broad-leaved paperbark).

Distribution

To date, more than 4 million hectares of melaleuca forests have been mapped. About 90 per cent of these (more than 3.7 million hectares) occur in the Northern Territory and northern Queensland (Table 16). Melaleucas occur as a sub-dominant canopy species in a further 3.7 million hectares of forest.

Melaleuca forests occur on a wide range of sites throughout non-arid Australia. Generally, these are damp or wet sites such as coastal or sub-coastal areas that dry out seasonally. Often these forests are narrow strips of dense pure stands, tens of metres wide, along streams and swamps. About 75 per cent of the melaleuca forests in northern Australia are large tracts of low woodland spread across estuarine plains and seasonal swamps. Figure 6 shows the regions of the continent in which this forest type is found.

Tenure

Nationally, over 85 per cent of melaleuca forests occur on leasehold or private land, which are generally used for cattle production (Table 16), and about 10 per cent are located in conservation reserves.

		Tenure area ('000 ha)								
State/ Territory	Private	Lease- hold	Conservation reserve	Other	Multiple -use	Un- resolved	Total			
ACT	0	0	0	0	0	0	0			
NSW	91	0	79	22	8	2	202			
NT	382	543	115	6	0	27	1 072			
Qld	470	1 916	211	11	35	(1)	2 643			
SA	2	(1)	(1)	0	0	0	2			
Tas	0	0	0	0	0	0	0			
Vic	3	0	12	(1)	2	(1)	18			
WA	(1)	102	6	47	0	0	155			
Australia	949	2 560	424	86	45	29	4 093			

Table 16: Tenure of melaleuca forests, by State and Territory

⁽¹⁾ Area less than 1000 ha.



Figure 6: Thumbprint of regions in which melaleuca forests occur

Box 4: Melaleuca – the paperbark

The common name for a number of *Melaleuca* species is paperbark, an apt description of the papery bark consisting of thin layers of cork. The leaves of a few *Melaleuca* species supply the raw material for an expanding tea tree oil industry: tea tree oil is used as an antimicrobial antiseptic oil or formulated into creams, shampoos, soaps, mouthwashes and toothpastes.

Rainforest

Specht and his co-authors identified 104 rainforest communities (including what they call vine forest and vine thicket). In this report, Australian rainforests have been divided into three types: cool temperate, warm temperate and tropical, defined more by geography than by botanical association. Thus, tropical rainforest is defined here as all rainforest occurring north of the Tropic of Capricorn: the data presented may therefore include rainforest elements, particularly those at altitude in the Great Dividing Range, that may fit a botanical definition of warm temperate rainforest. Cool temperate rainforest is made up of all rainforests in Tasmania plus those in New South Wales and Victoria dominated by Nothofagus species, and the remainder is designated as warm temperate.

Box 5: More on rainforests

Rainforests are highly valued for the richness of their biodiversity, the aesthetics of their structure and their finequality timbers. About half of the north-east Queensland tropical rainforests had been logged or cleared for agriculture by the 1980s, when most were listed as World Heritage sites. While the declaration of World Heritage status did not change the tenure of these forests, those within the multiple-use tenure category (about 495 000 hectares) were progressively excluded from logging. Rainforests in the World Heritage listed areas owned privately are not bound by the 'no-logging' policy.

Currently, tourism is the main economic use of tropical rainforests. The Wet Tropics Management Authority estimated that the whole of the wet tropical rainforests of northeast Queensland earned \$750 million for the region in 1997.

The tropical rainforests of north-east Queensland contain highly diverse flora, constituting a genetic resource for plantation trees and ornamental plants. Some species – *Castanospermum australe* (blackbean), for example – are potentially important sources of pharmaceuticals. Indigenous peoples have put tropical rainforest plants to a variety of uses, including food and medicines, ornamentation, string and wooden implements.

Logging of cool temperate rainforests in Tasmania has been limited for reasons such as inaccessibility, generally low sawlog yields, and formal and informal reservation for conservation purposes. About 6 per cent is designated for selective harvesting within Special Timbers Management Units, on cycles of up to 200 years, for small quantities of speciality timbers. Following an assessment process, some areas of rainforest on private land in north-west Tasmania are currently being converted to eucalypt plantations.

Tourism is an important industry in some Tasmanian rainforests, such as those in the vicinity of the Gordon River. Another economically important use of cool temperate rainforests in Tasmania is the production of honey from the blossom of leatherwood trees. More than 500 tonnes of *Eucryphia lucida* (leatherwood) honey can be produced in Tasmania in a good season.

Table 17: Tenure of rainforests, by State and Territory

		Tenure area ('000 ha)								
State/ Territory	Private	Lease- hold	Conservation reserve	n Other	Multiple -use	Un- resolved	Total			
ACT	0	0	0	0	0	0	0			
NSW	36	0	101	2	69	(1)	209			
NT	157	21	60	(1)	0	12	252			
Qld	807	392	459	68	827	13	2 567			
SA	0	0	0	0	0	0	0			
Tas	17	0	187	145	196	0	545			
Vic	0	0	2	(1)	(1)	0	3			
WA	(1)	(1)	2	4	0	(1)	7			
Australia	1 017	414	812	220	1 093	26	3 583			

Note: Column or row total may not add up due to rounding.

⁽¹⁾ Area less than 1000 ha.



Figure 7: Thumbprint of regions in which rainforests occur

These definitions are arbitrary. Comprehensive mapping of rainforest types has not been completed nationally, but broad estimates of the areas, based on the above definitions, can be given. Thus, there are 0.9 million hectares of tropical rainforest, 2.1 million hectares of warm temperate rainforest and 0.6 million hectares of cool temperate rainforest. In all, there are about 3.6 million hectares of rainforest in Australia, which is about 2 per cent of the forest estate.

Tropical rainforests

Tropical rainforests occur in many countries; collectively, these forests house an estimated 50 per cent or more of all species on earth. Australia's tropical rainforests constitute less than 1 per cent of the world's total area. Nevertheless, these forests are particularly significant because parts of them are the only remaining relicts of forest that once dominated Australia when areas of high rainfall were far more widespread than they are today. Regional differences in tropical rainforests result from differing rainfall patterns and amounts: areas that receive rain for most of the year have 'wet' rainforests, whereas those that get most of their rain during the monsoon season are classed as 'dry' or 'monsoonal' rainforests. The latter are commonly called vine thickets and scrubs.

Warm temperate rainforests

Warm temperate rainforests, sometimes called sub-tropical rainforests, display a high diversity of tree species, including *Ceratopetalum apetalum* (coachwood), *Schizomeria ovata* (crab apple) and Sloanea woollsii (yellow carabeen). Palms are often present, as are various climbing plants, epiphytes and ferns.

Cool temperate rainforests

Cool temperate rainforests are found only in Australia, New Zealand, southern South America and the north-east coasts of North America. Australia's cool temperate rainforests are often dominated by *Nothofagus cunninghamii* (myrtle), with conifers such as *Lagarostrobos franklinii* (huon pine), *Phyllocladus aspleniifolius* (celery top pine) and *Athrotaxis selaginoides* (King Billy pine) also forming part of the tree layer in Tasmania. In eastern Victoria, dominant canopy species include *Atherosperma moschatum* (southern sassafras) and *Elaeocarpus holopetalus* (mountain quandong). *Nothofagus gunnii* (deciduous beech) becomes important at high altitudes in Tasmania.

Distribution

Table 17 shows the distribution of rainforest in Australia by State and Territory, and Figure 7 shows the regions of the continent in which rainforest is found.

Tenure

The nature of the available data on rainforest distribution does not allow a breakdown by tenure category for the three rainforests types of tropical, warm temperate and cool temperate. Table 17 shows the tenure of all rainforest in Australia. About 28 per cent occurs on private land, 23 per cent in conservation reserves and 31 per cent as multiple-use forest.

Casuarina forest

Casuarinas are common in the Australian landscape, with approximately 60 species occurring throughout Australia. The family is collectively called casuarina or sheoak and includes the genera *Casuarina, Allocasuarina* and *Gymnostoma*; species of the family are also found in New Guinea, Indonesia, Malaysia and the Pacific Islands.

In Australia, Specht and his co-authors identified 13 casuarina plant communities. Of these, three form forests in which casuarina species are considered the dominant canopy species; these constitute the casuarina forests described below.

Distribution

Table 18 shows that there are about 1 million hectares of casuarina forests, mostly in New South Wales. Figure 8 shows the regions of the continent in which this forest type is found. A further 8 million hectares of forest contain casuarinas as a sub-dominant canopy species (three communities – these are not treated as casuarina forests in this report).

Nationally, forests of *C. cristata* (belah or black oak) have the widest distribution, ranging from southern Queensland through western New South Wales and north-west Victoria to

	Tenure area ('000 ha)								
State/ Territory	Private	Lease- hold	Conservation reserve	Other	Multiple -use	Un- resolved	Total		
ACT	0	0	0	0	0	0	0		
NSW	4	781	9	4	3	(1)	802		
NT	0	0	0	0	0	0	0		
QLD	56	(1)	0	1	3	0	62		
SA	20	114	13	0	0	0	147		
TAS	(1)	0	0	0	0	0	1		
VIC	(1)	0	(1)	0	0	0	0		
WA	(1)	23	16	(1)	(1)	0	40		
Australia	81	919	39	6	6	0	1 052		

Table 18: Tenure of casuarina forests by State and Territory

Notes: Column or row total may not add up due to rounding ⁽¹⁾ Area less than 1000 ha.



Figure 8: Thumbprint of regions in which casuarina forests occur

Box 6: Some facts about casuarinas

Casuarinas are characterised by their leaf structure, which at first glance resembles that of conifers. The drooping, needle-like foliage is actually composed of photosynthetic branchlets with tiny leaves, only the tips of which can be seen by the naked eye. The name 'casuarina' comes from the perceived similarity of the drooping branches to the feathers of the cassowary bird, for which the Malay word is *Kasuari*. Casuarinas are used occasionally in the manufacture of timber products. For example, *Allocasuarina fraseriana* (Western Australian sheoak) has been used in the Western Australian furniture industry for many years. The quantities used are very small because the resource is small, but the product is keenly sought after and very expensive. Species such as *C. cristata* (belah or black oak) are often used for fence posts and firewood, and as windbreaks on agricultural land. central southern South Australia and across to central southern Western Australia.

C. cristata grows on substrates varying from stony slopes and shallow calcareous loams over calcrete to heavy clay soils, in average rainfalls ranging from 200-600 millimetres annually. It tends to grow in groves, originating from the production of root suckers, the normal method of propagation for this species. The forests vary in height up to 30 metres and form woodland or open forests, depending on site quality. The most dense stands are usually found in depressions, where C. cristata forest is often one of a mosaic of forest types that may include acacias such as Acacia harpophylla (brigalow) and A. pendula (myall), and other species such as Atalaya hemiglauca (whitewood), Geijera parviflora (wilga) or Heterodendrum oleifolium (inland rosewood).

C. cunninghamiana, often referred to as river oak, sheoak or creek oak, commonly occurs as open forest up to 35 metres in height along watercourses throughout eastern Australia, only being replaced by *C. glauca* (swamp oak) in saline coastal swamps.

Tenure

Table 18 shows the tenure of casuarina forests in Australia. About 76 per cent of casuarina forests occur within New South Wales; of these, more than 95 per cent are found on leasehold land. Nationally, less than 4 per cent of this forest type is found within conservation reserves.

Mangrove forest

Mangroves are usually small, robust trees ranging from 3 to 8 metres in height. However, certain species in northern Australia can reach 30 metres; conversely, in more hostile environments the plants may not grow as tall as 2 metres, in which case they are not considered forest in this report. Specht and his co-authors identified eight mangrove communities.

Mangrove forests are woody communities, often of dense pure stands, that develop on sediments in sheltered estuaries, inlets and bays. These areas are subject to periodic tidal inundation; mangroves have evolved various mechanisms to persist in this environment. Such adaptations include ways of excluding or secreting salts and a shallow spreading root system with various root adaptations to assist in gaseous exchange associated with metabolism.

Distribution

Australia's 1 million hectares of mangrove forests represent less than 1 per cent of the total native forest area. They are found discontinuously along the warmer coasts, from the Pilbara and Kimberley in the west to south of Sydney in the east, and in small areas of coastal Victoria and South Australia. Table 19 shows the area of mangrove forests occurring in each State and Territory. Figure 9 shows the regions of the continent in which mangrove forests are found. High-quality mapping of the

	Tenure area ('000 ha)								
State/ Territory	Private	Lease- hold	Conservation reserve	Other	Multiple -use	Un- resolved	Total		
ACT	0	0	0	0	0	0	0		
NSW	4	0	1	1	(1)	(1)	7		
NT	260	40	48	(1)	0	94	442		
Qld	138	58	149	43	1	8	398		
SA	15	0	1	(1)	0	4	20		
Tas	0	0	0	0	0	0	0		
Vic	1	0	4	(1)	0	(1)	5		
WA	4	20	27	102	0	20	173		
Australia	422	118	231	146	1	126	1 045		

Table 19: Tenure of mangrove forests, by State and Territory

Note: Column or row total may not add up due to rounding.

⁽¹⁾ Area less than 1000 ha.



Figure 9: Thumbprint of regions in which mangrove forests occur

occurrence of mangrove forests remains a significant need in many places.

Mangrove forests around the tropical northwest, north and north-east coasts are the most species-diverse. The mangrove forests further south, along the south coast of Victoria and the South Australian gulfs, are much less rich in species and are dominated by one species, *Avicennia marina* (white mangrove), the most widespread and common of all mangrove species. A small outlier of mangrove forest occurs in the Lechenault Inlet near Bunbury, south of Perth. No mangroves occur in Tasmania.

Tenure

Nationally, 40 per cent of mangrove forests are in private ownership, 22 per cent within conservation reserves and 12 per cent within leasehold (Table 19). Tenure attribution for mangrove forest is not of a high quality. Most occur below the high-water spring tidal level: it is unclear how this relates to ownership.

Box 7: The usefulness of mangroves

Mangrove forests fulfil a useful role as food sources for humans and animals; they stabilise the shoreline and provide habitat and breeding sites for birds and other wildlife. There is also an increasing awareness of the importance of such environments as fish 'nurseries'.

Mangrove plants are an important resource for Indigenous peoples in the Northern Territory – they yield pleasant honey and fruits that can be cooked and eaten. They are also a source of medicines and implements, and the timber can be used for firewood and construction. The leaves are palatable for stock. Many fish and shellfish are common in mangrove swamps and are used by both Indigenous and non-Indigenous urban populations.



Figure 10: Thumbprint of regions in which callitris forests occur

Callitris forest

The Australian cypress pine genus *Callitris* is one of a number of Gondwanan conifer genera that still survive. Specht and his co-authors identified 21 *Callitris* plant communities. Of these, seven form forest in which *Callitris* species are considered the most dominant canopy species; these constitute the callitris forests described below. *Callitris* species occur in a further 10 forest communities as subdominants.

There are 14 species of *Callitris*, of which the most significant forest-forming species is *Callitris glaucophylla* (white cypress). This has a straight trunk and can grow to a height of 30 metres, but typically grows to 15–20 metres.

Fuel modification through grazing has reduced fire frequency and intensity, allowing the spread of *Callitris* species, principally *C. glaucophylla.* Other common species include *C.* *endlicheri* (black cypress), *C. intratropica* (northern cypress), *C. verrucosa* (Murray pine) and *C. columellaris* (coastal cypress).

Previous estimates of the area of callitris forest have been in the range of about 4 million hectares. The estimated area reported here is about 0.9 million hectares (Table 20). The reason for this change is one of classification. *Callitris* species often occur in association with a range of eucalypt species and were previously classified as callitris forest because of the commercial significance of this species. However, in most cases, *Callitris* species are actually sub-dominant in the canopy. Such mixed forests are correctly classified as eucalypt forests.

Recent work done by the National Forest Inventory has estimated that, although less than 1 million hectares of callitris-dominant forest has been identified through new mapping, there are at least another 6.5 million hectares of forest which have *Callitris* species occurring in the canopy. In total, this is an increase of approximately 85 per cent in area over previous knowledge. Thus, pure *Callitris* stands make up about 0.5 per cent of Australia's native forest estate, and *Callitris* species occur in the canopy of about 4 per cent of Australia's native forests.

Distribution

Callitris forests are generally drought-resistant and many are frost-tolerant. They are usually found in areas with a rainfall of 300–650 millimetres a year, from the arid tropics around the Hamersley Ranges and through the coastal eucalypt forests of the Northern Territory to rain-shadow areas in the Snowy Mountains. The largest tracts of callitris forests occur in eastern Australia, where they are found discontinuously from the Murray River to the Great Dividing Range north of Injune in Queensland. Figure 10 shows the regions of the continent in which this forest type is found; Table 20 shows the area occurring in each State and Territory. Callitris forest (mostly *C. glaucophylla*) occurs predominantly in Queensland, New South Wales and South Australia. In New South Wales, it includes the Pilliga region north of Coonabarabran, known as the Pilliga Scrub, which is the largest area of native forest in New South Wales west of the Great Dividing Range. Elsewhere in that State, the medium height woodland cypress forests have been extensively cleared for agriculture, leaving small stands in multiple-use forests and corridors along roads and travelling stock routes.

C. glaucophylla forests occur in the Flinders Ranges of South Australia; further south, remnants of *C. preissii* (Murray pine, mallee pine, southern cypress pine) forest occur in the largely cleared agricultural regions of that State.

Tenure

Table 20 shows the tenure of callitris forests by State and Territory. Nationally, about 35 per cent occur on leasehold land, 34 per cent in multiple-use forests, around 23 per cent on private lands and 8 per cent in conservation reserves.

		Tenure area ('000 ha)								
State/ Territory	Private	Lease- hold	Conservation reserve	Other	Multiple -use	Un- resolved	Total			
NSW	97	20	35	4	226	0	382			
NT	0	0	0	0	0	0	0			
Qld	95	142	2	4	66	(1)	309			
SA	0	139	0	0	0	0	139			
Tas	0	0	0	0	0	0	0			
Vic	5	0	32	(1)	(1)	(1)	37			
WA	0	0	0	0	0	0	0			
Australia	197	300	69	8	292	(1)	867			

Table 20: Tenure of callitris forests, by State and Territory

Note: Column or row total may not add up due to rounding.

⁽¹⁾ Area less than 1000 ha.



Figure 11: Thumbprint of regions in which 'other forest' occurs

	Tenure area ('000 ha)									
State/ Territory	Private	Lease- hold	Conservation reserve	Other	Multiple -use	Un- resolved	Total			
ACT	0	0	0	0	0	0	0			
NSW	71	230	5	4	2	(1)	312			
NT	39	0	0	0	0	4	43			
Qld	2 960	1 793	537	234	956	10	6 490			
SA	14	38	11	(1)	0	0	63			
Tas	(1)	0	30	16	72	0	118			
Vic	201	0	81	17	54	8	360			
WA	105	524	106	311	3	(1)	1 048			
Australia	3 390	2 586	770	582	1 086	22	8 435			

Table 21: Tenure of 'other forest', by State and Territory

Note: Column or row total may not add up due to rounding. ⁽¹⁾ Area less than 1000 ha.

Box 8: The use of cypress timber

Cypress timber and products have been widely used by Indigenous peoples and also constitute an important part of Australia's forestry heritage. Cypress pine is a versatile, durable, termite-resistant timber; it is used in housing construction and for flooring, cladding and fence posts. In New South Wales and Queensland, large quantities of *Callitris glaucophylla* (white cypress) sawlogs are milled each year, and extensive areas are managed for long-term timber production. In the Northern Territory, *C. intratropica* (northern cypress) has been used for similar purposes.

Other forests

For this report, about 8.4 million hectares or just over 5 per cent of Australia's native forests are classified as 'other forest'. Within this classification are three groups: 'mixed', 'unknown type' and 'minor genera'. It should be noted that in this context the term 'mixed' indicates a number of genera, not a number of species. Fourteen of the forest communities recognised by Specht and his co-authors fall into this forest type.

Mixed forests

There are 6 million hectares of mixed forests, or about 4 per cent of the entire native forest estate. They fall into three groups:

- forests for which the dominant canopy genera were not included in the database;
- forests in which there are a number of genera in the canopy but no single dominant genus (rainforests, although often matching this criterion, are not included here); and
- forests in which communities occur in small patches and have not been mapped at a level detailed enough to distinguish the different communities. This has occurred, for example, where forest dominated by *Angophora* species is found along a creek-line within an area dominated by other species.

Forests of unknown type

There is limited information about the species composition of the canopy for 1.9 million hectares or 1 per cent of native forests. Satellite information makes it possible to map small patches of forest in grassland and agricultural regions that previously were ignored by vegetation mappers or were only referred to as existing in a mosaic. There is good information about the location and size of many such patches, but it is not yet known for certain what species dominate the canopy. These patches are called 'forests of unknown type' in this report.

Forests dominated by minor genera

A small proportion of the forest estate is made up of forests dominated by genera other than those already mentioned. About 0.5 million hectares of forest are dominated by genera such as *Adansonia, Angophora, Atalaya, Banksia, Brachychiton, Flindersia, Heterodendrum, Leptospermum* and *Lysiphyllum*.

Distribution

Figure 11 indicates the regions in which 'other forest' occurs; Table 21 shows that nearly 77 per cent of the 8.4 million hectares classified as 'other forest' are in Queensland. About 12 per cent are in Western Australia and the remainder is made up of relatively small patches in the other States and the Northern Territory.

Tenure

Table 21 shows the tenure of 'other forest'. Of forests in this category, 40 per cent are private and 31 per cent are leasehold. About 12 per cent fall into the multiple-use tenure category and 9 per cent are in conservation reserves.

Plantation forests

Australia has just over 1 million hectares of plantations, or about 0.7 per cent of the country's total forested area. The distribution of plantations by National Plantation Inventory region (see Map 8) is given in Table 22.

Table 22: Distribution of hardwood and softwood plantations, by National Plantation Inventory region

	Distribution (ha)				
Region	Hardwood	Softwood			
Western Australia	42 040	88 800			
Tasmania	62 020	71 970			
Green Triangle	390	139 060			
Lofty Block	650	16 160			
Central Victoria	10	25 620			
Murray Valley	230	162 540			
Central Gippsland	19 040	59 180			
East Gippsland/Bombala	260	32 130			
Southern Tablelands	270	20 000			
Central Tablelands	0	73 110			
Northern Tablelands	50	13 040			
North Coast	32 320	11 260			
South East Queensland	1 120	147 370			
North Queensland	170	19 530			
Northern Territory	0	4 220			

Source: National Plantation Inventory (1997).

Softwood plantations

There are nearly 0.9 million hectares of softwood plantations, representing about 80 per cent of the plantation estate (Table 23). At least 90 per cent of softwood plantations contain exotic conifers, mostly *Pinus radiata* (radiata or Monterey pine). The only native conifer used in plantations on a significant scale is *Araucaria cunninghamii* (hoop pine), although *Araucaria bidwillii* (bunya pine) has also been tried in New South Wales.

The area of softwood plantations established in each five-year period between 1940 and 1994 is shown in Figure 12. Most of the plantations established before 1960 have been harvested, and some of the more recent plantings are on those harvested areas. The most extensive softwood plantings are in the upper Murray Valley region around the New South Wales towns of Tumut, Batlow and Tumbarumba and in north-eastern Victoria, the south-east Queensland region, and the Green Triangle region, which straddles the South Australian–Victorian border.

Hardwood plantations

Australia has about 160 000 hectares of hardwood plantations (Table 23), in which eucalypt species are predominant (the remainder consists largely of tropical rainforest species). Only a few eucalypt species are used widely in plantations: these include *Eucalyptus* globulus (Tasmanian or southern blue gum), *E.* nitens (shining gum), *E. pilularis* (blackbutt) and *E. grandis* (flooded or rose gum). The area of hardwood plantations established in each five-year period between 1940 and 1994 is shown in Figure 12.

The majority of hardwood plantations occur in four regions: Tasmania, Western Australia, the north coast of New South Wales and Central Gippsland in Victoria. The Tasmanian hardwood plantation estate is the largest in Australia. In 1997 hardwood plantations were expanding at a rate of about 5000 hectares a year in that State. There are plans to further expand plantation establishment in New South Wales and Victoria, while in Western Australia 20 000 and 25 000 hectares of mainly E. globulus plantation were established in 1996 and 1997 respectively. Small plantations specialising in high-quality cabinet wood species are being established in north-east Queensland.

Both public and private growers have recently reported significant increases in the rate of establishment of hardwood plantations. Current planting plans suggest that about 80 per cent of new plantings will be of hardwood species.





In addition to the areas shown, there are abo 18,280 hectares of plantations where the age (planting period) is unknown, 13,330 hectares of which are hardwood. "Figures for the 1960–64 planting period include 6260 hectares that were planted in the Western Austalian region before 1962. This inflates the rational figures for that period by 32 percent (softwoods) and 60 per cent (hardwoods).

Source: National Plantation Inventory (1997).

Table 23: Plantation area, by species

Softwood	Area (ha)
Pinus radiata	642 110
P. elliottii	72 880
P. caribaea	54 160
Araucaria species	45 300
P. pinaster	28 880
Minor softwood species	13 020
Unidentified softwood species	27 630
Total softwood plantation area	883 980
Hardwood	
Eucalyptus globulus	41 260
E. pilularis/E.grandis mix ⁽¹⁾	22 210
E. nitens	12 230
E. regnans	5 980
Minor hardwood species	11 310
Unidentified hardwood ⁽²⁾	65 580
Total hardwood plantation area	158 570
Total	1 042 600 ⁽³⁾
 (1) Approximately 60 per cent E. grand (2) An estimated 70 per cent is a mix of E. globulus. (3) Column total has been rounded to pagaset 10 bases 	dis. of E. nitens and the

Source: National Plantation Inventory (1997).

Plantation tenure

Table 24 shows the tenure of plantations by State and Territory. The data are presented as percentages because tenure was not reported in the 1997 National Plantation Inventory. Percentages given are based on a range of information sources. More than two-thirds of the total plantation estate is publicly owned and the remainder is private. The majority of softwood plantations are publicly owned, but more hardwood plantations are on private land than on publicly owned land. Of the States and Territories, New South Wales, Victoria and Queensland contain the most plantations.

Table 24: Plantation tenure and type, by State and Territory⁽¹⁾

State/Territory	Multiple-use (%)		Private (%)		
	Softwood	Hardwood	Softwood	Hardwood	Total (%)
ACT	1.3	0.0	0.0	0.0	1.3
NSW	18.0	2.4	5.9	0.2	26.5
NT	0.1	0.0	0.3	0.0	0.4
Qld	15.5	0.1	1.1	0.0	16.7
SA	6.8	0.1	2.6	0.1	9.6
Tas	4.3	1.1	2.9	4.1	12.4
Vic	9.7	0.7	9.6	1.0	21.0
WA	6.5	1.3	1.5	2.7	12.0
Australia	62.1	5.7	24.0	8.1	100.0

Source: derived from Quarterly Forest Products Statistics (March 1996). ⁽¹⁾ As a proportion of total plantation area.