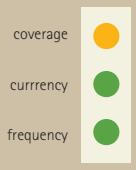

Forest available for timber production

Indicator 2.1a

Area of forest land and net area of forest land available for timber production

Rationale

This indicator is a fundamental element of the capacity of forests to meet society's demand for wood products.

Timber is produced from both native forests and plantations. Seven per cent of Australia's forests are publicly managed for wood supply with a further area of forest under leasehold and private tenure also potentially available, depending on land holder intent, markets and environmental constraints. In total a gross area of 74 per cent is not legally restricted.

The area of forests available for timber harvesting indicates the capacity of our forests to meet domestic and export demand for wood and wood products. International reporting standards define the area available for timber production as land where harvesting is 'not legally restricted'.

Timber is produced from native forests, which are managed for a range of uses as well as timber production. Timber is also produced from plantations, which are developed and managed intensively for timber production in a similar way to agricultural crop production. There were 1.6 million hectares (net productive area) of plantation forests established in Australia up to December 2002. This compares with approximately 473 million hectares used for agriculture. Further details on plantations are provided in Indicator 2.1c.

In Australia, timber harvesting is not permitted in nature conservation reserves. Timber harvesting is not legally restricted from leasehold land, multiple-use forests and private land. The areas of forest in those tenures are shown in Table 44. Timber may also be harvested from some categories of other crown land.

Table 44: Area of native forest by tenure not legally restricted from timber harvesting ('000 ha)

Tenure	ACT	NSW[1]	NT	Qld	SA	Tas	Vic	WA	Australia
Leasehold land	–	9 470	16 313	35 581	0	–	46	8 920	70 330
Multiple-use forests[2]	0	2 496	0	2 925	0	1 062	3 312	1 600	11 395
Private land	n/a	8 523	15 511	10 213	0	922	1 298	1 639	38 106
Total	0	20 489	31 824	48 720	0	1 984	4 656	12 159	119 832

Source: National Forest Inventory (2003)

[1] Since these data were prepared the area of multiple-use forest in New South Wales has decreased due to additions to nature conservation reserves arising from Regional Forest Agreements.

[2] Includes areas of multiple-use forest reserved from timber harvesting to protect particular plant or animal species, catchment or other values.

The national area of forest not legally restricted from timber harvesting is 119.8 million hectares, or 74 per cent of Australia's forests. However, the area potentially available is significantly less because extensive areas are leasehold land predominantly used for grazing. As well, much of the area does not contain marketable species or is too far from markets to support viable timber production.

The area available for timber harvesting is further reduced by a range of regulatory constraints concerned with environmental and economic factors that are addressed by codes of practice and licences. The net area of forest where timber may be harvested after allowing for those constraints is approximately 64 per cent of the national total area of multiple-use forests (Table 45). The net area has not been assessed for leasehold land and private forests.

Harvesting of mixed species forest

Table 45: Net harvestable area as a proportion of total multiple-use forest (per cent)

Net harvestable area	ACT	NSW	NT	Qld	SA	Tas[1]	Vic	WA[2]	Australia
Per cent	*0*	*63*	*0*	*64*	*0*	*60*	*62*	*70*	*64*

Source: National Forest Inventory (2003)
[1] Tasmanian data as at June 2001
[2] Data from Australia's State of the Forests Report (1998)

Victoria has been able to identify the percentage of each of the native forest areas by land tenure where timber harvesting is permitted (Table 46). This demonstrates that, with the exception of nature conservation reserves, there are native forests technically available for timber harvesting in all tenures.

Table 46: Native forest areas in Victoria in which timber harvesting is permitted

Tenure	Proportion of tenure (%)
Multiple-use forest	*62*
Nature conservation reserves	*0*
Other crown land	*37*
Leasehold land	*30*
Private land	*27*

Source: Department of Sustainability and Environment, Victoria.

Since the 1998 State of the Forests Report, Regional Forest Agreements and other land use decisions have changed the tenure of around 2 million hectares of predominantly publicly owned forest, largely from multiple-use forest (which allows for timber harvesting) to nature conservation reserve (which emphasises protection of features of the forest environment).

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coverage
currrency
frequency

Growing stock in native forests available for timber production

Indicator 2.1b

Total growing stock of merchantable and non-merchantable tree species on native forest land available for timber production

Rationale

A fundamental element of the productive capacity of the area of native forest.

Growing stock for native forests is not normally reported as part of forest management in Australia. Merchantable growing stock is used in the calculation of sustainable yields for multiple-use forests.

The 'growing stock' is the volume of timber—merchantable and non-merchantable—in the forest at a particular time. The trend in growing stock may indicate whether the harvesting of timber products being undertaken is sustainable.

In practice, forest managers measure growing stock of merchantable tree species to forecast sustainable yield for multiple-use forests. The term 'merchantable' refers to timber that is of saleable quality. Non-merchantable timber is not of saleable quality. Whether timber is saleable depends to some extent on its intrinsic properties but to a greater extent on market supply and demand factors. The distinction between merchantable and non-merchantable is therefore arbitrary because market factors change.

Sustainable yield is the volume of timber products that can be harvested from the forest under a given management regime without reducing the long-term timber production capacity. The key elements of management that affect sustainable yield are the silvicultural system applied and the rotation, that is, the tree age when harvesting is planned.

With the exception of Tasmania, there are little or no data available on growing stock, potential sustainable yield or the owner's management intentions for private native forests. Sustainable yield is considered in Indicator 2.1d.

Non-merchantable coastal tea-tree (*Leptospermum laevigatum*) and eucalypt forest

Plantation resources

coverage
currrency
frequency

Indicator 2.1c

The area, age and future yield from plantations of native and exotic species

Rationale

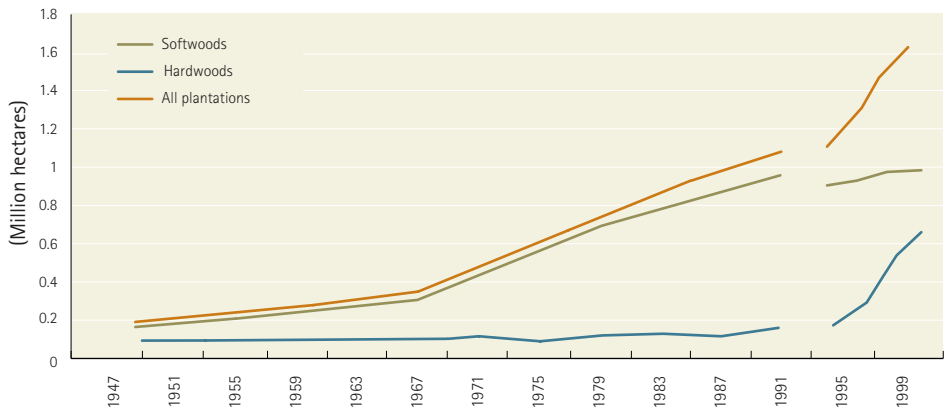
This is a direct measure of plantation production.

The area of softwood plantations was 988 000 hectares in 2002. The rate of expansion of new softwood plantations is low and the potential supply of softwood plantation timber will increase modestly over the next 20 years. There were 638 000 hectares of hardwood plantations in 2002. The majority of that area was established in recent years, much of it on former agricultural land. Hardwood plantation timber supply will potentially increase five-fold over the next 40 years.

Development of plantation forests in Australia started in the late 19th century when governments realised that additional sources of timber, especially softwood timber, were needed for building. The rate of development varied widely from year to year depending on government reforestation and economic development programs and interest from the private sector.

The total plantation estate reached about 200 000 hectares by 1960 (Figure 31). The area of softwood plantations increased rapidly from the 1960s to the 1980s, largely due to loan agreements between the Australian and State governments. The area of hardwood plantations reached 50 000 hectares by 1980 and did not increase further until the late 1980s when substantial private sector investment in hardwood plantations commenced.

Figure 31: Cumulative area of plantations over time



Source: Gerrand *et al.* (2002)

Note: The discontinuity between 1991 and 1994 is due to data inconsistencies prior to the start of the National Plantation Inventory.

The area of softwood plantations reached about 988 000 hectares in 2002 (see Table 47 and Figure 31). The annual average area of new softwood plantations established was more than 10 000 hectares for most of the 1990s but declined to 5 200 hectares in 2002. In contrast, the area of new hardwood plantations—almost entirely eucalypt species—doubled between 1991 and 1994 and increased four-fold between 1994 and 2002, albeit from a small base.

Table 47: Area of plantations ('000 ha)

Plantation type	1991	1994	2002
Hardwoods	84	159	638
Softwoods	893	884	988
Total	977	1 043	1 628

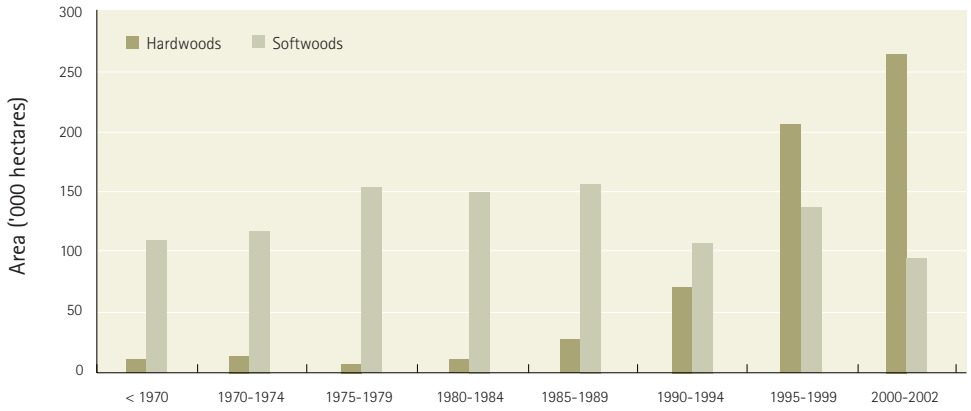
Sources: Resource Assessment Commission (1992); National Plantation Inventory of Australia (1997, 2003)

Note: The apparent decline in the area of softwood plantations between 1991 and 1994 is due to data inconsistencies prior to the start of the National Plantation Inventory

The area of plantation according to year of planting (Figure 32) shows how the rate of establishment of new softwood plantations has reduced since the 1980s. Most of the area of softwoods now planted each year is replanting existing areas after harvesting, rather than establishing new areas.

In contrast, most of the hardwoods are the first crop on the site. Only small areas of hardwoods have reached harvest age, and the rate of establishment of new hardwood plantations greatly exceeds the area harvested annually.

Figure 32: Area of plantations according to year of planting



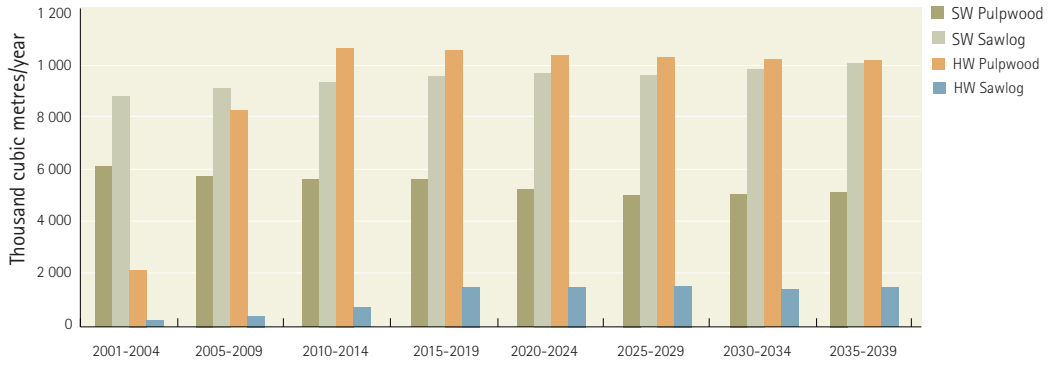
Source: National Plantation Inventory (2001, 2003)

The National Forest Inventory has developed estimates of potential future timber production from the existing plantations (Figure 33; the estimates assume no additional plantations). These estimates are based on records and assumptions about yields of timber products per unit land area and assume that all plantation sites harvested are replanted so that the current size of the plantation estate is maintained.

For softwood plantations there is a considerable amount of data available from over 100 years of experience to underpin the assumptions. By contrast, there is relatively little operational experience for hardwood plantations and the forecasts are therefore less reliable. The proportion of the total volume produced that is suitable for sawlogs is particularly difficult to estimate accurately.

The production from softwood plantations is nearing its maximum potential and is expected to reach a plateau by the end of the current decade (Figure 33). Most of the hardwood plantations are still immature. Potential production of hardwood will increase substantially in the next few years from about 2 million cubic metres per year in the period to 2004 to a maximum level of around 10 million cubic metres per year after 2010.

Figure 33: Estimated potential national production from plantations 2001–2039



Source: Ferguson *et al.* (2002); National Forest Inventory (2003)

Notes: Pulpwood includes roundwood used for poles, posts and reconstituted wood panels. Veneer log volumes are included with sawlog volumes. HW = hardwood; SW = softwood

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Plantation of native blue gum (*Eucalyptus globulus*)

Removal of wood products

Indicator 2.1d

Annual removal of wood products compared to the sustainable volume

Rationale

A measure of the actual harvest, to meet society's demand for wood products, against the sustainable level of production.

Multiple-use forests are the major source of native forest wood products. The volumes harvested from public native forests are less than the sustainable level. Private native forests are substantial sources of wood products in Queensland, New South Wales and Tasmania.

It is important to compare the volume of wood harvested annually with the forecast sustainable yield to ensure that the environmental values and productive capacity of forests are not compromised. Plantations are developed and managed primarily for timber production and market forces, rather than ecological sustainability. This indicator therefore focuses on native forests.

Sustainable yields from forests can be calculated in various ways, but should take into account environmental, social and economic factors. The concept of a sustainable level of production is that the forest can provide for society's needs and maintain its productive capacity.

Timber products can be divided into major and minor wood products. Major wood products include veneer logs, sawlogs and pulpwood. Pulpwood includes logs used for paper and wood-based panel products. There are formal processes, backed by legislation or codes of forest practice, to calculate sustainable sawlog yields for publicly managed native forests, primarily multiple-use forests. The volume of timber available for harvest is based on the net area of forest available for timber production after areas unavailable for economic, environmental and other reasons have been excluded. Low quality sawlogs and pulpwood are also harvested from native forests, usually as a residual product from high quality sawlog production. Sustainable volume calculations are not determined for those products.

Minor wood products include posts and poles, bush sawn/hewn timber, firewood, speciality timber, and sleepers. Licences or permits are usually required to harvest minor wood products. The supply of these products is often opportunistic and may not be factored into sustainable yield calculations.

Sustainable sawlog volumes are determined using timber resource information, including forest type and age-class, volume data, terrain, accessibility information, growth and yield forecasts, and other values such as recreation, water and conservation. Once calculated, the sustainable volumes are used to produce an optimum schedule of harvesting, and a view of the future spatial and temporal characteristics of the forest.

Sustainable volumes vary over time according to management strategies, improved resource data and utilisation standards, and areas of land available for harvesting. The estimates are therefore reviewed periodically, usually every five years. For a range of reasons, some States and Territories allow annual harvest levels to fluctuate around the sustainable volume, but periodic reconciliation with sustainable yield is necessary to ensure future supply.

For Queensland, the supply of wood products from private native forests has often exceeded the supply from public native forests. For New South Wales and Tasmania, the supply from private native forests is significant but less than the supply from public native forests. Private native forests are a minor source of wood products in the other States.

The vast majority of private native forest managers in Australia have not adopted formal sustainable forest management procedures. Most have tended to be opportunistic in supplying timber, depending on immediate needs and the availability of markets. The Queensland Timber Board and Queensland Government are working with the Australian Government to assess private native forests in south-east Queensland for timber and some non-timber values. The results will be used to recommend assessment methods in other regions and is being undertaken in conjunction with a survey of landowner management intent.

Major wood products

Harvesting of wood products occurs primarily in New South Wales, Queensland, Tasmania, Victoria and Western Australia (Table 48). Harvest of wood products in native forests is not permitted in the Australian Capital Territory and South Australia. Sustainable yields have not been determined for the Northern Territory.

Over the past decade, the annual harvest of wood products has, on average, been less than the sustainable volume (Table 48). The data show a downward trend in volumes of sawlogs and veneer logs harvested from native forests in all States but Tasmania. The volume of pulpwood harvested has declined in all States except Tasmania and Victoria.

In 1996–1997, Victoria recalculated the sustainable volume to include all grades of sawlogs, based on the proportion of medium quality logs to low quality logs harvested in 1995–1996, which were subsequently reviewed in 2002 for all forest management areas. An outcome of the Tasmanian Regional Forest Agreement was to increase the available sawlog volume by 100 000 cubic metres in 1998–1999 to support the Forestry Growth Plan.

In 1999 the Queensland government agreed to a 25-year transition from public native forest harvesting in south-east Queensland to a plantation-based industry. Some harvesting will occur in these forests before they are transferred to nature conservation reserve. Hardwood plantations are being established to provide an alternative resource.


Michael F. Ryan

Young blue gum (*Eucalyptus globulus*) and mature radiata pine (*Pinus radiata*) plantation forest

Table 48: Sawlog, veneer log and pulpwood production from native forests ('000 cubic metres)

	1992–1993	1993–1994	1994–1995	1995–1996	1996–1997	1997–1998	1998–1999	1999–2000	2000–2001
Sawlogs and veneer logs from multiple-use forests									
NSW sustainable volume[1]	–	–	–	–	–	–	595	629	518
NSW harvested volume[1]	1151	1262	1224	1075	942	806	572	497	554
Qld sustainable volume	–	–	–	–	–	–	–	–	–
Qld harvested volume[2]	344	345	367	308	339	317	324	296	289
Tas sustainable volume[3]	300	300	300	300	300	300	400	400	400
Tas harvested volume[3]	292	209	309	276	262	273	266	281	294
Vic sustainable volume[4]	743	743	743	743	921	921	921	921	921
Vic harvested volume[4]	632	660	664	589	729	804	821	820	667
WA sustainable volume[5]	758	758	758	–	704	704	704	510	–
WA harvested volume[5]	636	615	694	544	568	581	541	471	–
Sawlogs and veneer logs harvested from private native forests									
New South Wales	393	346	254	248	441	111	–	–	–
Queensland	339	425	416	340	260	210	230	270	230
Tasmania[3]	–	–	–	–	216	162	203	162	126
Pulpwood harvested from multiple-use forests									
New South Wales	710	700	699	768	605	615	472	503	533
Queensland[2]	1.3	0	0	2.7	3.5	0.5	0	0	1.0
Tasmania3	–	–	–	–	1550	1890	1624	2368	2762
Victoria4	–	–	–	1011	1033	1120	1165	1403	1580
Western Australia5	639	570	673	654	610	601	515	446	–
Pulpwood harvested from private native forests									
New South Wales	53	45	60	22	87	–	–	–	–
Tasmania[3]	–	–	–	–	1188	1714	1553	2367	1912
Western Australia[5]	99	74	59	89	58	–	–	–	–
Other States	–	–	–	–	–	–	–	–	–

Source: National Forest Inventory (2003)

Notes: Sawlogs and veneer logs from native forest hardwood and softwood species. Pulpwood includes logs used for pulp and paper products, woodchips and panel products.

[1] For New South Wales, sustainable yields are determined and the volumes shown are for high quality sawlogs and veneer logs. The Regional Forest Agreements permit the volume harvested to vary by 25% in any year and by 5% over a five-year period. Low quality sawlogs and pulpwood are also produced where high quality sawlogs are harvested.

[2] For Queensland, the volumes for multiple-use forests include timber harvested from multiple-use forest and other crown land.

[3] Source: Tasmanian RFA Background Report (2001).

[4] For Victoria, sustainable yields are expressed as net volume (i.e., gross volume less allowances for defect). Pulpwood volume includes logs that are sawn but do not meet sawlog grade standards. For Victoria, until 1995–96 the sustainable yield figures did not include D grade (i.e., low quality) sawlogs. This changed in 1996–97 to include D grade sawlogs.

[5] Source: Annual Reports of the Department of Conservation and Land Management; includes sawlogs and veneer logs from multiple-use forest and other crown land. Figures to 1998–99 are those set by Ministerial determination and include jarrah saw logs grade 1 and 2, and karri saw logs grade 1. Figures for 1999–2000 are those set by the Regional Forest Agreement and include jarrah sawlogs grades 1 and 2, and karri sawlogs grades 1 and 2.

Minor wood products

Sustainable volume figures for minor wood products are not usually determined but strategies are being developed for some products. Posts, poles and rails are often removed as part of thinning and sawlog harvesting in native multiple-use forests. Permits are usually required for removal of minor products, including South Australia where specific approvals are granted for firewood removal under the *Native Vegetation Act 1991*. Timber harvested for didgeridoos, bark painting and sculpture in the Northern Territory is covered in Indicator 6.1b.

A national approach for firewood collection and use in Australia was developed in 2001. It aims to ensure all firewood collection, including commercial cutting, is ecologically sustainable and not a major cause of loss or degradation of remnant forests or the habitats of threatened species. This national approach forms the basis for each State and Territory to develop its own firewood collection action plan or strategy.

Victoria released a draft firewood strategy discussion paper in 2002 in conjunction with forest management plans for publicly owned forests. Data on firewood removal from private forests is not available. Table 49 shows estimates for firewood consumed in 2000.

Table 49: Estimated firewood use in 2000

State/Territory	Millions of tonnes
Australian Capital Territory	0.03–0.06
New South Wales	1.18–1.68
Northern Territory	–
Queensland	0.23–0.45
South Australia	0.32–0.53
Tasmania	0.61–0.85
Victoria	0.96–1.48
Western Australia	0.45–0.69
Total	4.52–5.74

Source: Driscoll (2000)

Further reading

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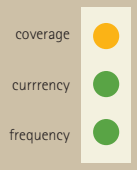

Non-timber forest products

Indicator 2.1e

Annual removal of non-timber forest products (e.g. berries, mushrooms, game, honey, wildflowers, tree ferns, possums), compared to the sustainable level

Rationale

This indicator provides an indication of the level of use of non-timber forest products compared with forecast sustained yield, including some products that are significant for Indigenous communities.

No national data are kept on the non-timber forest products that are sourced solely from forested areas. Some State and Territory governments estimate sustainable harvest volumes for selected plant and animal species.

In recent times the quantities of non-timber products from Australia's forests being used for commercial purposes have increased. Management of non-timber products is becoming increasingly formalised through management plans and programs. There is a need to quantify volumes taken and sustainable yields, but there are few available data.

Animals and animal products

Removing native animals from Australian forests is prohibited or subject to regulations enforced by government agencies. There are few examples of hunting adversely affecting the viability of a forest-dependent animal species. The thylacine (*Thylacinus cynocephalus*), also known as the Tasmanian tiger, may be an exception. Hunting in the 19th to early 20th centuries is suspected to have been a significant cause of its extinction.

Some native and exotic animals are used for commercial purposes. These include introduced deer, native brush-tail possum (*Trichosurus vulpecula*) and certain species of wallabies. Information on the use of licensing for hunting of these species indicates harvesting pressure. For example, bag limits and hunting seasons are applied for hunting deer in Victoria, based on the provisions of the Victorian *Wildlife Act 1975*. The number of deer taken fluctuated from 8 600 to13 500 per year in the period between 1996–1997 and 2000–2001 while the number of licenses increased from 8 000 to just over 10 800. Although 2 715 valid deer licenses were issued in Tasmania in 1999–2000, only 760 deer were actually taken. This example demonstrates that the licence numbers may not accurately reflect the actual harvesting level.

Red and grey kangaroos (*Macropus rufus* and *M. fuliginous*) are also taken from the wild for a variety of products, including meat and skins. Red kangaroos live mainly in arid grassland, whereas grey kangaroos are also found in forested areas.

New South Wales has established a Kangaroo Management Program that specifies the number of kangaroos that may be taken each year for commercial use. The estimated population level, the allowed annual quota and the proportion of the quota actually taken are shown in Table 50.

Table 50: Commercial harvest of red and grey kangaroos in New South Wales ('000)

Year	Population	Quota	Take as % population	Take as % quota
1991	9 734	1 520	*9*	*56*
1992	7 982	2 074	*8*	*38*
1993	7 112	1 664	*10*	*47*
1994	5 963	1 409	*14*	*69*
1995	6 202	1 147	*16*	*85*
1996	5 170	1 206	*19*	*95*
1997	6 550	976	*17*	*92*
1998	8 363	1 175	*14*	*80*
1999	7 654	1 533	*11*	*61*
2000	7 689	1 390	*12*	*64*

Source: Kangaroo Management Program 2002–2006, NPWS (2002)

The data show that quotas have fluctuated with estimates of the populations and are set at a small proportion of the total population. The recorded harvest is low compared to total population size.

Non-wood plant products

A variety of plant products is taken from Australia's forests, generally under permit. The conditions applying to permits to remove plants vary from State to State. Legislation prohibits removal of plants and plant products from nature conservation reserves. The collection and commercial use of wildflowers is restricted by legislation and licences to protect threatened species.

There are records of the volumes of some plant products taken from forests in Queensland and New South Wales (Tables 51 and 52). Sustainable levels are not known for these products.

Table 51: Non-wood plant products, Queensland 2001–2002

Product	Amount
Bunya cones and banksia pods (pieces)	3 140
Pine cones (from plantations) (m^3)	2 150
Foliage (decorative; koala feed) (kg)	171 630
Fern fronds (pieces)	10 720
Leaf litter, mulch, bark, charcoal (m^3)	210
Christmas trees (from plantations)	1 740

Source: National Forest Inventory (2003)

Table 52: Non-wood plant products, New South Wales 2000–2001

Product	Amount
Native plants (number of permits)	9 870
Leaf for oil production (kg)	910
Bark (tonnes)	10
Broombrush (tonnes)	2 520
Charcoal (tonnes)	1 180

Source: National Forest Inventory (2003)

Seed

Harvesting of wild seed occurs for native forest regeneration and the maintenance of genetic diversity. Prior to the development of seed orchards or propagation programs, wild seed may be used to grow plantation stock. The amount of material collected is believed to be small compared to the total volume of seed for all but rare species, for which special permits are required (Table 53).

Table 53: Native tree seed harvested in New South Wales, Victoria and Tasmania (kg)

State/Territory	1997–1998	1998–1999	1999–2000	2000–2001
New South Wales	969	214	688	2 460
Victoria	7 100	4 700	6 000	4 800
Tasmania	1 370	564	1 278	1 712

Source: National Forest Inventory (2003)

Indigenous products

Indigenous people use a significant volume of forest products for commercial and subsistence art and crafts. For example, the Maningrida people (Arnhem Land, Northern Territory) reported that 1 476 and 937 bark paintings were produced in 1999–2000 and 2000–2001 respectively. Bark for these paintings is usually derived from the tree *Eucalyptus tetrodonta* (stringybark). Material for wood sculptures is also commonly derived from forests, and it was reported that 1 183 and 1 111 sculptures were produced in 1999–2000 and 2000–2001, respectively.

Extracting honeycombs from bee hives

Apiary

Forests in a number of Australian States and Territories are used to produce honey in commercial quantities. Tasmania is particularly well known for honey production, which contributed $2.1 million to the local economy in 1999–2000. Indigenous people use wild honey produced from a variety of native bee species occurring in forests, particularly in northern Australia. The value of the production of honey is reported in Indicator 6.1b.

First harvest of cork (*Quercus suber*) in experimental cork oak plantations

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frequency

Effectiveness of plantation establishment

Indicator 2.1f

Area and per cent of plantations established meeting effective stocking one year after planting

Rationale

This indicator determines success of the planting effort.

Monitoring is undertaken routinely following plantation establishment but plantation managers do not report the data at the national level.

The goal of plantation establishment is to achieve an adequate stocking of vigorous trees. Plantation establishment techniques and seasonal conditions, most importantly rainfall, have a major impact on planting success. Considerable research and development is being undertaken to develop and refine techniques (see Indicator 7.5f).

Acceptable stocking in a young plantation depends on tree species, the site and preferred plantation products. The planting rate can vary from a few hundred trees per hectare to a few thousand. Whatever the rate, costs are involved in preparing the site and obtaining and planting the trees. Additional costs may be incurred if remedial treatment is required due to inadequate stocking.

Plantation owners and managers usually set minimum acceptable stocking targets to be achieved within a set time after planting. Operational staff check stocking on a sample of the site to determine whether replanting is required. State Forests of New South Wales makes this information available to the public (Table 54).

Table 54: Percentage of newly planted forest effectively stocked

	Effective stocking (per cent)		
Plantation type	1998	1999	2000–2001
Hardwood	*94*	*100*	*95*
Softwood	*97*	*98*	*96*

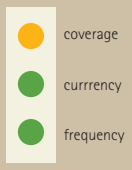
Source: State Forests of New South Wales

Young radiata pine (*Pinus radiata*) plantation

Further reading

State Forests of New South Wales (2001). Social, Environmental and Economic Report 2000/01. State Forests of New South Wales, Pennant Hills.

Regeneration in harvested areas



Indicator 2.1g

Area and per cent of harvested native forest effectively regenerated

Rationale

To determine success of the regeneration effort.

There are regulations that require regeneration of multiple-use forests where native forest harvesting occurs, and for private forests in some States. The definition of, and standard for, effective regeneration varies between States and Territories.

Effective regeneration of native forest after timber harvesting is necessary to manage a forest sustainably. Regeneration is not always necessary after thinning. To this end, an understanding of the forest management objectives and the dynamics of the forest type are necessary.

Public forest managers are required by codes of practice and other regulations to measure the effective regeneration of areas harvested for timber production and to report it publicly. Codes of practice also apply to private native forests in some States.

Measures of effective regeneration include stocking, density and species composition. State forest agencies establish standards for effective regeneration of multiple-use forests. Regeneration is assessed usually between one and three years after harvest. Further regeneration treatment is required if regeneration standards are not met. Browsing impacts on the effectiveness of regeneration. Each State has its own method of assessing the success or effectiveness of regeneration. The variation in methods is due to regional differences in forest types, climatic and biophysical conditions, and management objectives. While assessment techniques in even-aged stands are well developed, methods to measure regeneration success in multi-aged stands are still being developed.

Figures on effective regeneration are not available for all States and Territories for all tenures. However, case studies are provided for Victoria (Table 55) and Tasmania (Tables 56 and 57).

Table 55: Regeneration success in multiple-use forests, Victoria

Regeneration year	Total area treated (hectares)	Total area effectively regenerated (hectares)	Percentage effectively regenerated
1993–1994	9 328	6 987	*75*
1994–1995	6 742	5 902	*87*
1995–1996	8 961	8 046	*90*
1996–1997	3 789	2 706	*71*

Source: Department of Sustainability and Environment (2003)

Notes: Regeneration is assessed from 1.5 years to 3 years after harvesting. The regenerated areas shown are after the first regeneration treatment. Remedial treatment is undertaken where regeneration is inadequate. For 1996–1997 data are incomplete.

Table 56: Regeneration success in clearfelled eucalypt coupes, Tasmania

Regeneration year	Total area regenerated (hectares)	Area effectively regenerated (hectares)	Percentage effectively regenerated
1994–1995*	844	805	*95*
1995–1996	2 364	2 183	*92*
1996–1997	2 146	1 951	*91*
1997–1998	1 805	1 741	*96*

Source: National Forest Inventory (2003).

Notes: For multiple-use forests regenerated to native forest. The 1994–95 regeneration program was smaller than average because a very wet autumn restricted regeneration burns.

Table 57: Regeneration success in partially harvested eucalypt coupes, Tasmania

Regeneration year	Total area regenerated (hectares)	Total area effectively regenerated (hectares)	Percentage effectively regenerated
1994–1995	1 974	1 861	*94*
1995–1996	1 586	1 586	*100*
1996–1997	3 058	3 010	*98*
1997–1998	2 320	2 250	*97*

Source: National Forest Inventory (2003).

Note: For multiple-use forests regenerated to native forest.

Two management regimes are presented for Tasmania over a four-year period to 1998. The effective regeneration achieved ranged between 91 per cent and 100 per cent across the two regimes. Coupes where the stocking standard was not achieved were generally environmentally difficult sites (e.g., steep or rocky). The recent introduction in Tasmania of compliance reporting under the *Forest Practices Act 1995* will, in future, provide data on the achievement of prescribed stocking standards across all tenures in the State.

The small sample of areas assessed for regeneration in areas harvested for ironwood (*Erythrophleum chlorostachys*) in the Northern Territory revealed that the primary factor influencing regeneration was fire regime, and inadequate management of fire was adversely impacting on young trees. This points to a need for management plans to cover this factor if adequate regeneration is to be assured.

Mountain ash (*Eucalyptus regnans*) seedling after regeneration of harvested forest

Further reading

Department of Sustainability and Environment (2003). Regeneration and Reforestation Stocking in Victoria's Native State Forests 1993/94 to 1996/97. Forests Service Technical Report 03-1. Department of Sustainability and Environment, Melbourne.

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Genetic conservation of plantation species

coverage
currrency
frequency

Indicator 2.1h

Extent of exotic plantations managed according to documented procedures or management plans to maintain genetic resources

Rationale

Genetic resource management plans aim to maintain the full range of genetic resources available for commercial plantation species.

Research and development of genetic resources of a substantial number of species used in exotic plantations is progressing. The risk of narrowing the genetic variability of the trees used in plantations is being managed.

This indicator addresses the conservation of genetic resources of the exotic species used in plantations in order to enable the productivity of those plantations to be maintained. Conservation of genetic resources in native forests and in plantations of indigenous species is addressed in Indicator 1.3c.

Exotic species are those that are growing outside the region where they naturally occur. Species that are indigenous to Australia but are grown outside their natural range are treated as exotic and are reported under this indicator.

Many different species are used for timber plantations and farm forests in Australia. Some of the main species, their region of origin, and the regions in which they are used in plantations, are shown in Table 58.

Table 58: Some species used in plantations in Australia

Species	Region of origin	Region/s used in plantations
Pinus radiata	California	Southern Australia
Eucalyptus globulus subsp. *globulus*	Tasmania and south Gippsland, Victoria	Southern Australia, including Tasmania
Eucalyptus grandis	North coast New South Wales and Queensland	North coast New South Wales and southern Queensland
Eucalyptus pellita	Coastal New South Wales and Queensland	Coastal north Queensland
Eucalyptus nitens	New South Wales and Victoria	Southern Australia, including Tasmania
Acacia mangium	North Queensland, Papua New Guinea	Northern Territory

Source: National Forest Inventory (2003)


Michael F. Ryan

Controlled pollination bags on genetically improved radiata pine (*Pinus radiata*)

Whereas radiata pine (*Pinus radiata*) is clearly an exotic plantation species, Tasmanian or southern blue gum (*Eucalyptus globulus* subsp. *globulus*) is considered an indigenous species in plantations in Tasmania and an exotic species in plantations in Western Australia. Flooded gum (*E. grandis*) and red mahogany (*E. pellita*) are indigenous plantation species. Mangium (*Acacia mangium*) is being used in plantations well outside its natural range and is therefore an exotic species in these plantations.

Flooded gum and mangium are major timber plantation species worldwide. Conservation of the genetic material of these species where they occur naturally in Australia therefore has implications for plantations in other countries.

Tree species are selected for establishment in timber plantations on the basis of their suitability for timber or other products and their suitability for the climate and land at the plantation site. As in agriculture, the focus of genetic management for plantations is to improve productivity in terms of volume and value of products. This is possible because there are genetic differences between individuals in each species. Breeding from individuals with preferred characteristics enables genetic variation to be used to improve productivity.

Selecting individuals that grow more vigorously in the area available for plantation development can improve tree productivity. Better vigour may be related to better suitability to climate or soil and/or to better resistance to pests and diseases. Selecting individuals with better timber-producing properties can also improve productivity. For example, wood density and tree branching habit have substantial impacts on wood volume and value.

Genetic improvement of radiata pine (*Pinus radiata*) has been a focus of forestry research and development in Australia since soon after plantation forestry began here in the late 19th century. All radiata pine trees now planted in Australian plantations are the result of this genetic improvement. Less progress has been made for the other common plantation timber species because their use in plantations commenced more recently. Other timber plantation species for which genetic improvement research and development is underway include *Eucalyptus globulus*, *P. pinaster*, *P. brutia*, *E. cloeziana*, *E. grandis* and *E. camaldulensis*.

As in agricultural crop species, breeding plantation timber species for improved productivity carries the risk of narrowing the genetic variability within the plantations to the point that the selected genotypes are susceptible to unforeseen hazards. The key hazards of concern are usually pests and diseases. Tree breeding programs allow for this risk by trying to ensure that adequate genetic variability is maintained. The other key risk management strategy is to ensure the conservation of the exotic plantation species within its natural range.

Further reading

Mandal, A.K. and Gibson, G.L. (eds) (1998). Forest Genetics and Tree Breeding. CBS Publishers, New Delhi.