Criterion 2

Maintenance of productive capacity of forest ecosystems

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Plantation pine forest, Queensland.

Criterion 2 Maintenance of productive capacity of forest ecosystems

A key goal of sustainable forest management is to maintain the productive capacity of native and plantation forests. This allows provision of the forest goods and services used by society without compromising the ability of future generations to meet their own needs. The five indicators comprising Criterion 2 therefore aim to provide insights into whether Australia's native forests and commercial plantations used to produce wood and non-wood products are managed in a way that maintains their capacity to continue to produce those products in the long term.

Indicators 2.1a and 2.1b deal with the area of native forests available for wood production and the area of commercial plantations, how these areas have changed over time, and the annual area harvested by jurisdiction and by silvicultural system.

The main wood products harvested from Australia's native forests are high-quality sawlogs for solid wood products, and pulplogs for paper, cardboard, fibreboard and related products. Increasingly, logs are also used to produce peeled veneer for wood-based panel products. Native forests managed for wood production include areas of multiple-use public forests, but exclude areas that do not carry commercial species, or are unsuitable, inaccessible, or excluded by regulatory requirements such as for the protection of soil, water, flora and fauna, recreation and other values. Some areas of leasehold and private native forests are also available for wood production. The annual area of native forest that is harvested in each jurisdiction is reported in Indicator 2.1a according to the silvicultural system applied to each area.

Commercial plantations are the plantations managed for commercial wood production that are reported through Australia's National Plantation Inventory. Indicator 2.1b presents data on the changes over time in the area, species mix and ownership of Australia's commercial plantation estate.

Indicator 2.1c compares the volume of sawlogs harvested from native forests in each jurisdiction, with the harvest volumes determined to be sustainable. Permitted sawlog harvest volumes are set according to a calculated annual sustainable yield or allowable cut, derived from the area of forest

Landscape mosaic of radiata pine plantations and native forests, Bombala, New South Wales.

available for harvest, forest type and age class, standing wood volume, terrain, accessibility, and growth and yield data. Sustainable yield values also take into account restrictions on harvesting within the area available for harvest that are imposed by codes of forest practice, and by other rules and regulatory frameworks established to ensure the protection and maintenance of biodiversity and soil and water resources. Indicator 2.1c also reports on the harvest of softwood and hardwood plantation sawlogs and pulplogs, and on the forecast availability of sawlog and pulplog harvests from plantations over future decades.

Non-wood forest products are products other than wood that are derived from forests. The diverse range of non-wood forest products harvested from Australia's forests includes honey, wildflowers, seeds, animals, and sandalwood used to produce aromatic oil, and is summarised in Indicator 2.1d. These products are regionally and locally significant sources of employment, and are increasing in their commercial importance. Many Aboriginal and Torres Strait Islander peoples (referred to in SOFR 2018 as Indigenous peoples) rely to varying degrees on the use of non-wood forest products for customary purposes (e.g. medicine and livelihood) and commercial purposes (e.g. bushfoods, art and craft).

Harvesting wood from native forests is permitted only if systems are in place for forest regeneration, as the regeneration of a new forest stand is critical to maintaining the productive capacity of the forest. Data on the area of harvested forest that is regenerated successfully in a defined time period, and on the re-establishment of harvested plantations, are reported in Indicator 2.1e.

This icon indicates data, maps or graphics from *Australia's State of the Forests Report 2018* that are available for electronic download. Data used in figures and tables in this criterion, together with higher resolution versions of maps and other graphical elements, are available via www.doi.org/10.25814/5bda8a9ed76d5 and www.doi.org/10.25814/5be3bc4321162.

Indicator 2.1a

Native forest available for wood production, area harvested, and growing stock of merchantable and non merchantable tree species

Rationale

This indicator reports the capacity of forests to sustainably produce wood to meet society's needs into the future. The area of native forest available for wood production, the nature of the growing stock, and the area harvested over time provide means to demonstrate the sustainability of forest management.

Key points

- This indicator reports on four separate metrics:
  - the area of native forest on which wood production is not legally restricted or prohibited
  - the area of native forest on leasehold, private and multiple-use public forest tenures that is available and suitable for commercial wood production
  - the net harvestable area of multiple-use public native forest when additional local restrictions are taken into account
  - the annual area of multiple-use public native forest harvested.
- In 2015–16, the total area of native forest in Australia not legally restricted or prohibited from wood harvesting was 83.6 million hectares.
  - This area comprises predominantly leasehold forest, private forest, and multiple-use public forest. Within this area, the area from which trees may be legally harvested is substantially smaller due to regulatory exclusions or prescriptions.
  - Wood harvesting of native forests is not permitted in nature conservation reserves in any jurisdiction in Australia. No commercial harvesting is carried out in native forests in the Australian Capital Territory or South Australia.
- The extent of native forest that is available and suitable for commercial wood production was 28.1 million hectares in 2015–16. This figure excludes areas that are unsuitable for wood production or in which wood production is not economically viable.
  - The extent of native forest that was available and suitable for commercial wood production was 37.6 million hectares in 2005–06, and 29.3 million hectares in 2010–11.
  - This decline over time is a consequence of several factors, including reclassification of forest as non-forest based on improved mapping techniques for SOFR 2013, changes in forest tenure, transfers of multiple-use public native forests to the nature conservation reserve system, and continuing increases in the areas of multiple-use public native forest to which harvesting restrictions apply.
  - A total of 6.3 million hectares of public native forests were available and suitable for commercial wood production in 2015–16. Of this, 3.8 million hectares are of moderate, high or very high commerciality and are concentrated in the higher rainfall areas of south-west, south-east and eastern Australia.
  - A further 21.8 million hectares of leasehold and private tenure forests were also potentially available and suitable for commercial wood production. However, much of these forests are of low commerciality, are isolated from markets, are forests where harvesting is not operationally feasible or financially viable, or are used predominantly for grazing or for other purposes by the land owner or manager.
- The net area available and suitable for commercial wood production in multiple-use public native forests when additional local restrictions are taken into account (the net harvestable area) is 5.0 million hectares (12% of the total area of public native forests across all public tenures).
  - Harvesting in multiple-use public native forests is subject to strict requirements, exclusions and restrictions at the scale of individual operations, to maintain and manage non-wood values.
  - The net harvestable area of public native forests has declined by 50% from the 10.1 million hectares reported in 1995–96.
  - This decrease mostly resulted from transfer of areas of multiple-use public native forest to the nature conservation reserve system as a part of the Regional Forest Agreement process.

Continued

Continues

Key points

- The average annual area of multiple-use public native forests harvested in Australia in the period 2011–12 to 2015–16 was 78 thousand hectares.
  - This is a 24% decrease from the annual average of 102 thousand hectares for the period 2006–07 to 2010–11, which in turn was a 21% decrease from the annual average of 129 thousand hectares for the period 2001–02 to 2005–06.
  - The total area harvested on multiple-use public native forests in 2015–16, 73 thousand hectares, is 1.5% of the net harvestable area of public native forest, and 0.75% of the total area of multiple-use public native forest.
  - Of the area of multiple-use public native forest harvested over the period 2001–02 to 2015–16, 83% was harvested by using selection silvicultural systems (selection harvesting, native cypress pine harvesting and commercial thinning), 13% by clearfelling silvicultural systems (clearfelling, fire-salvage clearfelling, and intensive silviculture with retention), 4% by shelterwood systems, and 0.2% by variable retention systems.

The emphasis of this indicator is the area of native forests available for wood production, that is, the area in which harvesting is *not legally restricted*[102]. For the purpose of reporting for SOFR 2018, the term "not legally restricted" is confined to five national forest tenure categories: leasehold forest, multiple-use public forest, other Crown land, private forest and unresolved tenure. The sixth national forest tenure category, nature conservation reserve, is considered to be legally restricted from harvesting.

Harvesting is also subject to various forms of regulation on tenures where it is "not legally restricted", including codes of practice, management plans, and requirements to manage the forest for multiple values. Reasons for these restrictions include conservation and management of biodiversity and heritage, and protection of water supplies (see Indicators 7.1a and 7.1b). By regulation, no commercial harvesting is carried out in native forests in the Australian Capital Territory or South Australia. In Australia, the area of native forest available for wood production is therefore a function of tenure, legislation and regulation, as well as economic constraints.

[102] The Montreal Process guideline for this indicator (Montreal Process Working Group 2001) defines forest available for wood production as "forest land where wood product extraction is not legally restricted. For example, parks and other areas removed from harvest for protective purposes (i.e. soil protection) is legally restricted. Where harvesting is not legally restricted on private or public land and owners do or do not have a management intent to harvest, all this land would still be considered available for harvest".

The area of native forests available for wood production is one determinant of the potential domestic supply of wood-based products, and as such is an important input for calculating the sustainable yield of wood from native forests (see Indicator 2.1c).

This indicator also reports on the area of native forest harvested by jurisdiction, year and silvicultural system. The rationale for the indicator also refers to growing stock, which is the total volume of wood in all living trees in a forest at a given time. This is because increases or decreases in growing stock can indicate (among other things) the sustainability of resource use. However, limited data are available across Australia on current growing stock in native forests.

The Resource Assessment Commission (1992) compiled estimates of the growing stock of standing commercial wood, but no national estimates have been made since that work. Subsequent estimates of available growing stock have been and are used to estimate sustainable harvesting levels in multiple-use public native forests in New South Wales, Tasmania, Victoria and Western Australia, and for Tasmanian private forests (see Indicator 2.1c). However, updated data on available growing stock are not available for this indicator in SOFR 2018, and little information is available on the growing stock of non-merchantable tree species (tree species that do not produce saleable products).

Native forest area available for wood production

The major source of Australia's native timber and wood-based products is multiple-use public forests in New South Wales, Queensland, Tasmania, Victoria and Western Australia; forests on land with leasehold and private tenure also contribute to supply in some of these states. Supplies from leasehold and private tenures in the Northern Territory are limited and only occur periodically. Supplies also come from other Crown land in Queensland, and supplies may occur from land in unresolved tenure in New South Wales, Northern Territory and Queensland once the status of tenure is resolved.

Native forest not legally restricted from harvesting

Commercial wood harvesting is legally restricted or prohibited on nature conservation reserve tenure, on informal reserves (see Indicator 1.1c) on all other tenures, on private and leasehold forest that is under conservation covenant or reserved by other mechanisms, and on other Crown land where harvesting is inferred to be legally restricted as a result of government policy. Harvesting is not legally restricted on all other land. In previous SOFR reporting periods, all areas of the tenure categories 'other Crown land' and 'unresolved tenure' were regarded as legally restricted from wood harvesting, but relevant areas of these tenure categories are now included as not legally restricted (Table 2.1), although they are not included in commerciality assessments (see Table 2.2).

In 2015–16, the gross area of native forest in Australia not legally restricted or prohibited from wood harvesting was 83.6 million hectares (Table 2.1), which is 63% of Australia's total area of native forest. Within this area, the area from which trees may be legally harvested is substantially smaller due to regulatory exclusions or prescriptions. The largest areas of native forest not legally restricted from wood harvesting are in Queensland (41.9 million hectares comprising mostly leasehold and private forest), followed by the Northern Territory and New South Wales (17.2 million hectares and 12.6 million hectares respectively, again comprising mostly leasehold and private forest). The area of multiple-use public native forest not legally restricted from wood harvesting totals 8.1 million hectares across Australia.

In 2000–01, the area of native forest not legally restricted from wood harvesting was 119.8 million hectares, 74% of Australia's native forests at that time (SOFR 2003). This area decreased in absolute terms to 112.6 million hectares in 2005–06, but increased in proportional terms to 76% of Australia's native forests (SOFR 2008). SOFR 2013 reported a further decrease to 82.6 million hectares not legally restricted from harvesting in 2010–11, and to 67% of Australia's native forest. However, changes in the methodology underlying determination of Australia's forest area and tenure mean that the figures for the area and proportion of native forest not legally restricted from wood harvesting cannot readily be compared over time.

The Tasmanian Special Species Management Plan (DSG 2017) indicates that conditional access for the harvest of Tasmanian special-species timbers may be granted to Future Potential Production Forest Land (classified for SOFR 2018 under the national forest tenure 'Other Crown land') as well as Conservation Areas, Regional Reserves and Public Reserves (classified for SOFR 2018 as the national tenure 'Nature conservation reserve'). These areas are here treated as legally restricted from harvesting until harvesting approval is given.

Forests across all tenures, but particularly multiple-use public native forest, are increasingly managed for a range of values, such as soil and water protection, flora and fauna protection, and conservation, as well as or instead of wood production. This trend of changing use has contributed to continuing increases in the legal restrictions on the use of multiple-use public native forests for wood harvesting.

Forest available and suitable for commercial wood production

The area of native forest not legally restricted from wood harvesting substantially overestimates the area actually available to timber and wood-processing industries, because it includes forests that are unsuitable for wood harvesting or in which wood harvesting is not economically (commercially) viable, as well as forests that are excluded from harvesting on account of management intent, or as a result of local operational prescriptions and restrictions.

Between 1960 and 1990, data were provided by state and territory agencies to Australian Government agencies on the areas of native forest that were both commercially available and commercially suitable for wood production from multiple-use public forests, leasehold and private forests. Such reporting was not continued after 1992. Subsequently, Davey and Dunn (2014) undertook a national assessment of merchantability and productivity of native forests, with these parameters together giving commercial suitability; then intersected this spatial coverage with areas available for commercial harvesting on the leasehold, private and multiple-use public forest estate (to give commercial availability); and then produced a map of native forests available and suitable for commercial wood production, by their level of assessed commerciality. Forest 'available and suitable' for commercial harvesting is forest with a commerciality rating of very low, low, moderate, high or very high (Davey and Dunn 2014).

Figure 2.1 shows the national distribution of native forest areas by their assessed level of commerciality as at June 2016.

Table 2.2 shows the estimated area of native forest that is available and suitable for wood harvesting in 2006, 2011 and 2016, categorised by its commerciality rating, and separately for the tenures leasehold forest, private forest and multiple-use native public forest. A small amount of commercial harvesting may occur in native forest on other tenures, such as 'other Crown land' and 'unresolved tenure' (see Table 2.1), but commercial forest in those tenures is not considered in this analysis.

For 2006, as reported in SOFR 2008, a total of 37.6 million hectares of native forest was assessed as available and suitable for commercial wood production, which was 33% of the 112.6 million hectares of forest in these tenures. Of this area, 9.9 million hectares were of moderate, high or very high commerciality (not shown).

SOFR 2013 reported that, in 2011, the estimated area of native forest available and suitable for wood harvesting had decreased to 36.6 million hectares, which was 40% of the 92.1 million hectares of native forest in the tenures leasehold, private and multiple-use public native forest. However, this value was an overestimate because of an analytical error relating to the reclassification of forest as non-forest based on improved mapping techniques for SOFR 2013, and a revised estimate is shown in Table 2.2. The estimate is now that 29.3 million hectares of native forest were available and suitable for commercial wood production in 2011 (Table 2.2), which was 32% of the 92.1 million hectares of native forest in these tenures, and 8.3 million hectares less than the 2006 estimate. Of this 29.3 million hectares of commercial forest as at 2011, 8.1 million hectares were of moderate, high or very high commerciality (not shown).

Around 6.5 million hectares of the reduction in reported area from 2006 was attributed to the reclassification of forest as non-forest based on improved mapping techniques for SOFR 2013. The remaining 1.8 million hectares of the reduction in area from 2006 was attributed to forest becoming unavailable for wood production as a result of increased reservation (as a combination of formal and informal reserves, management prescriptions, and conservation covenants on private land) (ABARES, unpublished).

Table 2.1: Area of native forest that is or is not legally restricted from wood harvesting, by tenure and jurisdiction, 2015–16 ('000 hectares)

National forest tenure	Total native forest	Legally restricted from wood harvesting	Not legally restricted from wood harvesting									Proportion not legally restricted from wood harvesting (%)
			ACT	NSW	NT	Qld	SA	Tas.	Vic.	WA	Total	
Leasehold forest	47,246	4,922	0	3,973	8,276	26,180	0	0	0	3,894	42,323	90
Multiple-use public forest	9,772	1,639	0	1,318	0	2,826	0	503	2,144	1,342	8,133	83
Nature conservation reserve	21,719	21,719	0	0	0	0	0	0	0	0	0	0
Other Crown land	11,042	10,656	0	0	0	386	0	0	0	0	386	3
Private forest	41,031	9,079	0	7,212	8,841	11,812	0	708	945	2,435	31,952	78
Unresolved tenure	805	32	0	77	37	659	0	0	0	0	773	96
Total	**131,615**	**48,047**	**0**	**12,581**	**17,153**	**41,863**	**0**	**1,211**	**3,088**	**7,671**	**83,567**	**63**

Notes:

Legal restrictions on wood harvesting apply in all native forests in the ACT and SA; on nature conservation reserves; on informal reserves on all other tenures; on private and leasehold forest that is under conservation covenant, or regulated or reserved by other mechanisms (see Indicator 1.1c); and are presumed to apply to areas of 'other Crown land' that is not available to commercial wood harvesting.

Wood harvesting on Tasmania's Future Potential Production Forest Land is currently restricted through regulation and is classed here as 'Other Crown land' and legally restricted from harvesting.

Tenures are national tenure categories (see Introduction and Indicator 1.1a) and may not coincide with state or territory tenure categories.

Totals may not tally due to rounding.

Source: ABARES.

This table, together with other data for Indicator 2.1a, is available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

As at 2016, the estimated area of native forest available and suitable for wood harvesting had decreased to 28.1 million hectares, which was 29% of the 98.0 million hectares of native forest in the tenures leasehold, private and multiple-use public native forest (Table 2.2). This was a further decrease of 1.3 million hectares from the corrected figure for 2011. While there were tenure changes during the reporting period (Indicator 1.1a), most of the decrease was a result of further reservation or protection of native forests, as well as the reclassification as non-commercial of a small area of forests previously classified as being of very low commerciality (Table 2.2). Of this 28.1 million hectares of commercial forest as at 2016, 7.7 million hectares were of moderate, high or very high commerciality (not shown).

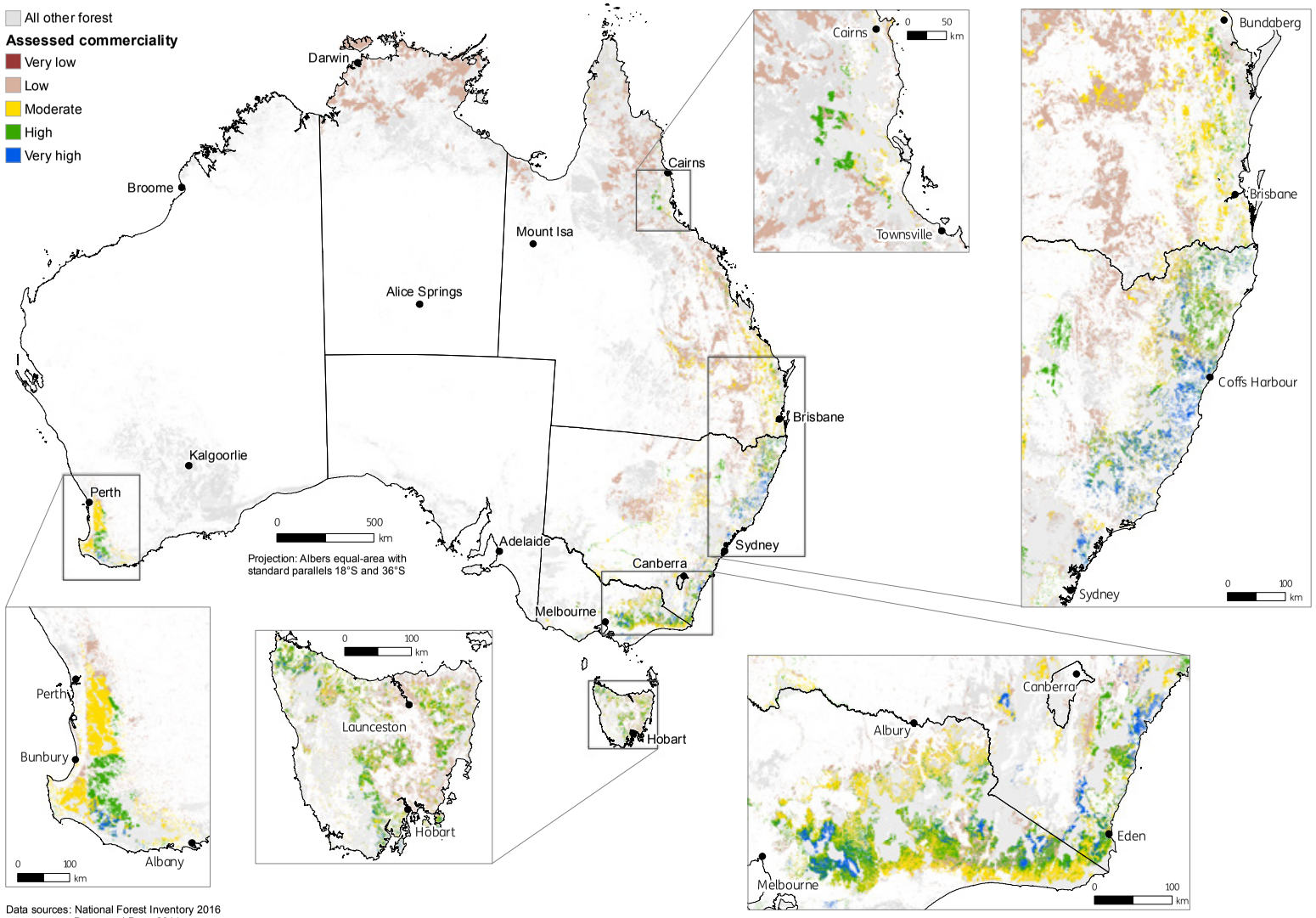
A longer-term view of the changes in the area of native forest available and suitable for wood production is provided in Figure 2.2.

Of the 28.1 million hectares of commercial native forest as at 2016, 6.3 million hectares (22%) is on multiple-use public forest tenure (Table 2.2). This is 64% of the 9.8 million hectares of multiple-use public native forests. The balance of the commercial native forest is on leasehold and private tenure forests (8.2 million hectares and 13.6 million hectares, respectively), but comprises a smaller proportion of the area of forest on these tenures (17% and 33%, respectively).

Of the 7.7 million hectares of native forests of moderate, high or very high commerciality as at 2016, 3.8 million hectares (50%) is on multiple-use public forest tenure (Table 2.2). These forests of moderate, high or very high commerciality are concentrated in the higher rainfall areas of south-west, south-east and eastern Australia (Figure 2.1). A much smaller proportion of the area of leasehold and private tenure forests (8% and 1%, respectively) is of moderate, high or very high commerciality.

A large part of the native forest on leasehold and private land that is available and suitable for commercial wood production contributes minimally to commercial wood supply. This is due to those forests being of low commerciality, being isolated from markets, being forests where harvesting is not operationally feasible or financially viable, or being used predominantly for grazing or for other purposes by the land owner or manager. Commercial harvests in the Northern Territory and northern Queensland are especially limited because of accessibility and remoteness.

Figure 2.1: Australia's native forest available and suitable for commercial wood production, 2016



Notes: Native forest 'available and suitable' for harvesting is native forest with a commerciality rating of very low, low, moderate, high or very high, assessed across the leasehold, private and multiple-use public forest estate (but not other tenures). 'All other forest' on this map includes native forest of limited, possible or no commerciality; sandalwood; forest of unknown floristics and structure; conservation reserves where harvesting is excluded, including on private land by conservation covenant, regulation or other mechanism; plus forests on formal nature conservation reserves, other Crown land, or land of unresolved tenure.

No forest was assessed as very low commerciality in 2016: the small areas of forest assessed as very low commerciality for SOFR 2013 in Victoria are now regarded as non-commercial based on the findings of Forest Solutions (2013).

Source: Davey and Dunn (2014); National Forest Inventory, ABARES.

A higher resolution version of this map is available via www.doi.org/10.25814/5be3bc4321162

Table 2.2: Australia's native forest available and suitable for commercial wood production, by commerciality rating, 2006, 2011 and 2016

		Area ('000 hectares)									
				Commercial forest (forest available and suitable for harvesting)							
				Wood commerciality rating							
Reporting year	Tenure[a]	Total forest[b]	Non-commercial forest and forest legally restricted from harvesting[c]	Very low	Low	Moderate	High	Very high	Total[d]	Proportion of total forest that is commercial[e] (%)	Proportion of total forest that is of moderate, high or very high commerciality[f] (%)
2006 (SOFR 2008)	Leasehold forest	65,132	51,155	4	12,790	845	308	30	13,977	21	2
	Multiple-use public forest	9,410	2,194	84	2,203	2,496	1,784	649	7,216	77	52
	Private forest	38,099	21,652	42	12,567	2,428	1,013	396	16,447	43	10
	Total	**112,641**	**75,001**	**130**	**27,561**	**5,769**	**3,105**	**1,075**	**37,640**	**33**	**9**
2011 rev[g] (revised from SOFR 2013)	Leasehold forest	48,533	38,206	0	9,399	627	277	23	10,327	21	2
	Multiple-use public forest	10,159	3,919	72	2,435	1,956	1,283	494	6,240	61	37
	Private forest	33,394	20,613	38	9,335	2,099	925	384	12,781	38	10
	Total	**92,086**	**62,739**	**110**	**21,170**	**4,682**	**2,485**	**901**	**29,347**	**32**	**9**
2016 (SOFR 2018)	Leasehold forest	47,246	39,094	0	7,596	390	164	2	8,151	17	1
	Multiple-use public forest	9,772	3,476	0	2,465	2,063	1,284	484	6,296	64	39
	Private forest	41,031	27,421	0	10,346	2,049	840	374	13,611	33	8
	Total	**98,049**	**69,991**	**0**	**20,407**	**4,502**	**2,289**	**861**	**28,058**	**29**	**8**

[a] The existence of commercial forest on the tenure categories 'other Crown land', 'nature conservation reserve', and 'unresolved tenure' is not considered in this analysis, even though harvesting is not legally restricted on some areas of 'other Crown land' and 'unresolved tenure' (see Table 2.1).

[b] Figures for total forest in each tenure category are from Indicator 1.1a for 2006 (SOFR 2008), 2011 (SOFR 2013) and 2016 (this SOFR), using the forest coverages available at those times. Areas of forest of various commerciality ratings at those dates were obtained by overlaying these coverages and the commercial forest layer described in Davey and Dunn (2014).

[c] 'Non-commercial forest and forest legally restricted from harvesting' includes forest of limited, possible or no commerciality; sandalwood (not associated with other commercial species); forest of unknown floristics and structure; and conservation reserves on private and public land where harvesting is excluded by conservation covenant, regulation or other mechanisms. Forests on formal nature conservation reserves, other Crown land and land of unresolved tenure are not included on this table.

[d] 'Total' Commercial forest is the sum of the areas of forest of very low, low, moderate, high and very high commerciality.

[e] The proportion of the total area of forest in a tenure category that is classified as very low, low, moderate, high or very high commerciality.

[f] The proportion of the total area of forest in a tenure category that is classified as moderate, high or very high commerciality.

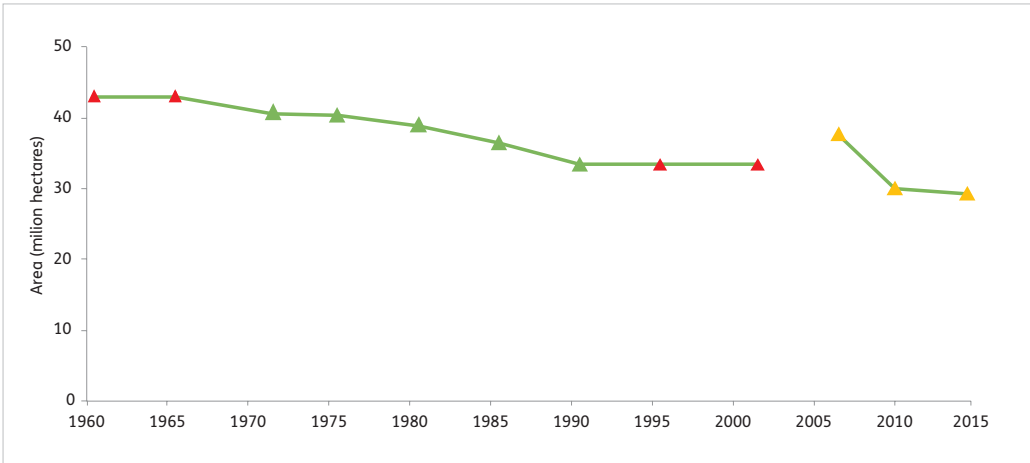
[g] '2011 rev' data are a revision of the figures published in SOFR 2013.

Totals may not tally due to rounding.

Source: Davey and Dunn (2014), ABARES.

This table, together with other data for Indicator 2.1a, is available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

Figure 2.2: Australia's native forests available and suitable for commercial wood production, 1960–2016



Notes:

Only leasehold, private and multiple-use public forest is considered in this analysis.

Green data points are derived from tabular data provided by state and territory agencies to Australian Government agencies and used for reporting in Resource Assessment Commission (1992). Red data points are estimates based on those tabular data and ancillary historical data. Yellow data points are based on the spatial assessment of forest commerciality reported in Davey and Dunn (2014) (as corrected) and the various SOFR forest coverages (Table 2.2). Methodological changes caused the increase after 2001. Spatial data was incomplete and poor for the first yellow data point.

Source: Resource Assessment Commission (1992), Davey and Dunn (2014), and ABARES (including historical forest resource datasets and publications from the Bureau of Agricultural Economics and the Commonwealth Forestry and Timber Bureau).

The data used to create this figure, together with other data for Indicator 2.1a, are available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

Net harvestable area of forest

The net harvestable area is the area used as the basis of sustainable yield calculations for multiple-use public native forests. The net harvestable area represents the net area of available and suitable forest on multiple-use public native forest land after allowing for local and/or operational constraints on wood harvesting. Net harvestable area is determined by subtracting the following areas from the gross available multiple-use public native forest area:

- areas within multiple-use forests that are reserved for nature conservation, water and heritage purposes, and/or are zoned for management purposes that do not permit wood harvesting
- forest exclusions resulting from the application of conditions in codes of forest practice or other regulatory instruments
- forests determined to have operational constraints (e.g. roading access) or to be non-merchantable – that is, to be not suitable for wood production because of the age, size and species of trees, or because they have been damaged by fire or disease.

Only a proportion of these regulatory or environmental exclusions can be mapped in advance of forest operations. Some prescriptions such as for riparian zones, fauna and flora exclusion areas, and for protection of rare, fragmented or dispersed values, are applied as a result of field observation during preparation of a site for wood harvest.

The net harvestable area of public native forest was 5.0 million hectares in 2015–16, which was a decline of 0.52 million hectares (9%) from the area reported in SOFR 2013, and a decline of 5.1 million hectares (50%) from the 10.1 million hectares reported in 1995–96 (Table 2.3). The decline over this period includes reductions resulting from the implementation of Regional Forest Agreements in four states that saw significant areas of multiple-use public native forest transferred to the nature conservation reserve system (Davidson et al. 2008). The net harvestable area of public native forest in 2015–16 is 12% of the area of public native forest in Australia, compared to 22% in 1995–96.

In New South Wales, the net harvestable area of public native forest declined from 2.35 million hectares in 1995–96 to 1.02 million hectares in 2015–16 (Table 2.3), a reduction of 57%. The 0.21 million hectare reduction in net harvestable area between 2010–11 and 2015–16 was not due to new prescriptions or large transfers of land into nature conservation reserves, but rather to application of net harvest modifier models (FCNSW 2016b) that incorporate new data on the relationship between mapped exclusions and actual exclusions in coastal forest harvesting operations.

In Tasmania, the net harvestable area of public native forest decreased from 0.81 million hectares in 1995–96 (36%) to 0.56 million hectares in 2010–11 (23%) (Table 2.3). This was due to the reallocation of areas of multiple-use public native forest as nature conservation reserves during implementation of the 1997 Regional Forest Agreement and the 2005 Tasmanian Community Forest Agreement, and to changes to provisions in the Tasmanian *Forest Practice Code* (Davey 2018a; FPA 2012). The net harvestable area of public native forest further decreased to 0.38 million hectares (15%) in 2015–16, a reduction of 0.19 million hectares, in the implementation of the 2013 Tasmanian Forest Agreement and the extension to the Tasmanian Wilderness World Heritage Area in 2013 (FPA 2012, 2017a).

Table 2.3: Net harvestable area of public native forest[a], and proportion of total public native forest[a], by jurisdiction, 1995–96 to 2015–16

State	Net harvestable area of public native forest	1995–96	2000–01	2005–06	2010–11	2015–16
NSW	Area ('000 hectares)	2,352	1,516	966[b]	1,229[b]	1,020
	Proportion of total NSW public native forest (%)	35	20	12	16	12
Qld	Area ('000 hectares)[c]	3,186	2,340	2,178	2,030	1,921
	Proportion of total Qld public native forest (%)	40	26	27	22	22
Tas.[d]	Area ('000 hectares)	811	787	607	563	376
	Proportion of total Tas. public native forest (%)	36	35	27	23	15
Vic.	Area ('000 hectares)	2,555	1,010	930	835	824
	Proportion of total Vic. public native forest (%)	41	15	14	13	12
WA	Area ('000 hectares)	1,157	904	848	848	849
	Proportion of total WA public native forest (%)	6	6	7	7	6
Total	**Area ('000 hectares)**	**10,061**	**6,557**	**5,528**	**5,505**	**4,989**
	Proportion of total public native forest (%)	**22**	**14**	**13**	**14**	**12**

[a] Public native forest comprises the tenures multiple-use public native forest, nature conservation reserve and other Crown land. Data do not include harvestable areas on leasehold or private lands accessible to public forest agencies for wood harvesting.

[b] The increase in the reported net harvestable area for NSW public native forests between 2005–06 and 2010–11 resulted from use of a new standardised methodology and a corporate geo-database.

[c] Data for Queensland are net harvestable area on multiple-use public native forest only, but not other Crown land or unresolved tenure.

[d] Data for net harvestable area for Tasmania for 1995–96 to 2010–11 apply to all state forests (multiple-use public native forest) and other Crown land available for harvesting. Data for 2015–16 are only for Permanent Timber Production Zone Land managed by Forestry Tasmania (now Sustainable Timber Tasmania) and not for other public tenures.

Note: Area statements of public forest reported in SOFR 1998, 2003, 2008, 2013 and 2018 are used to calculate proportion of total public native forest.

Source: State and Territory government agencies, including FPA (2007, 2012, 2017a), Forest Practices Board (2002) and DSE (2003, 2008); ABARES.

This table, together with other data for Indicator 2.1a, is available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

In Victoria, the net harvestable area of public native forest decreased from 2.55 million hectares in 1995–96 to 0.82 million hectares in 2015–16, a decrease of 68% (Table 2.3). There were several reasons for this decrease: some multiple-use public native forest was transferred to nature conservation reserves, some forest became unavailable due to changes in prescriptions in the *Victorian Code of Practice for Timber Production* and to changes in special protection zones, and some forest was reassessed as unsuitable for wood production because of operational constraints and a lack of merchantable wood (DEPI 2014d).

In Western Australia, the net harvestable area of public native forest declined from 1.16 million hectares in 1995–96 to 0.85 million hectares in 2005–06 (Table 2.3), a decrease of 27%. This was a result of the transfer of parts of the multiple-use public native forest estate to nature conservation reserves, and the introduction by the Western Australian Government of a policy for the protection of old-growth forests. The net harvestable area has remained unchanged from 2005–06 to 2015–16.

In 1999, the Queensland Government signalled a phase-out of harvesting in public native forest in south-east Queensland in favour of wood production from hardwood plantations and private native forests (SOFR 2008); subsequent planning processes excluded harvesting from further areas of public native forests. This has resulted in the steady decrease in the net harvestable area of public native forest from 3.2 million hectares (40%) in 1995–96 to 2.0 million hectares (22%) in 2010–11, a decline of 36%. With a change in Queensland Government policy, the phase-out of harvesting was terminated in 2012 (SOFR 2013). The net harvestable area has decreased by a further 0.11 million hectares since 2010–11.

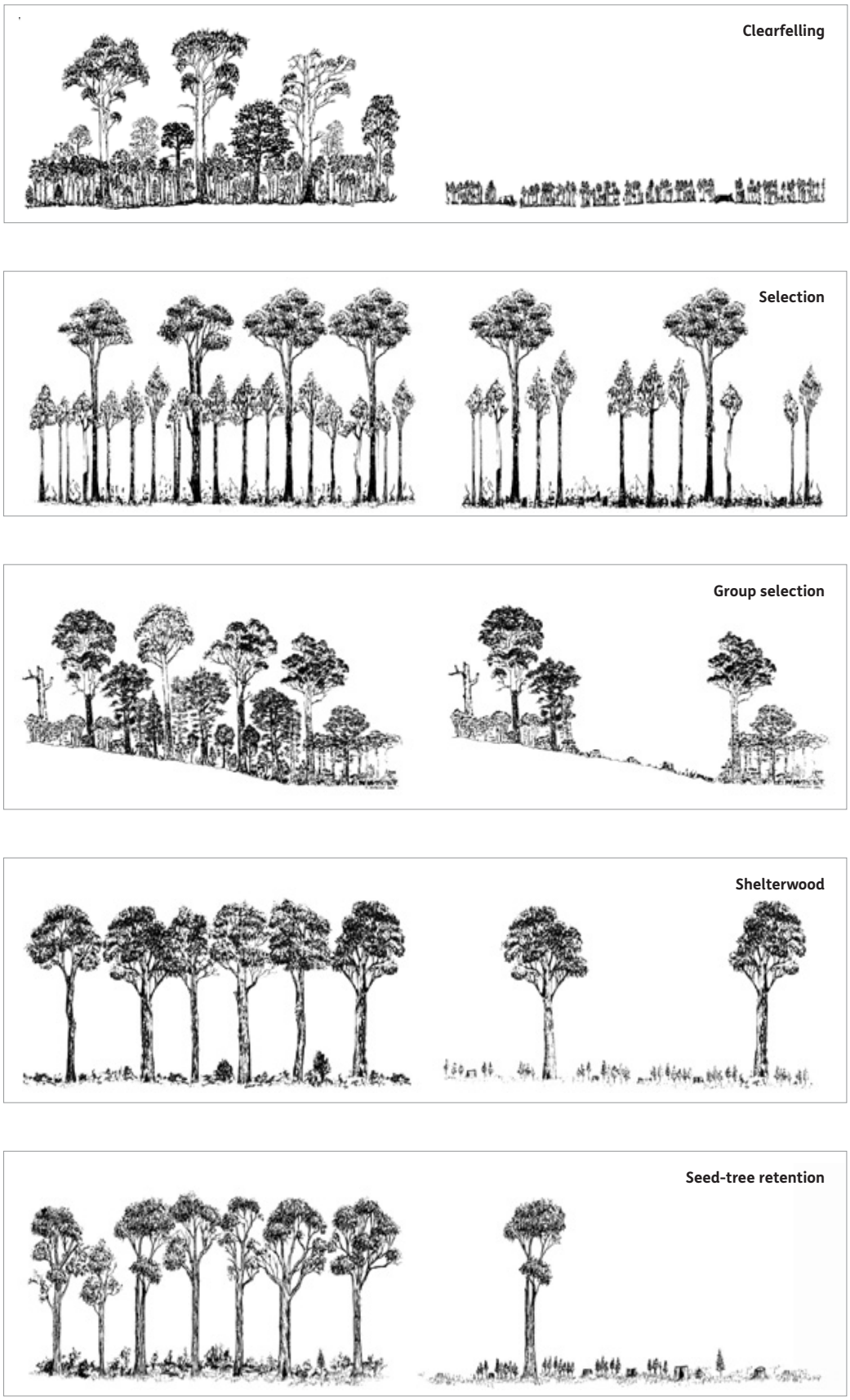
No estimates of the net harvestable area of private and leasehold forests in any jurisdiction were available for SOFR 2018. An estimated 0.36 million hectares (27%) of Victoria's private and leasehold forests were available and suitable for timber production in 2000–01 (DSE 2003). By June 2014, under the private native forestry property vegetation plan (PNF PVP) approval process, 0.55 million hectares of private forests in New South Wales (7% of NSW private forests) had been approved for sustainable harvest of timber resources (NSW OEH 2016b), the majority (73%) of which area was in north-eastern New South Wales.

Area of native forest harvested for wood

While limited data are available on the area of private native forests harvested annually in Australia, agencies managing public forests report annually or five-yearly on the area of forest that is harvested and regenerated under various silvicultural systems (Figure 2.3). Some data are also available for the area harvested in private forests in Tasmania and leasehold forests in Queensland.

The area of multiple-use public native forest harvested in Australia is summarised by silvicultural system in Table 2.4, and by jurisdiction in Table 2.5. Nationally, the total area harvested annually has declined steadily from 141 thousand hectares in 2001–02 to 73 thousand hectares in 2015–16, a 48% decrease. The mean annual harvest area in various

Figure 2.3: Silvicultural systems used in Australia's native forests



Source: Adapted from original artwork by Fred Duncan in Wilkinson (1994).

A higher resolution version of this graphic is available via www.doi.org/10.25814/5be3bc4321162

Table 2.4: Area (hectares) of silvicultural systems used in multiple-use public native forest in Australia

	Silvicultural system[a]										
Reporting year	Clear-felling[b]	Fire salvage (clear-felling)[b]	Intensive silviculture with retention[b]	Shelter-wood	Variable retention[c]	Selection[d,e]	Native cypress pine silviculture[d,e]	Commercial thinning[d]	All systems	Cleared for mining[f]	Total area harvested
2001–02	10,607	100	7,958	7,920	0	68,968	29,576	14,952	140,081	630	140,711
2002–03	11,184	400	6,546	6,500	0	67,631	29,767	14,684	136,712	390	137,102
2003–04	10,440	1,800	5,862	4,330	38	60,112	33,075	12,995	128,652	–	128,652
2004–05	9,680	600	5,118	4,310	39	56,146	29,693	12,747	118,333	500	118,833
2005–06	7,580	900	5,719	2,870	0	60,755	30,954	9,895	118,673	340	119,013
2006–07	8,310	500	4,855	2,780	342	64,411	25,120	10,478	116,796	600	117,396
2007–08	6,710	1,500	3,566	3,040	413	61,302	38,200	12,039	126,770	920	127,690
2008–09	5,410	1,000	3,662	2,700	336	40,193	21,300	12,261	86,862	690	87,552
2009–10	3,900	3,000	4,508	5,260	190	43,139	27,450	8,622	96,069	990	97,059
2010–11	3,880	2,850	6,877	3,890	330	30,792	22,512	6,993	78,124	1,250	79,374
2011–12	2,668	290	4,040	3,590	70	30,655	29,311	6,298	76,922	1,360	78,282
2012–13	3,597	440	3,053	4,800	270	30,995	32,210	8,253	83,618	790	84,408
2013–14	2,936	320	3,776	3,390	47	30,554	27,684	4,921	73,628	1,390	75,018
2014–15	3,014	310	3,381	2,770	415	35,974	27,910	3,333	77,107	910	78,017
2015–16	3,291	266	3,382	3,180	150	27,576	30,678	3,544	72,067	1,140	73,207
Annual mean, 2001–02 to 2005–06 (SOFR 2008 reporting period)	**9,898**	**760**	**6,241**	**5,186**	**15**	**62,722**	**30,613**	**13,055**	**128,490**	**372**	**128,862**
Annual mean, 2006–07 to 2010–11 (SOFR 2013 reporting period)	**5,642**	**1,770**	**4,694**	**3,534**	**331**	**47,959**	**26,916**	**10,079**	**100,924**	**890**	**101,814**
Annual mean, 2011–12 to 2015–16 (SOFR 2018 reporting period)	**3,101**	**325**	**3,526**	**3,546**	**190**	**31,151**	**29,559**	**5,270**	**76,668**	**1,118**	**77,786**
Annual mean, 2001–02 to 2015–16	**6,214**	**952**	**4,820**	**4,089**	**179**	**47,277**	**29,029**	**9,468**	**102,028**	**793**	**102,821**
15-year total as proportion of 15-year total for all silvicultural systems (%)	**7**	**1**	**5**	**4**	**0.2**	**48**	**25**	**10**	**100**		

–, not separately reported.

[a] Some silvicultural systems are illustrated in Figure 2.3.

[b] Clearfelling, fire-salvage clearfelling and intensive silviculture with retention are all clearfelling silvicultural systems. Intensive silviculture with retention includes areas harvested with seed-tree and/or habitat-tree retention, and alternate coupe harvesting. Variable retention silviculture is not a clear-felling system, and is reported separately.

[c] Variable retention silviculture is a silviculture system implemented in wet forests as an alternative to clearfelling systems with the explicit goal of maintaining species, habitats and structural features.

[d] Selection, native cypress pine silviculture and commercial thinning are all selection silvicultural systems.

[e] For the SOFR 2018 reporting period, Queensland data includes harvest figures for native forests with Crown timber rights on the national tenure categories leasehold forest and other Crown land (area figures given in footnotes to Table 2.5).

[f] Jarrah forests in Western Australia that are harvested as part of clearing for bauxite mining are shown as 'cleared for mining'.

Notes:

No harvesting of native forest is permitted from public forests in the Australian Capital Territory, Northern Territory or South Australia.

Data for the years 2009–10 and 2010–11 have been updated since SOFR 2013.

Source: Data provided by NSW, Qld, Tas., Vic. and WA.

This table, together with other data for Indicator 2.1a, is available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

SOFR reporting periods fell from 129 thousand hectares in period 2001–02 to 2005–06, to 102 thousand hectares in the period 2006–07 to 2010–11 (a 21% decrease), then further to 78 thousand hectares in the period 2011–12 to 2015–16 (a further 24% decrease). The total area harvested on multiple-use public native forests in 2015–16, 73 thousand hectares, is 1.5% of the net harvestable area of public native forest, and 0.75% of the total area of multiple-use public native forest.

Tasmania, Victoria and Western Australia use clearfelling as a silvicultural system to promote native forest regeneration in certain forest types. Annual clearfelling data of native forests in Table 2.4 include native forest regenerated to native forest and, in Tasmania, native forest converted to plantation during the period 2001–02 to 2010–11 (the conversion of native forest to plantations on public land in Tasmania was phased out by 2010). Salvage of fire-damaged native forest stands using clearfelling systems in Victoria and Tasmania, and areas clearfelled in association with bauxite mining in Western Australia, are reported separately (Table 2.4). Intensive silviculture with retention includes areas harvested with seed-tree and/or habitat-tree retention, practised in Tasmania, Victoria and Western Australia, and alternate coupe harvesting in the Eden region of New South Wales.

Variable retention silviculture is a silviculture system implemented in wet forests as an alternative to clearfelling systems, and with the explicit goal of maintaining species, habitats and structural features (Baker and Read 2011). Table 2.4 reports variable retention silviculture separately; this type of silviculture commenced in Tasmania in 2003 and in Victoria in 2013. A shelterwood silvicultural system used for nurturing and promoting regeneration in specific forest types is primarily practised in Western Australia and also in Tasmania.

Of the area of multiple-use public native forest harvested over the period 2011–12 to 2015–16, 86% was harvested by using selection systems, 9% by clearfelling systems, 5% by shelterwood systems, and 0.2% by variable retention systems (Table 2.4). The annual average area harvested by clearfelling systems (clearfelling, fire-salvage clearfelling and intensive silviculture with retention) decreased from 17 thousand hectares in 2001–02 to 2005–06 (13% of the total area harvested), to 12 thousand hectares in 2006–07 to 2011–12 (12% of the total area harvested), to 7 thousand hectares in 2011–12 to 2015–16 (9% of the total area harvested) (Table 2.4).

New South Wales, Queensland, Tasmania, Victoria and Western Australia apply selection harvesting silvicultural systems, including group or gap selection, Australian group selection, single-tree selection (including light, moderate and heavy selection systems and diameter-limit cutting), and mixtures of group selection and single-tree selection, based on the known regeneration responses of the different forest types. Native cypress pine silviculture (applied in New South Wales and Queensland) and commercial thinning of regrowth stands (applied in New South Wales, Tasmania, Victoria and Western Australia) also both use selection harvesting techniques; these are reported separately (Table 2.4).

Table 2.5 reports the area harvested from multiple-use public native forest annually, and the annual means for the three most recent SOFR reporting periods and for the 15-year period 2001–02 to 2015–16, by jurisdiction. New South Wales and Queensland together contributed 78% of the area of multiple-use public native forest harvested in Australia in the SOFR 2018 reporting period 2011–12 to 2015–16. Over the three SOFR reporting periods, New South Wales and Queensland each contributed more than one-third of the area of multiple-use public native forest harvested in Australia.

The mean annual area of multiple-use public native forest harvested continues to decrease in the SOFR 2018 reporting period, with a 24% decline nationally between the SOFR 2013 period (101,814 hectares) and the SOFR 2018 period (77,786 hectares), and all states other than Queensland reporting declines between these periods (Table 2.5). Tasmania experienced a 64% decrease in the mean annual area harvested between the SOFR 2013 period (11,218 hectares) and the SOFR 2018 period (4,020 hectares), while New South Wales, Victoria and Western Australia experienced decreases of 36%, 25% and 16%, respectively. Queensland also experienced a decline (by 26%) in the mean annual area of multiple-use public native forest harvested between these two periods when harvest areas on native forests with Crown timber rights are excluded.

The *Forest Management Plan 2014–2023* for south-western Western Australia (CCWA 2013) discusses the sustainability of wood volumes and growing stock of jarrah, karri and marri forests (*Eucalyptus marginata*, *E. diversicolor* and *Corymbia calophylla*, respectively), and Western Australia has a long history of reporting the annual area of forest harvested for wood (Table 2.6). The average annual harvested area of jarrah (*Eucalyptus marginata*), karri (*E. diversicolor*) and wandoo (*E. wandoo*) forest types decreased from 30,180 hectares in 1976–80 to 7,938 hectares in 2011–15, a 74% reduction. The majority of harvesting occurred using selection and shelterwood silvicultural systems.

Table 2.5: Forest area (hectares) harvested annually from multiple-use public native forest in Australia

Reporting year	NSW[a]	Qld[b]	Tas.	Vic.	WA	Total
2001–02	50,351	47,700	14,900	10,500	17,260	140,711
2002–03	49,062	48,300	16,900	8,500	14,340	137,102
2003–04	45,337	48,400	17,090	8,100	9,725	128,652
2004–05	42,523	41,100	17,500	7,600	10,110	118,833
2005–06	43,233	47,700	12,500	7,800	7,780	119,013
2006–07	44,806	43,900	11,520	6,900	10,270	117,396
2007–08	52,960	44,200	12,990	7,800	9,740	127,690
2008–09	27,952	32,500	12,370	6,400	8,330	87,552
2009–10	38,499	32,300	8,710	5,900	11,650	97,059
2010–11	27,484	28,200	10,500	5,800	7,390	79,374
2011–12	27,444	34,000	2,590	5,398	8,850	78,282
2012–13	31,221	35,000	4,190	5,427	8,570	84,408
2013–14	23,807	35,000	3,610	4,481	8,120	75,018
2014–15	22,235	40,000	4,700	4,332	6,750	78,017
2015–16	17,878	38,000	5,010	4,819	7,500	73,207
Annual mean, 2001–02 to 2005–06 (SOFR 2008 reporting period)	46,101	46,640	15,778	8,500	11,843	128,862
Annual mean, 2006–07 to 2010–11 (SOFR 2013 reporting period)	38,340	36,220	11,218	6,560	9,476	101,814
Annual mean, 2011–12 to 2015–16 (SOFR 2018 reporting period)	24,517	36,400	4,020	4,891	7,958	77,786
Annual mean, 2001–02 to 2015–16	36,319	39,753	10,339	6,650	9,759	102,821
15-year total as proportion of 15 year total for all systems (%)	**35**	**39**	**10**	**6**	**9**	**100**

[a] Total area planned for harvest in New South Wales multiple-use native forests. Table 2.17 in Indicator 2.1e reports the net area harvested in the context of regeneration assessment.

[b] For the SOFR 2018 reporting period, also includes harvest areas on Queensland native forests with Crown timber rights on the national tenure categories leasehold forest and other Crown land (2011–12, 7,500 hectares; 2012–13, 7,500 hectares; 2013–14, 10,000 hectares; 2014–15, 7,500 hectares; 2015–16, 16,000 hectares).

Notes:

For all jurisdictions except NSW, the area reported is the area harvested under the silvicultural system used in the harvesting event.

Other than the Queensland figures for the years identified above, the harvesting figures are from multiple-use public native forest or tenures that the Crown treats (or treated) as multiple-use public native forest.

Harvest areas include areas harvested before plantation establishment (Tas.) and bauxite mining (WA).

No harvesting of native forest is permitted from public forests in the ACT, NT or SA.

Source: Data provided by NSW, Qld, Tas., Vic. and WA.

This table, together with other data for Indicator 2.1a, is available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

Table 2.6: Average area (hectares) of multiple-use public native forest harvested in Western Australia

Period	Selection, shelterwood and other harvest[a] (jarrah and wandoo)	Clearfelled or partially cut (karri)	Thinned[b] (karri)	Total
1976–80	27,340	2,792	48	30,180
1981–85	23,244	1,722	322	25,288
1986–90	18,266	1,330	656	20,252
1991–95	14,236	1,788	124	16,148
1996–2000	19,436	1,668	180	21,284
2001–05	11,032	724	608	12,364
2006–10	7,486	508	962	8,956
2011–15	6,980	318	640	7,938

[a] Includes harvesting for a range of silvicultural objectives, including thinning, selection and shelterwood silviculture systems in jarrah and wandoo forest, and jarrah forest harvested before being cleared for bauxite mining.

[b] Thinning of regrowth karri forests.

Source: SOFR (2013), Western Australian Department of Biodiversity, Conservation and Attractions.

This table, together with other data for Indicator 2.1a, is available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

Indicator 2.1b

Age class and growing stock of plantations

Rationale

This indicator uses the area, age class and growing stock of native and exotic species plantations to assess the volume of timber that Australia's plantation forests can supply now and into the future.

Key points

- The area of commercial plantations managed for wood production in Australia in 2014–15, as reported in *Australian plantation statistics 2016*, was 1.97 million hectares.
  - This commercial plantation area was lower than the 2.02 million hectares reported for 2010–11. This change reflects a combination of plantation land that was not commercially productive being converted to agricultural or other land uses, and revisions of area figures on land use by plantation managers (for example by including plantation land that was fallow between rotations)
  - The reduction in the area of commercial plantations between 2010–11 and 2014–15 was 44 thousand hectares.
- Of the total commercial plantation estate area in 2014–15, 52% was planted with softwood species, 47% with hardwood species, and less than 1% with mixed and other species.
  - As at 2014–15, there were 997 thousand hectares of commercial plantations in their first rotation (the period from first planting to first harvest), 641 thousand hectares in their second, third or fourth rotation, and 335 thousand hectares where the rotation is unknown.
  - The area of commercial softwood plantations increased by 1% between 2010–11 and 2014–15, while the area of commercial hardwood plantations decreased by 5%.
- The area proportion of Australia's commercial plantation estate where the trees are privately owned increased from 76% to 79% between 2010–11 and 2014–15, while the proportion where the trees are owned by government organisations decreased from 24% to 21%.
  - The ownership structure of the privately owned commercial plantation estate shifted towards institutional investors over this period, with institutional investor ownership of commercial plantations increasing from 31% to 50%.

Commercial plantations provided over 85% of Australia's total log harvest in 2014–15 (see Indicator 2.1c). Growing trees in commercial plantations, harvesting logs, and processing them into sawnwood, paper and paperboard, panels and other wood products, generates substantial regional employment (see Indicator 6.5a). Commercial plantations provide the raw material for major rural industries, even though they occupy only a small part of the rural land estate (see Indicator 1.1a).

Until the 1990s, most commercial plantations established in Australia were pines and other softwood species grown to produce sawnwood. Many were planted on land where there had previously been native eucalypt forests. Most commercial plantations established over the past 20 years have been hardwood plantations (mainly eucalypts) grown to produce pulplogs. New commercial plantations during this period have been generally established on cleared agricultural land, because the clearing of native vegetation (including native forests) for new plantation development is now either

prohibited or significantly restricted by state and territory legislation and policies.

The rationale for Indicator 2.1b identifies 'growing stock' – the total volume of wood in all living trees in a forest at a given time, often referred to as 'standing volume' – as an indicator of potential wood supply from commercial plantations. Growing stock is not usually measured in Australia, but ABARES, under the auspices of the National Plantation Inventory (NPI), develops forecasts of merchantable plantation log supply every five years (see Indicator 2.1c).

Plantation areas and values

The area of Australia's commercial plantation estate from 1940, including data from before the establishment of the NPI in 1995, is shown in Figure 2.4. Non-commercial plantations and other planted forests are reported separately, under the 'Other forest' category in Indicator 1.1a.

The first data for the NPI were collected in 1995, with the first comprehensive map-based report published in 1997, which reported that Australia had just over 1 million hectares of plantations. The area of plantations almost doubled from 1990 to 2015 (Figure 2.4), with hardwood plantations accounting for most of that expansion. Government policies and programs and joint government/industry initiatives, such as *Plantations for Australia: the 2020 Vision* (Private Forestry Consultative Committee 2002), were important in identifying and facilitating the removal of impediments to plantation development over this period.

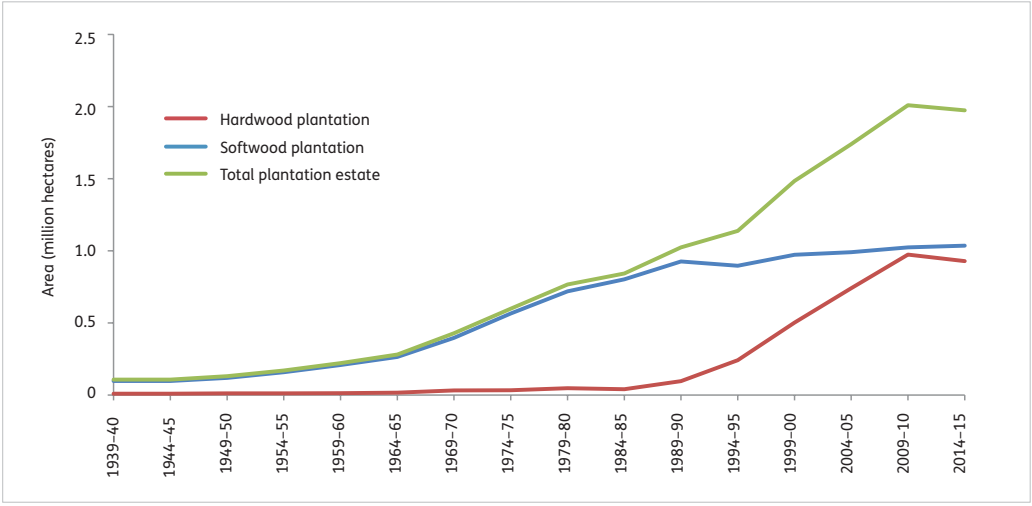
The commercial plantation estate decreased from 2.02 million hectares in 2010–11 to 1.97 million hectares in 2014–15 (Figure 2.4) as a result of plantation growers and managers returning unproductive plantation land to agriculture or to landholders on the expiration of hardwood plantation lease arrangements. The area of commercial softwood plantations increased by 1% between 2010–11 and 2014–15, while the area of commercial hardwood plantations decreased by 5%.

The 2014–15 area data for commercial plantations reported in this indicator are taken from *Australian plantation statistics 2016* (ABARES 2016b), which is the most recent spatial update of Australia's commercial plantation estate. More recent tabular data on plantation areas as at June 2016 are available in *Australian plantation statistics 2017 update* (Downham and Gavran 2017), and as at June 2017 in *Australian plantation statistics 2018 update* (Downham and Gavran 2018), but differ only slightly from the figures reported here. The area figures reported in SOFR 2018 Indicator 1.1a also differ slightly from those reported in *Australian plantation statistics 2016*, due to conversion of the vector format dataset used in Australian plantation statistics 2016 to the raster format dataset used for area analyses in SOFR 2018 (see Indicator 1.1a).

Australia's total commercial plantation estate in 2014–15 comprised 1.04 million hectares of softwood plantations, 0.928 million hectares of hardwood plantations, and 9.7 thousand hectares classified in the 'mixed and other' category (plantations of mixed hardwood and softwood species, and plantations for which species were not reported). A total of 52% of the total commercial plantation forest area is softwood plantations (primarily exotic pines), 47% is hardwood plantations (primarily eucalypts), and less than 1% is 'mixed and other' plantations.

Figure 2.5 shows the distribution of plantation establishment (first rotation) and re-establishment (second and subsequent rotations) by five-year period, from prior to 1970 to 2011–15. After 1990, re-establishment of exotic softwood plantations (funded mainly by government investment) was augmented by establishment of new hardwood plantations of a range of eucalypt species (funded mainly by private-sector investment).

Figure 2.4: Australia's commercial plantation area, 1939–40 to 2014–15

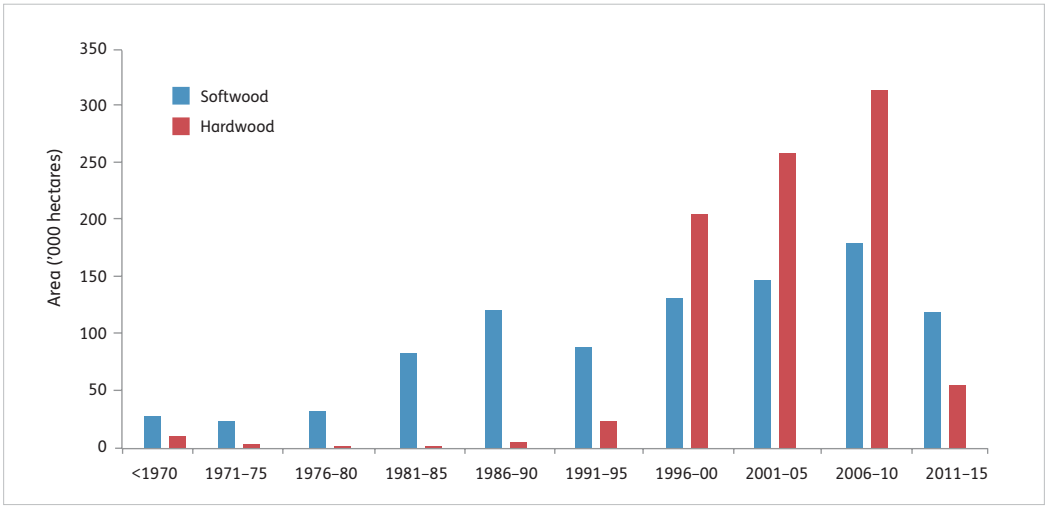


Note: Total plantation estate data for 1999–2000 to 2014–15 also include plantations in the 'Unknown or mixed' category.

Source: Bureau of Agricultural Economics, Commonwealth Forestry and Timber Bureau, National Plantation Inventory, ABARES (2016).

The data used to create this figure, together with other data for Indicator 2.1b, are available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

Figure 2.5: Area of commercial plantation establishment and re-establishment by five-year period, to 2011–15



Note: Plantation establishment refers to establishment of first-rotation plantations on sites not previously carrying plantation; plantation re-establishment refers to establishment of second and subsequent plantation rotations on sites previously carrying plantations.

Source: ABARES (2016b), National Plantation Inventory.

The data used to create this figure, together with other data for Indicator 2.1b, are available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

Table 2.7: Area of commercial plantation estate, and proportions by jurisdiction, 2014–15

	Commercial softwood plantations	Commercial hardwood plantations	Total plantation estate
Total area ('000 hectares)	**1,035**	**928**	**1,973**
Proportion by jurisdiction (%)			
Australian Capital Territory	0.7	0	0.4
New South Wales	30	9	20
Northern Territory	0.2	5	2
Queensland	19	4	12
South Australia	12	6	9
Tasmania	7	25	16
Victoria	22	21	21
Western Australia	10	30	19

Notes: Includes plantations where type is unknown. Totals may not tally due to rounding.

Source: ABARES (2016b).

This table, together with other data for Indicator 2.1b, is available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

Table 2.7 shows the total area of Australia's commercial plantation estate (softwood, hardwood and total) in 2014–15, and the proportions by jurisdiction. Victoria had the largest area proportion of the national commercial plantation estate (21%), including 22% of the national commercial softwood plantation area and 21% of the national commercial hardwood plantation area. New South Wales had the next largest area proportion of the national commercial plantation estate (20%), followed by Western Australia (19%) and Tasmania (16%).

In 2014–15, there were 997 thousand hectares of commercial plantations (mainly hardwoods) in their first rotation, 641 thousand hectares of commercial plantations (mostly softwoods) in their second, third or fourth rotation (the majority of which are in their second rotation), and 335 thousand hectares of commercial plantations where the rotation is unknown (Table 2.8).

Commercial softwood plantations are managed for sawlogs with rotation lengths between 25 and 35 years. The majority of commercial hardwood plantations are managed for pulplogs with rotation lengths between 10 and 15 years. The remaining commercial hardwood plantations are managed for sawlogs and are generally grown on longer rotations of between 25 and 45 years.

Figure 2.6a and Figure 2.6b show the area of plantations as at 2014–15, in commercial plantations managed for sawlog and pulplog production respectively, by age class. The majority of softwood plantation trees as at 2014–15 were planted between the periods 1981–85 and 2011–2015; almost all commercial plantations managed for sawlogs are softwood plantations. The majority of commercial hardwood plantation trees as at 2014–15 were planted between the periods 1996–2000 to 2006–10; the majority of commercial plantations managed for pulplogs are hardwood plantations.

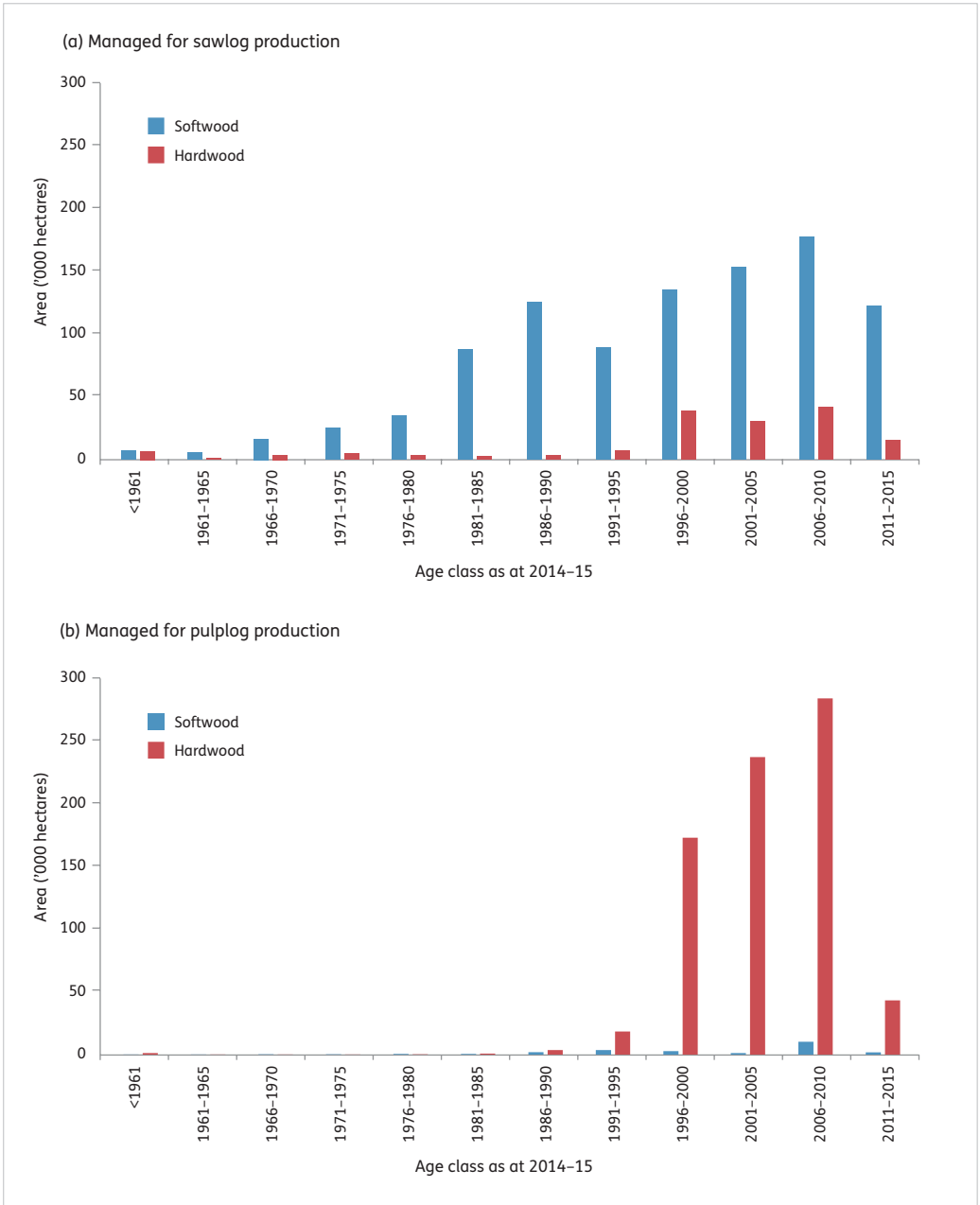
Table 2.8: Area of components of Australia's commercial plantation estate, by type and rotation, 2014–15

	Area ('000 hectares)			
Rotation	Softwood	Hardwood	Mixed and other categories	Total
1	358	630	9	997
2	447	142	0.5	589
3	45	6	0	51
4	1	0	0	1
Unknown	185	150	0	335
Total	1,035	928	10	1,973

Notes: 'Unknown' is where information is unavailable about the rotation. Totals may not tally due to rounding.
Source: ABARES (2016b).

This table, together with other data for Indicator 2.1b, is available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

Figure 2.6: Area of Australia's commercial plantation growing stock, 2014–15, by age-class



Note: Plantations of unknown age and harvested plantations awaiting re-establishment are not included.
Source: National Plantation Inventory.

The data used to create this figure, together with other data for Indicator 2.1b, are available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

Commercial plantation ownership

Ownership of plantation trees

Figure 2.7 depicts the proportion of area of Australia's commercial plantation estate at 2014–15, by tree and land ownership categories and by age class. In 2014–15, the majority of commercial plantations (an average of 65% across all age classes) were under private tree ownership. Commercial plantations with publicly owned trees averaged 33% across all age classes, and commercial plantations with jointly owned trees averaged 2%.

During the period from 2010–11 to 2014–15, there was a progressive change in commercial plantation ownership (specifically, ownership of plantation trees) from public to private owners. Over this period, the area proportion of Australia's commercial plantation estate that was privately owned increased from 76% to 79%, while the proportion owned by government organisations decreased from 24% to 21% (Table 2.9).

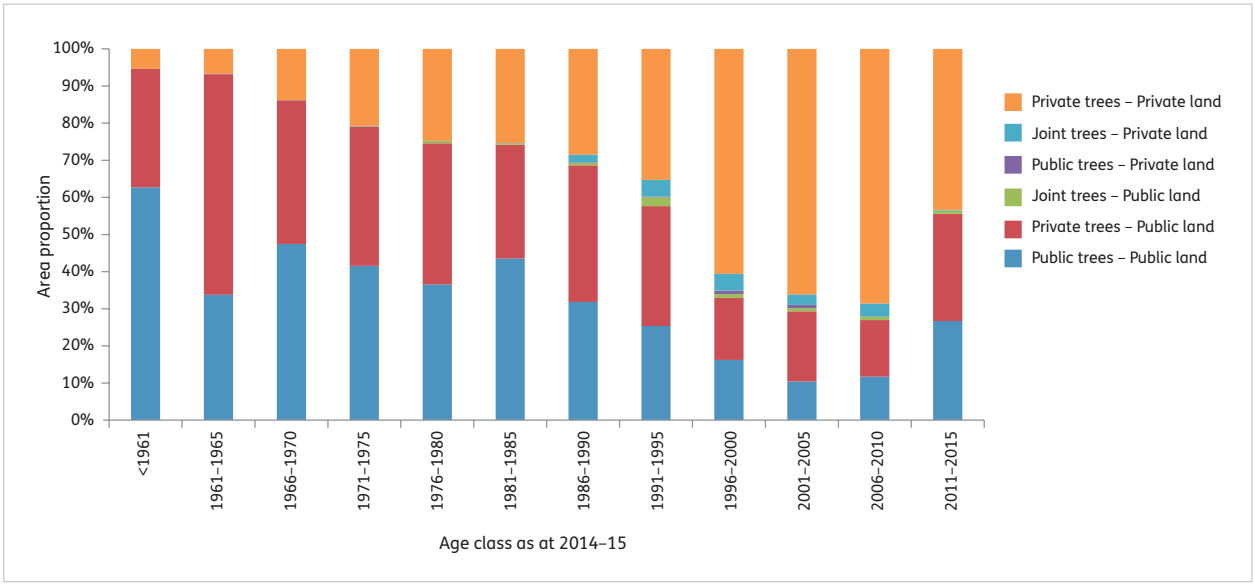
Over this period, farm foresters and other private owners (including small-scale plantation woodlot owners) increased their ownership of the area of commercial plantations from 8% to 21%, due primarily to commercial plantations that were previously owned by managed investment schemes (MISs) under land lease arrangements reverting to the landowner. Ownership by institutional investors (including international superannuation funds) increased from 31% to 50%, due largely to purchase of commercial plantations that were previously owned by MISs. In contrast, private ownership by timber industry companies fell from 13% to 4%, and the proportion of commercial plantations owned by MISs reduced from 24% to 5% (Table 2.9).

Ownership of plantation land

In 2014–15, the majority of commercial plantations that were established or re-established before 1996–2000 were on public land (an average of 79% across these age classes) (Figure 2.7). For plantations with age classes between 1996–2000 and 2006–2010, the majority (an average of 69%) were on private land.

In the period 2011–15, 56% of commercial plantations established or re-established were on public land and 44% were on private land (Figure 2.7). However, the figures for 2011–15 are calculated for a much smaller area of new plantation establishment than are the figures for earlier years (see Figure 2.40, Indicator 2.1e).

Figure 2.7: Area proportion of commercial plantation land and trees in ownership categories, 2014–15, by age-class



Notes: Joint ownership includes government and private ownership arrangements.

Data are area proportions in 2014–15 for each age-class category. Plantations of unknown age, harvested plantations awaiting re-establishment, and new plantations awaiting establishment are not included.

Source: National Plantation Inventory.

The data used to create this figure, together with other data for Indicator 2.1b, are available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

Table 2.9: Area proportion of commercial plantations by ownership category, 2010–11 to 2014–15

	2010–11	2011–12	2012–13	2013–14	2014–15
Commercial plantation area ('000 hectares)	**2,017**	**2,013**	**2,013**	**2,000**	**1,973**
Ownership area proportion (%)					
Private owners	76	76	81	81	79
Institutional investors	31	32	40	40	50
Timber industry companies	13	13	13	13	4
Farm foresters and other private owners	8	8	8	8	21
Managed Investment Schemes (MISs)	24	23	20	20	5
Government organisations	24	24	19	19	21

Notes: Ownership data refer to ownership of trees. Joint venture arrangements between government agencies and private owners are included under 'Governments' where government is the manager of the plantation resource. Totals may not tally due to rounding.

Source: Gavran (2013), Gavran (2014), ABARES (2016b).

This table, together with other data for Indicator 2.1b, is available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

Plantation species

The main Australian commercial plantation species by climate and rainfall region, and the main uses for the wood they produce, are shown in the SOFR 2018 Introduction, Table I.i.

In 2014–15, the commercial softwood plantation estate was dominated by radiata pine (*Pinus radiata*; 74% by area) and the southern pines (15% by area) (ABARES 2016b). Southern pines comprise Caribbean pine (*P. caribaea*), slash pine (*P. elliottii*) and several varieties of these; a hybrid between southern pine varieties is now the preferred plantation softwood in subtropical and tropical regions of Australia. Both radiata pine and the southern pines are managed primarily for sawlog production. Other regionally important softwood species are maritime pine (*P. pinaster*) in Western Australia, and hoop pine (*Araucaria cunninghamii*) in south-east Queensland, both of which are also managed primarily for sawlog production.

In 2014–15, the commercial hardwood plantation estate was dominated by Tasmanian blue gum (*Eucalyptus globulus*; 53% by area) and shining gum (*E. nitens*; 25% by area), both of which are managed primarily for pulpwood production (ABARES 2016b).

Blackbutt (*E. pilularis*) and flooded gum (*E. grandis*) together comprise 3% of the total hardwood plantation estate area; Dunn's white gum (*E. dunnii*) and various acacia species (such as *Acacia mangium*) each account for 3% by area; and the spotted gums (*Corymbia maculata*, *C. variegata* and related species) comprise 2% by area. A further 7% by area is other eucalypts such as mountain ash (*E. regnans*) and Sydney blue gum (*E. saligna*), and 3% by area is other hardwood species, such as African mahogany (*Khaya senegalensis*) and teak (*Tectona grandis*). All these species are managed primarily for sawlog production.

Hardwood plantation (*Eucalyptus regnans*), Gippsland, Victoria.

Indicator 2.1c

Annual removal of wood products compared to the volume determined to be sustainable for native forests, and future yields for plantations

Rationale

This indicator measures the harvest levels of wood products in relation to future yields. The capacity to implement strategies to deal with changing demand for forest products based on future yields from both native and plantation forests is an integral part of sustainable forest management.

Key points

- An average annual volume of 1.14 million cubic metres of high-quality sawlog was harvested from multiple-use public native forests (including other native forests where timber is owned by the Crown) in the SOFR 2018 reporting period 2011–12 to 2015–16.
  - This is a continued and progressive decline from 1.96 million cubic metres in the SOFR 2008 reporting period 2001–02 to 2005–06, and 1.44 million cubic metres in the SOFR 2013 reporting period 2006–07 to 2010–11.
- The average sustainable sawlog yield from multiple-use public native forests declined nationally by 53% across the five SOFR reporting periods from 1992–93 to 2015–16.
  - This decline was a consequence of several factors. These include transfer of multiple-use public native forests into nature conservation reserves, which reduced the area of native forest available for harvesting; increased restrictions on harvesting in codes of forest practice and other regulatory instruments; revised estimates of forest growth and yield due to improved information and incorporation of climatic effects; and, especially in Victoria, impacts of occasional, intense broad-scale bushfires.
  - Nationally, sustainable yield is forecast to continue to decline to around 38% of the level reported in SOFR 1998 by the period of 2030–34. After that time, it is forecast to increase, given no further reductions in net harvestable area and successful management of risk from wildfire, disease and climate change.
- The volume of sawlogs harvested from multiple-use public native forests in the each of the five reporting periods from 1992–93 to 2015–16 was within sustainable yield levels in New South Wales, Tasmania, Victoria and Western Australia or within allowable tolerances, and within the allowable cut in Queensland.
  - The national sawlog harvest level was below sustainable yield levels by 23% for the reporting period 2011–12 to 2015–16, and below sustainable yield levels by 7–15% for each of the previous four SOFR five-yearly reporting periods.
- The average annual harvest volume of wood from native forest in Tasmania in the SOFR 2018 reporting period 2011–12 to 2015–16 was 2.4 million cubic metres less than that in the SOFR 2013 reporting period 2006–07 to 2010–11. Similarly, the value of wood products harvested annually from native forest in Tasmania declined by $141 million between these two SOFR reporting periods.
  - These changes were due to policy and infrastructure changes in Tasmania in 2013, as well as earlier market changes.
- In 2015–16, Australia harvested a total of 4.1 million cubic metres of native forest logs, 9.8 million cubic metres of plantation hardwood logs, and 16.2 million cubic metres of plantation softwood logs.
- The annual log harvest from plantations, and the contribution of plantations to Australia's total sawlog and pulplog harvest, have both increased steadily since 2000–01. The contribution of plantations to Australia's total sawlog and pulplog harvest reached 86% in 2015–16.
  - Over the period 2000–01 to 2015–16, the annual plantation hardwood pulplog harvest increased from 0.9 million cubic metres to 9.6 million cubic metres.
  - The total sawlog and pulplog harvests from softwood plantations are expected to remain relatively constant over the period from 2015–19 to 2055–59. During the same period, the total sawlog harvests from hardwood plantations are expected to increase, while the total pulplog harvests from hardwood plantations are expected to decrease.

Continued

Continues

Key points

- The national harvest of sawlogs from private native forests has declined progressively since the period 2001–06.
  - Based on ABARES data, the decrease in sawlog harvest from private native forests over the period 2011 to 2016 was 30% in Queensland, 47% in Tasmania, and 71% in New South Wales (the jurisdictions in which the largest volume of sawlogs are harvested from private native forests). The reasons for this decline differ between states, and are not always clear.
- As the supply of high-quality logs from public multiple-use native forests declines, the importance of private native forests for the supply of hardwood logs is predicted to increase.
  - The management intent for private native forests, and their commerciality, will increasingly determine the long-term national supply of high-quality native hardwood logs.
  - There is insufficient information to assess the sustainability of current or predicted future rates of wood harvest from private native forests.

This indicator examines the extent to which a sustainable harvest of wood products is being achieved in native forests, and the availability of future yields of wood products from native forests and plantations. The indicator reports the average annual sustainable yield in multiple-use public native forests, actual annual harvests in multiple-use public[103] and private native forests, projections of sustainable yields from public native forests to 2054, forecast availability of wood products from public and private native forests, and projected future yields from commercial plantations to 2059.

This indicator reports native forest harvesting only for those states where there is significant ongoing native forest harvesting on public and/or private land, namely New South Wales, Queensland, Tasmania, Victoria and Western Australia. Native forest harvesting does not occur in the Australian Capital Territory or South Australia, and at most only a very small volume of commercial harvesting of native forest occurs on public, private or leasehold land in the Northern Territory. Commercial plantation log availability projections are reported using National Plantation Inventory (NPI) regions in Australia (ABARES 2016a).

This indicator also describes the impact of changes in tenure and forest practices on the area of native forest available for the harvesting of wood products. These impacts directly affect the sustainable yields available from native forests and the volumes of wood products harvested.

The main log products harvested from commercial plantations and native forests are sawlogs, sliced and peeled veneer logs (used for wood-based panel products) and pulplogs (used for paper products). Other wood products harvested from commercial plantations and native forests include round and split posts, poles, piles, girders, bush sawn/hewn timber, fuelwood logs and firewood, specialty timber and sleepers. The data presented in this indicator pertain mainly to sawlogs (with logs for sliced veneer generally included in that category) and pulplogs. Sandalwood harvest in Western Australia and Queensland is also considered in this indicator.

Most of Australia's native forest wood products are from multiple-use public native forests, with the remainder from forest on leasehold land, other Crown land and private land. Harvesting in public native forests is subject to regulatory frameworks designed to balance environmental, social and economic values, while maintaining the productive capacity of forests (see Indicators 7.1a and 7.1b). Harvesting on other tenures is subject to state regulatory requirements. Tasmania is the only jurisdiction to publish periodic estimates of wood production from private forests (e.g. PFT 2005).

Sustainable yield from public native forests

The concept of a sustainable level of forest production is that environmental values and the productive capacity of forests are not compromised while providing for society's needs (SOFR 2003); this applies to both wood and non-wood products. Sustainable yield[104] is thus defined as "The yield of products (e.g. wood, water) from an area of forest that ensures that the functioning of the forest ecosystem as a whole is maintained and the flow of products can continue indefinitely under a given management strategy and suite of sustainable-use objectives".

A sustainable timber yield is calculated as the volume of wood (specifically, higher-grade sawlogs) that can be removed each year from an area of forest while ensuring maintenance of the functioning of the native forest system as a whole and the supply of wood products in perpetuity. States in which native forest harvesting on public land occurs have formal processes, backed by a regulatory framework (including legislation, management plans, codes of practice and non-legislative

[103] Harvest data for multiple-use public native forests includes harvest data for native forests on other tenures where timber rights are owned by the Crown.

[104] Western Australian legislation (*Conservation and Land Management Act 1984*) requires that harvest levels for timber production from State forest and timber reserves in Western Australia are on a 'sustained yield basis'. The Western Australian Regional Forest Agreement (Western Australia and Commonwealth of Australia 1999) defines 'Sustained Yield' as the yield that a forest can produce continuously at a given intensity of management. Sustained yield management implies continuous production planned so as to achieve, at the earliest practical time, a balance between growth increment and cutting within a suite of sustainable use objectives. CCWA (2013) states that sustained yield or sustained timber yield, for the purpose of the *Western Australia Forest Management Plan 2014–2023*, means the first-grade and second-grade sawlog yield (see Table 2.11 for definitions) that the forest can produce for an extended period (to at least the year 2070) at a given intensity of management. Sustained yield as applied in Western Australia, for the purpose of SOFR reporting, is taken to be synonymous with sustainable yield.

policies: see indicators in Criterion 7), that allow calculation of sustainable sawlog yields for publicly managed native forests (primarily multiple-use public forests).

State agencies in New South Wales, Queensland, Tasmania, Victoria and Western Australia that harvest wood from multiple-use public forests have been forecasting sustainable yields and reporting actual harvest levels since the reporting of sustainable yield in SOFR 1998. In the case of Queensland, harvest forecasts and yields include harvest from 'Other Crown land'. The harvesting of wood products from native forests is not permitted in the Australian Capital Territory and South Australia. The Northern Territory has no multiple-use public forests.

The sustainable yield of native forest wood products is thus currently calculated based on the production of high-quality products (generally higher-grade hardwood eucalypt sawlogs, but in New South Wales and Queensland including softwood sawlogs from cypress pine), with the quantity of wood harvested constrained so that future harvesting can occur on a non-declining yield basis. In Western Australia, sandalwood harvesting from forests on Crown and alienated lands[105] is regulated on an 'allowable harvest'[106] basis (DEC 2012b; DPaW 2015b). The harvest of small amounts of sandalwood in Queensland from leasehold land is regulated by a code of practice for native forest timber production (DNPRSR 2014).

High-quality hardwood sawlogs are logs graded to utilisation standards developed and used by state agencies. Native softwood sawlogs are cypress pine sawlogs, and are classed as high-quality or low-quality in New South Wales, and as sawlog-grade in Queensland. High-quality sawlogs in New South Wales were previously known as 'quota' sawlogs. Low-quality sawlogs (or 'non-quota' sawlogs) are sawlogs not included in the high-quality category because they do not meet quality or size specifications. Other hardwood log products include poles, piles, girders and other solid logs. Low-quality sawlogs, pulplogs and other wood products are harvested from native forests, usually as a residual product arising from harvesting for high-quality sawlogs; sustainable yields are generally not determined for these other wood products. Miscellaneous wood products such as firewood, industrial fuelwood, sleeper logs and fencing material form another category of wood product, and can be harvested with or following harvest of high-quality, low-quality and other hardwood products.

Sustainable sawlog harvest volumes are calculated using data on forest type and age-class, standing wood volumes, terrain, accessibility, tree (forest stand) growth and yield, as well as recreational use, water supply, and conservation requirements. The volume of wood available for harvesting is calculated based on the net harvestable area (see Indicator 2.1a), which is the net area of forest available for high-quality sawlog production after areas unavailable for economic, environmental and other reasons have been excluded. Calculations also take into account restrictions on harvesting imposed by codes of practice and other regulations, and risks associated with disease, fire, storm damage and aspects of climate change. Once calculated, sustainable volumes are used to produce harvesting schedules and forecasts of the future spatial and temporal characteristics of forest production.

The substantial transfer of multiple-use public forest to the national reserve system, and specifically to nature conservation reserve tenure, at and after the RFA processes between 1995 and 2005 (Davey 2018a), and subsequently, resulted in many states implementing transitional long-term sustainable wood supply strategies aimed at reducing disruption to the forest industry. These strategies included supplementing the public native forest wood supply with high-quality wood resources from public hardwood plantations, and from the purchase of private forests or logs from private forests. The harvest from public native forests under these long-term supply strategies is considered sustainable because the strategies are designed to maintain the capacity of native forests to produce wood in perpetuity on a non-declining yield basis after a specified transition period.

As sustainable harvest volumes vary over time (due, for example, to changing forest management strategies and utilisation standards, improved resource data, and changes in the net harvestable area of public native forest), calculations are reviewed periodically, usually every 5 to 10 years. Annual harvesting levels will fluctuate around the sustainable volume, with overcuts in some years being balanced by undercuts in other years over a defined period.

National perspective

Table 2.10 reports the proportional change in state and national sustainable yields across the five SOFR reporting periods, compared with the baseline of the first SOFR period (SOFR 1998: 1992–93 to 1995–96).

For the SOFR 2018 reporting period of 2011–12 to 2015–16, the average sustainable yield from multiple-use public native forests declined nationally by 53% from that in the SOFR 1998 reporting period of 1992–93 to 1996–97, with declines between 30% and 75% across the five States (Table 2.10). This decline was due to: transfer of multiple-use public native forests into nature conservation reserves, which reduced the area of native forest available for wood harvesting (see Davidson et al. 2008; the Tasmanian Forest Agreement in 2013 is a further example); increased restrictions on wood harvesting in codes of forest practice; revised estimates of forest growth and yield due to improved information and incorporation of climatic effects; and, especially in Victoria, impacts of occasional, intense broad-scale bushfires (Forests NSW 2010; VicForests 2011b; SOFR 2013). During the reporting periods between SOFR 1998 (1992–93 to 1995–96) and SOFR 2013 (2006–07 to 2010–11), the calculated Tasmanian average sustainable yield increased as a consequence of transitional arrangements involving supplementation with high-quality sawlogs

[105] Alienated land is freehold land in Western Australia subject to an agreement relating to the use of that land entered into under the *Land Administration Act 1997* (WA) between the Minister and person who is the holder of the freehold land.

[106] 'Allowable harvest' equates to the term 'allowable cut', which is the amount of forest product that can be cut in a period. The allowable harvest is specified in the *Sandalwood (Limitation of Removal of Sandalwood) Order (No. 2) 2015*.

Table 2.10: Proportional change in sustainable yields from multiple-use public native forests across SOFR reporting periods, by jurisdiction

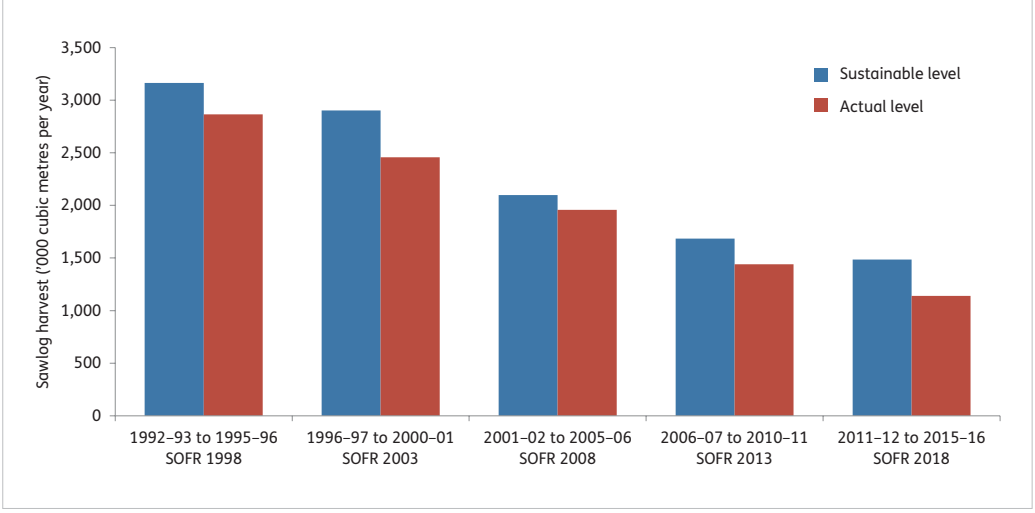
Jurisdiction	Change in sustainable yields from multiple-use public native forests from SOFR 1998 (1992–93 to 1995–96) (%)			
	SOFR 2003 (1996–97 to 2000–01)	SOFR 2008 (2001–02 to 2005–06)	SOFR 2013 (2006–07 to 2010–11)	SOFR 2018 (2011–12 to 2015–16)
NSW	-16	-37	-42	-45
Qld[a]	-11	-14	-37	-45
Tas.	20	17	7	-30
Vic.	-3	-33	-48	-52
WA	-17	-60	-76	-75
Australia	**-8**	**-34**	**-47**	**-53**

[a] Following the 1999 decision by the Queensland government, harvesting of state-owned timber resources changed from a sustainable yield volume basis applied to multiple-use forest, to an allowable cut from Queensland's area available for wood production.

Note: Product groups and standards used in determining sustainable yield are consistent across reporting periods in all jurisdictions.

This table, together with other data for Indicator 2.1c, is available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

Figure 2.8: Average annual harvest and sustainable yield for multiple-use public native forests (including other native forests where timber rights are owned by the Crown) in Australia, by SOFR reporting period



Notes:

Sawlog includes only high-quality and sliced veneer hardwood and cypress pine logs.

In all states other than Queensland, yield data apply only to multiple-use public native forests.

The most recent SOFR reporting period includes Queensland's allowable cut estimates as the 'Sustainable level', while the 'Actual level' reports logs harvested from Queensland's 'Defined Forest Area' that includes harvests from leasehold land and freehold land where trees are owned by the State through a forest consent ('profit a prendre') agreement.

SOFR 1998 data includes an updated adjustment applied to Victorian data as a D+ sawlog equivalent. Data for Victoria in all SOFR reporting periods are D+ sawlog equivalent. SOFR 2008 and SOFR 2013 periods contain updated data from CCWA (2012).

Source: ABARES database, state agencies, updated data used in SOFR 2013.

The data used to create this figure, together with other data for Indicator 2.1c, are available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

from public hardwood plantations, before reducing in the SOFR 2018 reporting period (2011–12 to 2015–16) due to implementation of the 2013 Tasmanian Forest Agreement.

Figures 2.8–2.13 show the reported harvested volume from multiple-use public native forests, nationally and by jurisdiction, averaged across the periods covered by the five SOFR reports (see Table 2.10). For all states except New South Wales and Queensland, average harvest volumes were lower than the sustainable yields for each of the reporting periods, and in those jurisdictions were within allowable tolerances.

In the SOFR 2018 period 2011–12 to 2015–16, the national average annual volume of high-quality sawlogs harvested from multiple-use public native forests (including other native forests where timber rights are owned by the Crown) was 1.14 million cubic metres. This is a continued and progressive decline from 1.96 million cubic metres in the SOFR 2008 reporting period 2001–02 to 2005–06, and 1.44 million cubic metres in the SOFR 2013 reporting period 2006–07 to 2010–11 (Figure 2.8). The level of actual harvest for 2011–12 to 2015–16 was 23% below the calculated sustainable sawlog yield. The national actual harvest volume from multiple-use public native forests for the four previous SOFR reporting

periods was 7–15% lower than the sustainable sawlog yield. The actual harvest volume has decreased over the past five reporting periods in line with the decrease in sustainable yields (Figure 2.8).

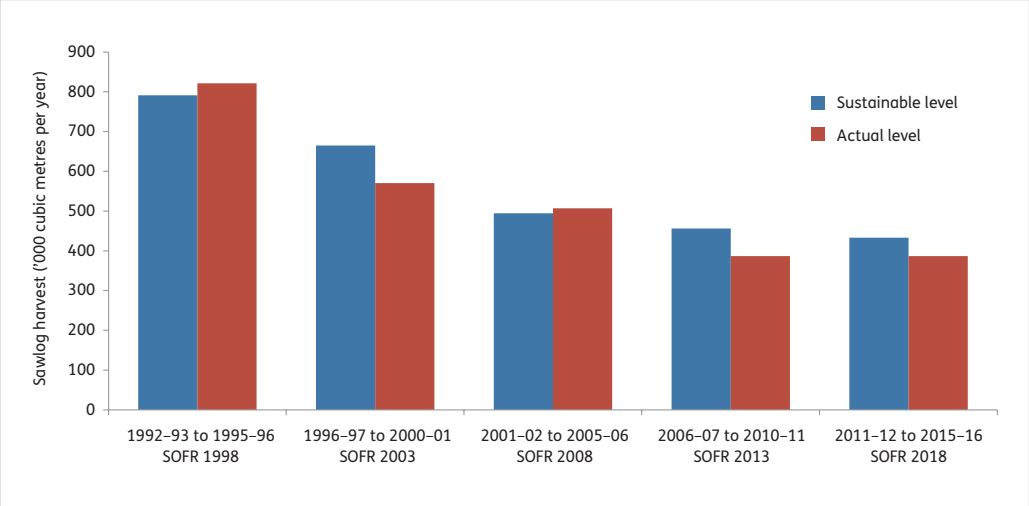
New South Wales

In New South Wales, the actual harvest was slightly higher than the sustainable yield in two of the five SOFR reporting periods (Figure 2.9), but was within allowable limits. Under state wood supply agreements applicable to multiple-use public native forests (Integrated Forestry Operations Approvals, IFOAs), the forest management agency in New South Wales is permitted to vary its actual cut over time: for example, in the Upper North East IFOA, overcuts of up to 5% above the annual allocation of high-quality large sawlogs and large veneer logs can occur in a 4 or 5 year period provided this is balanced by subsequent undercuts so that there is no overall overcut within the approval period.

The sustainable yield from New South Wales public forests for the period 1992–98 was 791 thousand cubic metres of hardwood 'quota' sawlogs and cypress pine sawlogs combined. The figures previously reported in SOFR 2003 and SOFR 2008 from New South Wales for actual logs harvested for the SOFR periods up to 1997–98 included 'non-quota' sawlogs; these figures have now been adjusted to represent only the 'high-quality sawlogs' and cypress pine logs reported after this period, so that log quality is comparable across the five SOFR periods (Figure 2.9)[107].

Forests NSW (2010) forecasted the yields of native forest wood product flows for the state and its regions from 2010 to 2110, and further reductions to sustainable yield were made across 2012–14 for the North East region. An average annual yield of 323 thousand cubic metres of high-quality sawlogs is forecast for multiple-use public forests between 2020 and 2054, but the yield over time is forecast to be uneven. Supplementation from private forests and hardwood plantations is expected to lead to a wood flow that is more even over time. NSW Government (2014) reviewed the wood resources on public forests in north-eastern New South Wales and provided a forecast of high-quality log supply from these forests to 2108.

Figure 2.9: Average annual harvest and sustainable yield for multiple-use public native forests in New South Wales, by SOFR reporting period



Notes:

Sustainable yields are for harvests from multiple-use public native forests, including supplementation from hardwood plantations on multiple-use public forest. Actual harvest levels do not include high-quality logs harvested from hardwood public plantations (see Figure 2.16).

Component figures for hardwood, brushwood (rainforest species), cypress pine and veneer logs from multiple-use public native forests are in 'quota sawlog equivalents' up to 1998–99, and figures for hardwood high-quality large and small sawlog, veneer sawlog and cypress pine from multiple-use public native forests are in 'high-quality equivalents' from 1999–2000. Poles, piles and girders from multiple-use public native forests are included in high-quality equivalents for calculating sustainable yield and reporting actual harvested level from 2006–07.

Source: Data used for SOFR 2013 as amended; Forests NSW, Forestry Corporation NSW and ABARES databases.

The data used to create this figure, together with other data for Indicator 2.1c, are available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

[107] 'Quota' sawlogs are sawlogs of a specified quality and dimension that contribute to the committed volumes outlined in New South Wales Forest Agreements and Integrated Forest Operation Approvals (IFOAs) applying to multiple-use public native forests. 'Non-quota' sawlogs are inferior quality sawlogs that do not contribute to the committed volumes outlined in Forest Agreements and IFOAs. Further explanation of the grade categories used in New South Wales and reported in Figure 2.9 can be found in NSW Government and Office of Environment and Heritage (2011).

Tasmania

A legislated annual minimum yield of 300 thousand cubic metres of 'category 1 and 3' sawlogs from Tasmania's multiple-use public native forest was in place from the first reporting of sustainable yield in 1992, until 2013. The calculated sustainable sawlog yield from Tasmania's multiple-use public native forests was greater than this legislated yield (Figure 2.10; Table 2.10) in line with short-term forest management strategies (Forestry Tasmania 2007) up until 2010–11 (SOFR 2013).

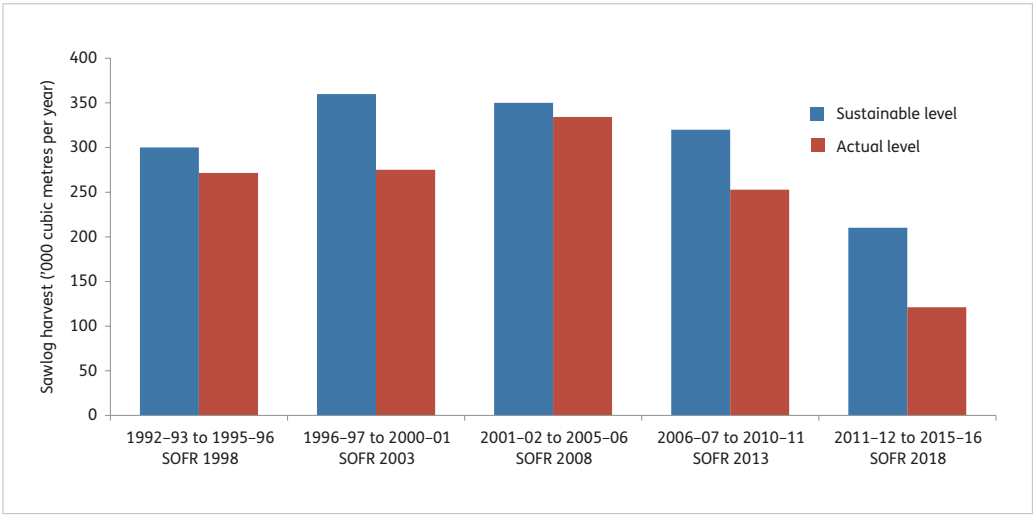
Since the Tasmanian Regional Forest Agreement was signed in 1997, supplementation with high-quality sawlogs from hardwood plantations has formed part of the sustainable wood supply strategy to meet the legislated requirements. In 2002, a non-declining yield for native forest sawlogs of 225 thousand cubic metres was forecast to be maintained after 2020. Following the 2005 Tasmanian Community Forest Agreement, this sustainable yield of native forest sawlogs was reduced to 145 thousand cubic metres after 2023 (Forestry Tasmania 2007). Subsequently, following the 2012–13 Tasmanian Forest Agreement process, a further substantial reduction in net harvestable area available for wood production (Indicator 2.1a) led to the legislated yield of native forest sawlogs being reduced to 137 thousand cubic metres after 2013, and to significant areas of multiple-use public native forest being reclassified as World Heritage Area, reserves and other Crown land (the latter named 'Future Potential Production Forest'; see Indicators 1.1a, 1.1c and 7.1a). As part of modelling for the Tasmanian Forest Agreement process, Burgman and Robertson (2012, p. 72) forecast a 100-year non-declining yield of 97 thousand cubic metres of high-quality sawlogs from native forests alone, for the land-use option adopted under the process.

Forestry Tasmania[108] (2014b) used the outcomes of the Tasmanian Forest Agreement process (including the 2013 World Heritage Area extension) to model the consequences of producing the legislated annual supply of 137 thousand cubic metres of native forest sawlog. The level of supply forecast was 137 thousand cubic metres to 2026, reducing to 100 thousand cubic metres until 2050, then reducing to a non-declining yield of 93 thousand cubic metres before increasing from 2063; high-quality sawlogs from public hardwood plantations were included in the schedule to compensate for the decrease of native forest sawlog after 2026.

As a result of these processes, the average annual sustainable yield of high-quality native sawlog reported in SOFR 2013 was 34% lower than that reported in SOFR 2018 (Figure 2.10). A further reduction would be apparent were the long-term figures for unsupplemented native forest supply to be used for this comparison.

The outcomes of the Tasmanian Forest Agreement process also significantly reduced the access to and supply of Tasmanian special-species timbers (see 'Special-species Timbers' below).

Figure 2.10: Average annual harvest and sustainable yield for multiple-use public native forests in Tasmania, by SOFR reporting period



Notes:

Sustainable yield and actual harvest levels are of category 1 and category 3 sawlogs and veneer logs. Actual harvest levels are from multiple-use public native forest only. Any supplementation from hardwood plantation or other Crown forests is not included in the actual harvest levels.

Source: FPA (2017a), data used in SOFR 2013, Forestry Tasmania annual and sustainability reports.

The data used to create this figure, together with other data for Indicator 2.1c, are available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

[108] From July 2017, Sustainable Timber Tasmania.

Victoria

Since the period reported in SOFR 1998, sustainable yields and harvest volumes in Victoria have declined, with harvest volumes remaining less than calculated sustainable yields (Figure 2.11). The major change was that regional forecasts of sustainable yields were reduced following the review by Vanclay and Turner (2001). The Victorian Auditor-General (2013) in reviewing the management of Victoria's native forest resources found that VicForests was harvesting at or within the estimated sustainable harvest level.

During the SOFR 2018 reporting period, management of multiple-use public native forests in eastern and western Victoria was divided between VicForests and the then Department of Environment and Primary Industries until November 2014, when management of western Victorian multiple-use public native forests was transferred to VicForests. Periodic resource outlooks for eastern Victoria have been published by VicForests (2011b, 2013, 2014, 2017), and Bassett et al. (2013) reviewed the expected wood yields from multiple-use public native forests in western Victoria.

Three periods of intense, broad-scale bushfire in eastern Victoria (2002–03, 2006–07, 2009; refer SOFR 2013, Figure 3.9) contributed to the significant decrease in sustainable yield during the SOFR 2013 reporting period 2006–07 to 2010–11. Restrictions on harvesting in mountain ash (*Eucalyptus regnans*) forests imposed following concerns for Leadbeater's possum (*Gymnobelidus leadbeateri*) have resulted in further decreases in sustainable yield during the five-year period to 2015–16. VicForests (2017) forecasts an immediate significant reduction in future sustainable yield (a 29% reduction compared to the resource outlook in VicForests 2011b) from 2017–18 onwards as a consequence of these restrictions associated with Leadbeater's possum.

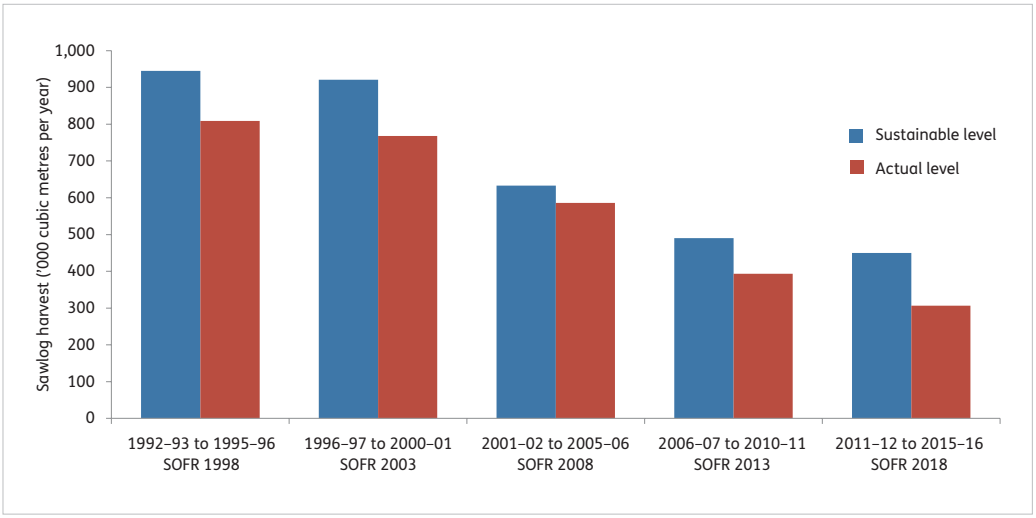
Western Australia

Independent reviews of sustainable yield (Ferguson et al. 2003, 2013) have supported the development of the two 10-year forest management plans in south-west Western Australia (CCWA 2004, 2013) which operated in the SOFR reporting period 2011–2016. These forest management plans require forecasts of the sustainable yield for high-quality jarrah (*Eucalyptus marginata*) and karri (*E. diversicolor*) sawlogs, and incorporate the allowable harvest of these species. The sustainable yield is forecast to increase over the next 50 years (CCWA 2013), subject to management of risk from bushfire, disease and climate impacts.

The current *Forest Management Plan 2014–2023* also specifies upper and lower limits for the allowable cut of both sawlogs and other bole volume for jarrah, karri and marri (*Corymbia calophylla*) (Table 2.11). The lower limit assumes that current industry technologies, practices and constrained markets for lower-grade logs apply throughout the plan, whereas the upper limit provides for potential expansion of silvicultural thinning programs and the development of markets for all lower-grade (non-sawlog) products. The capacity to remove commercially all lower-grade logs made available during the production of high-quality sawlogs, and to promote future sawlog growth (through thinning of regrowth forests), would contribute to forest health, fire management, and climate adaptation outcomes under the plan. Western Australia is the only state that applies principles of sustainable yield to lower grades of logs, including pulplogs, harvested from native forests.

The *Forest Management Plan 2014–2023* specifies an allowable cut for the plan period of first-grade and second-grade jarrah and karri sawlogs of a combined total of 191 thousand cubic metres per annum; this is 12% below

Figure 2.11: Average annual harvest and sustainable yield for multiple-use public native forests in Victoria, by SOFR reporting period



Notes:

Actual harvest levels are from multiple-use public native forest only. Category D+ or equivalent sawlogs are used for the all reporting periods. SOFR 1998 data includes an adjustment applied to Victorian data as a D+ sawlog equivalent (see SOFR 2013).

Source: SOFR 2003, SOFR 2008, SOFR 2013 and Victorian Department of Sustainability and Environment.

The data used to create this figure, together with other data for Indicator 2.1c, are available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

Table 2.11: Western Australian average annual allowable cut derived from the sustainable yield for sawlogs (cubic metres per year) for Forest Management Plans 2004–13 and 2014–23

		WA FMP 2014–2023	
Species/log grade	**WA FMP 2004–2013**	**Lower limit**	**Upper limit[a]**
Sustained yield of sawlog			
Jarrah first-grade and second-grade sawlog[b]	131,000	132,000[d]	160,000
Karri first-grade and second-grade sawlog[c]	54,000	59,000[d]	59,000
Total sawlog	**185,000**	**191,000[d]**	**219,000**
Other (non-sawlog) volumes arising[e]			
Jarrah other bole volume	534,000	292,000[f]	521,000[f]
Karri other bole volume	160,000[g]	164,000[f]	164,000[f]
Marri other bole logs	196,000	140,000[f]	254,000[f]

FMP – Forest Management Plan

[a] Upper limit is only accessible through the development of new markets for lower-grade wood products and must be approved by the Western Australian Minister for Environment (CCWA 2013).

[b] First-grade and second-grade jarrah sawlogs are logs cut from the bole of a jarrah (*Eucalyptus marginata*) tree that are a minimum of 2.1 metres in length, have a minimum under-bark diameter of 200 millimetres (first-grade) or 250 millimetres (second-grade), and have a minimum of 50% (first grade) or 30% (second grade) millable timber on the worst end-face. See www.dpaw.wa.gov.au/images/documents/conservation-management/forests/FMP/preparing_FMP_2014-23/timberharvman99.pdf.

[c] First-grade and second-grade karri sawlogs are logs cut from the bole of a karri (*Eucalyptus diversicolor*) tree that are a minimum of 2.4 metres in length, have a minimum under-bark diameter of 300 millimetres, and have a minimum of 50% (first grade) or 30% (second grade) millable timber on the worst end-face. See www.dpaw.wa.gov.au/images/documents/conservation-management/forests/FMP/preparing_FMP_2014-23/timberharvman99.pdf.

[d] Annual sustainable yields (sustained yield) of 146 thousand cubic metres for jarrah and 70 thousand cubic metres for karri (combined total 216 thousand cubic metres) based on standard silvicultural outcomes, sawlog utilisation and current markets were computed as the yields able to continue indefinitely. The average 'allowable' sustainable yield (allowable cut) is the sustained yield adjusted applying a 'safety margin' for first-grade and second-grade sawlog volume of 10% for jarrah and 15% for karri as recommended in Ferguson et al. (2013). The combined total allowable cut of 191 thousand cubic metres is 12% below the calculated sustainable yield of 216 thousand cubic metres.

[e] Bole log is a log extracted from the tree trunk between the ground and the crown break. Bole volume is the volume of a bole log. Other bole volume is the volume of bole log products not meeting first-grade or second-grade sawlog standards (CCWA 2013).

[f] The supply of lower-grade wood products arising as a consequence of sawlog sustained yields after application of a 'safety margin' for non-first-grade and non-second-grade sawlog volume of 10% for jarrah and 15% for karri as recommended in Ferguson et al. (2013). The figure for marri includes marri sawlogs resulting from jarrah and karri harvesting

[g] The Western Australian *Forest Management Plan 2004–13* (CCWA 2004) was amended on 1 November 2011, backdated to the commencement of the Plan, to allow the other bole yield of karri to increase from 117 thousand to 160 thousand cubic metres per year.

Source: CCWA (2004, 2013)

This table, together with other data for Indicator 2.1c, is available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

the combined forecast sustainable sawlog yield for karri and jarrah (CCWA 2013; Table 2.11 footnotes). The setting of an allowable cut lower than the projected sustainable yield made provision for possible future impacts of unforeseen bushfire, drought or disease events that could not be readily modelled in the sustained yield calculations.

The calculated sustainable yield and actual harvest yield of sawlogs from multiple-use public forests in Western Australia (Figure 2.12) declined significantly after the 1999 Western Australian Regional Forest Agreement and again after adoption of the *Forest Management Plan 2004–2013* (CCWA 2004). Sustainable yield calculated in the *Forest Management Plan 2004–2013* for first-grade and second-grade jarrah and karri sawlogs was 185 thousand cubic metres per annum (Table 2.11) reported in SOFR 2008. Sustainable yields have stabilised over the subsequent two SOFR reporting periods (2006–07 to 2010–11, and 2011–12 to 2015–16).

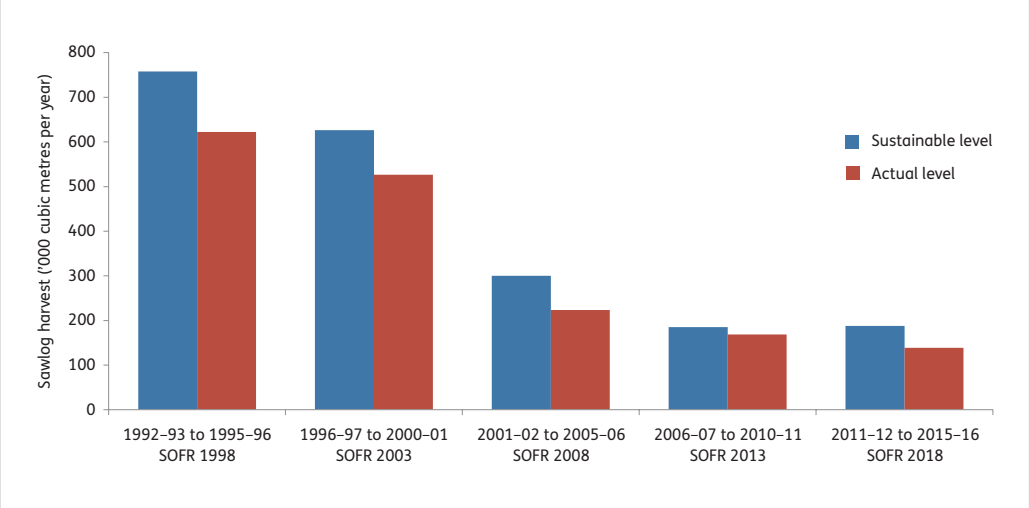
Queensland

In 1999, the Queensland government concluded an agreement with environmental and industry stakeholders to a 25-year transition period during which wood harvesting would be phased out from public native forests in the state's south-east, its major wood-producing area, with these forests to subsequently be gazetted as protected area tenures. The policy implemented in the agreement envisaged that future wood resource would be derived from newly established hardwood plantations and improved management of private native forests in south-east Queensland.

The Queensland government has also made a series of successive decisions on future harvesting levels and on nature conservation reserve areas in other areas of the State. These decisions resulted in the exclusion of harvesting from further areas of public native forests, although many areas were returned to the available harvest area in 2012 with a change in the Queensland government. These decisions are reflected in Figure 2.13, which shows a sustainable yield volume to 1999 and an allowable cut after this date. Queensland Government (1998) described the systems used to forecast sustainable yield before 1999. Wood harvest volumes have declined over all SOFR reporting periods, and remained close to the sustainable yield and allowable cut levels.

Native forest resource in Queensland continues to be made available under long-term wood supply agreements. The area available for wood production by the Crown comprises all State Forest and Timber Reserves, large areas of other Crown land (including leasehold land, Forest Entitlement Areas and unallocated state-owned land) and some freehold land over which the state retains ownership of forest products.

Figure 2.12: Average annual harvest and sustainable yield for multiple-use public native forests in south-west Western Australia, by SOFR reporting period



Notes:

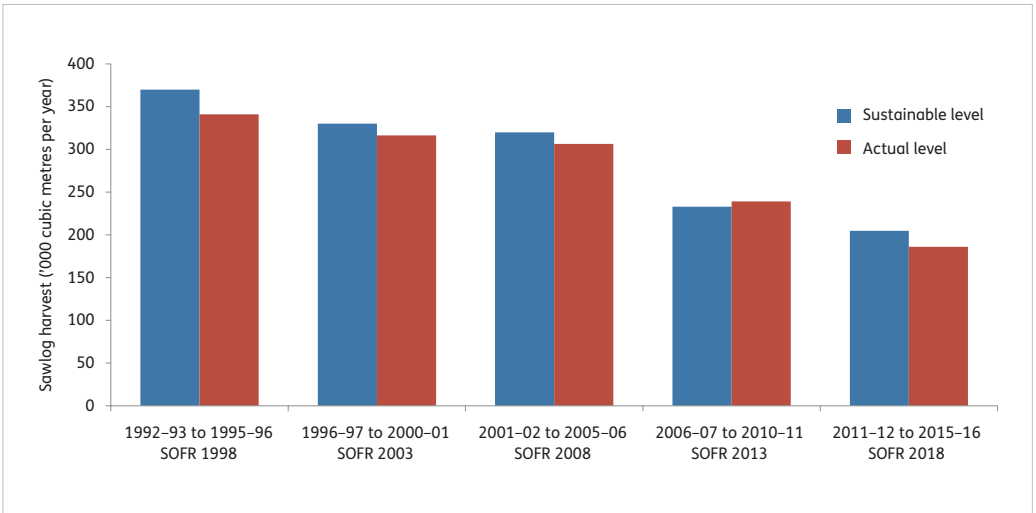
Sustainable yield and actual harvest levels are of first-grade and second-grade karri and jarrah sawlogs (see Table 2.11 for definitions) from forests regulated under the relevant Forest Management Plan (CALM 1994; CCWA 2004, 2013). SOFR 2008 and SOFR 2013 periods contain updated data from CCWA (2012).

Under each Forest Management Plan the annual harvest can exceed the average annual allowable cut in some years but must not, over the ten-year period of the plan, exceed the cumulative total allowable cut. Key performance indicators associated with the plans set the maximum amount by which the annual cut can exceed the average allowable cut: for the *Forest Management Plan 2004–2013* it was 10%; for the *Forest Management Plan 2014–2023* a progressive scaling down was introduced of 10% at year 3, 5% at year 6, and 3% at year 9.

Source: DEC 2012b, SOFR 2003, SOFR 2008, CCWA (2012), Department of Parks and Wildlife, and Department of Biodiversity, Conservation and Attractions.

The data used to create this figure, together with other data for Indicator 2.1c, are available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

Figure 2.13: Average annual harvest and allowable cut for state-owned native forests in Queensland, by SOFR reporting period



Notes:

Sustainable yield figures apply to 1999. After that date, figures are 'Allowable cut'.

Data are for hardwood and cypress pine sawlogs; other log categories (e.g. poles, fencing, sleeper and mining timber) are excluded.

Data for the SOFR 2018 period include an adjustment in 2012–13 to an allowable cut applying to Queensland's area for wood production, and actual levels include timber harvested from leasehold land and freehold land where trees are owned by the State through a forest consent agreement (a 'profit a prendre' agreement).

Sources: Queensland Department of Agriculture and Fisheries, SOFR 2003, SOFR 2008, SOFR 2013.

The data used to create this figure, together with other data for Indicator 2.1c, are available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

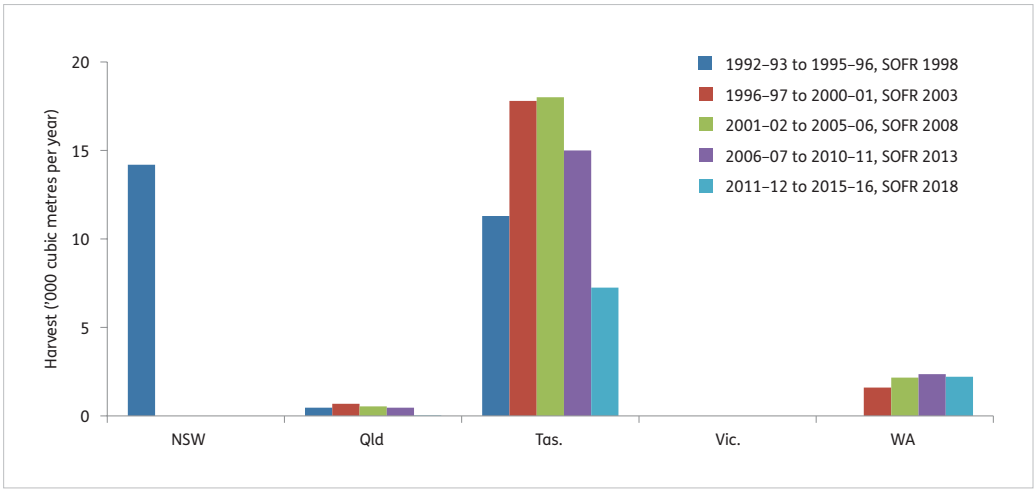
Special-species timbers and sandalwood

Figure 2.14 reports the average annual volumes of special-species timbers harvested from public native forests, by jurisdiction, for the five SOFR reporting periods. These volumes include sandalwood reported from Queensland and Western Australia. Harvesting of logs designated as cabinet rainforest timbers in New South Wales ceased after 1992–93 and no special-species sawlogs have been harvested in that state since that date. Tasmania has been the main source of special-species timbers nationally; a list of special-species timbers in Tasmania is presented in Table 2.12.

Tasmanian special-species timbers make an important contribution to the Tasmanian economy (DSG 2017). A strategy to sustain long-term production of Tasmanian special-species timbers (myrtle, blackwood, sassafras and various native pines) from public native forests was implemented in 2010 (Forestry Tasmania 2010). This was based on sustainable yield estimates, and included supply targets for the 10-year period to 2019 of 10,000 cubic metres per annum of blackwood and 500 cubic metres per annum of other special-species timbers (Table 2.12).

The 2013 Tasmanian Forest Agreement process led to a reduction in the public native forest production estate, and a reduction in the annual harvest of special-species timber sawlogs (Figure 2.14). Forestry Tasmania (2013b) reviewed the sustainable supply of Tasmanian special-species timbers from public native forest. Forestry Tasmania (2015b) then presented recalculated supply levels for category 4/utility sawlogs of special species timber from the Permanent Timber

Figure 2.14: Average annual harvest volumes of special-species timbers from multiple-use public native forests, by SOFR reporting period



Notes:

Special-species timbers include cabinet rainforest timbers (New South Wales) until 1992–93, Tasmanian special-species timbers, and sandalwood (Queensland and Western Australia: cubic metre equivalent converted from tonnes).

Figures for Tasmanian special-species timbers only include millable sawlogs (category 4/utility sawlogs) and exclude non-specification logs and craftwood.

Source: ABARES databases, state agencies.

The data used to create this figure, together with other data for Indicator 2.1c, are available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

Table 2.12: Annual log supply, Tasmanian special-species timbers, 2009–2019

Special-species timbers	Supply (cubic metres)
Blackwood (*Acacia melanoxylon*)	10,000
Silver wattle (*A. dealbata*)	500
Myrtle (*Nothofagus cunninghamii*)	500
Sassafras (*Atherosperma moschatum*)	500
Celery-top pine (*Phyllocladus aspleniifolius*)	500
Huon pine (*Lagarostrobos franklinii*)	500
King Billy pine (*Athrotaxis selaginoides*) and other species, including figured eucalypt (*Eucalyptus* spp.)	No volume target – arisings only[a]

Includes 'category 4' sawlogs and 'utility' logs.

[a] Arisings refer to logs produced as a result of planned harvest of other species or log grades.

Source: Forestry Tasmania (2010).

This table, together with other data for Indicator 2.1c, is available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

Production Zone managed by Forestry Tasmania, based on resource estimates of special-species timber found in areas for which preliminary harvest plans had been prepared and on application of sustainable yield principles. Updated supply levels were presented for blackwood (4,275 cubic metres per annum for the period 2015–2016 to 2026–2027, and 3,095 cubic metres per annum after 2027) and for other special-species timbers (a total across all other species of 560 cubic metres per annum for the period 2015–2016 to 2026–2027, and 285 cubic metres per annum after 2027). Forestry Tasmania (2017) and *The Tasmanian Special Species Management Plan* (DSG 2017) covered access to the Permanent Timber Production Zone as well as other land management categories and tenures.

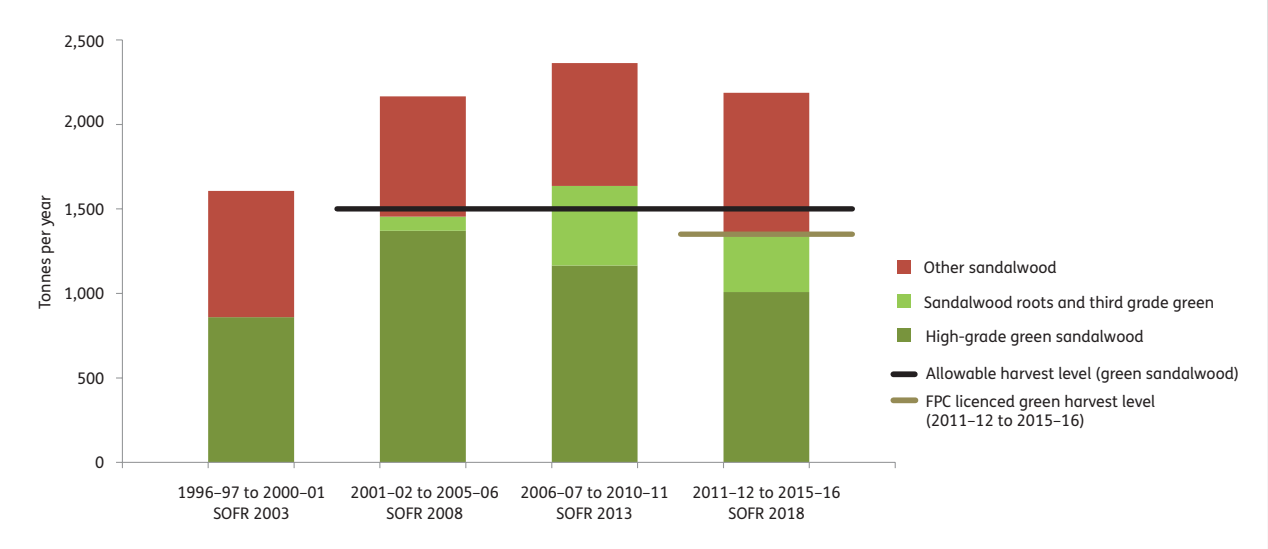
In Western Australia, harvests of wild-collected Australian sandalwood (*Santalum spicatum*) comprise high-grade and low-grade green[109] sandalwood, root, bark and dead sandalwood under licence from public and private lands. The total annual allowable harvest level of green sandalwood to 2016 was 1,500 tonnes per annum, of which the Forest Products Commission (FPC) was licenced to remove 1,350 tonnes per annum. Figure 2.15 reports the harvest of sandalwood by the FPC from Western Australian public native forest by SOFR reporting period. The allowable harvest level applies to high-grade green sandalwood, third-grade green sandalwood and sandalwood root, and does not include 'Other sandalwood'. Bark and dead material are included in the 'Other sandalwood' figures. Green (live) sandalwood trees produce more oil than dead trees and consequently have a higher commercial value.

Since 2006, improved harvesting techniques have resulted in greater utilisation of third-grade and sandalwood root products. These products were previously not able to be processed efficiently and were not included in total production. From 1 July 2016, a reduced annual harvest quota of 1,250 tonnes of green sandalwood and 1,250 tonnes of dead sandalwood has been set, of which 1,125 tonnes of green sandalwood is licenced to the FPC. This revised quota applies until 2026, when sandalwood plantations (including almost 6,000 hectares of public plantations and 20,000 hectares of private plantations) is expected to begin to contribute to the supply of sandalwood (DPaW 2015b; FPC 2016).

Supplementation from hardwood plantations

Sustainable yield estimates of high-quality sawlogs from multiple-use public native forests in New South Wales and Tasmania include supplementation with sawlogs of similar quality from public hardwood plantations. The supplementary component of sustainable yield estimates is based on projected yields of high-quality sawlogs from these plantations. The extent of supplementation is currently very small for Tasmania, but supplementary quantities of high-quality hardwood sawlogs are forecast to increase in New South Wales and Tasmania after 2025 (Forests NSW 2010, Forestry Tasmania 2014b).

Figure 2.15: Average annual harvest by the Forest Products Commission of Western Australian sandalwood from public native forests, by SOFR reporting period



Notes:
No data are available for SOFR 1998 reporting period 1992–93 to 1995–96.
Bark and dead material are included in 'Other sandalwood'.
Source: Western Australian Forest Products Commission annual reports.

The data used to create this figure, together with other data for Indicator 2.1c, are available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

[109] Green sandalwood is live sandalwood that meets minimum specified size and quality specifications and includes all grades including live root material.

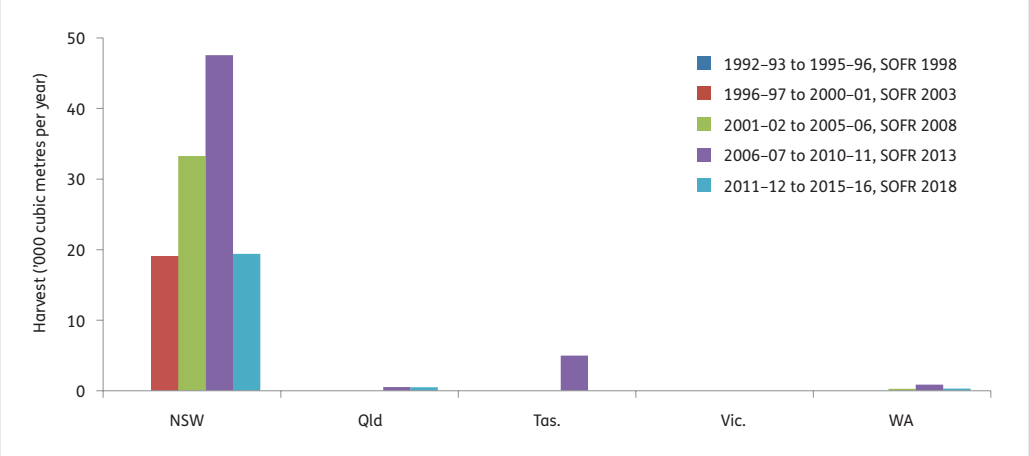
Figure 2.16 shows the average annual yield of high-quality hardwood sawlogs harvested from public plantations, by jurisdiction, for the five SOFR reporting periods. To date, the plantation sawlog yield in every state except for New South Wales has been small compared with the multiple-use public forest sawlog yield from the same jurisdiction. In New South Wales, high-quality hardwood sawlogs have been harvested from public plantations since 1997–98, and the north-eastern region of the state, in particular, contains older plantations available for harvest. Small amounts of high-quality sawlogs from plantations are becoming available in Tasmania and Western Australia.

Sawlog yields from private native forests

There is no calculated sustainable yield for wood production from native forests on private land across Australia, and there is insufficient information nationally to assess whether the current or future rate of wood harvest from private native forests is sustainable. However, increasing regulatory restrictions on harvesting operations on private land in all states have led to a reduction in wood harvest volumes from private forests. In practice, most private forest managers make limited use of their native forests for wood production, and respond only to immediate needs and opportunities in the market (Commonwealth of Australia 2016b). Thompson and Connell (2009) and Jay et al. (2009) provide a review of the issues confronting sustainable private native forests in Australia and particular regions.

For all SOFR periods, the supply of sawlogs from private native forests has been significant in New South Wales, Queensland and Tasmania, and comparatively small in Victoria and Western Australia, with the Northern Territory reporting sawlog production in only one period (Figure 2.17). The harvesting of sawlogs from private native forests has not been permitted in the Australian Capital Territory or South Australia since SOFR reporting begun. Based on ABARES data, the harvest of sawlogs from private native forests has decreased steadily in Queensland and Tasmania since the SOFR 1998 reporting period 1992–93 to 1995–96, and since the SOFR 2013 reporting period has declined by 30% in Queensland, by 47% in Tasmania, by 71% in New South Wales and by 80% in Western Australia (Figure 2.17). The decline in sawlog production in Tasmania was associated with the decline in pulplog production, as sawlog production is not profitable without the grower also being able to access pulplog markets; the decline in pulplog production resulted from overseas market changes and from reduced access to pulplog export facilities. A possible driver for the decline in New South Wales and Queensland has been increased regulatory requirements applying to private landowners, although it is also possible that a proportion of the private native sawlog harvest in New South Wales is not captured in these data. The decline in Western Australia reflects the episodic nature of the harvest of private native forests in the south-west of the state. The sawlog harvest from private native forest in Victoria increased during the SOFR 2018 reporting period but is a relatively small volume.

Figure 2.16: Average annual harvest of high-quality hardwood sawlogs from public plantations, by SOFR reporting period



Notes:

Plantation high-quality sawlogs are assessed against jurisdictional quality and size specifications for similar products from native forest. These specifications are similar between states.

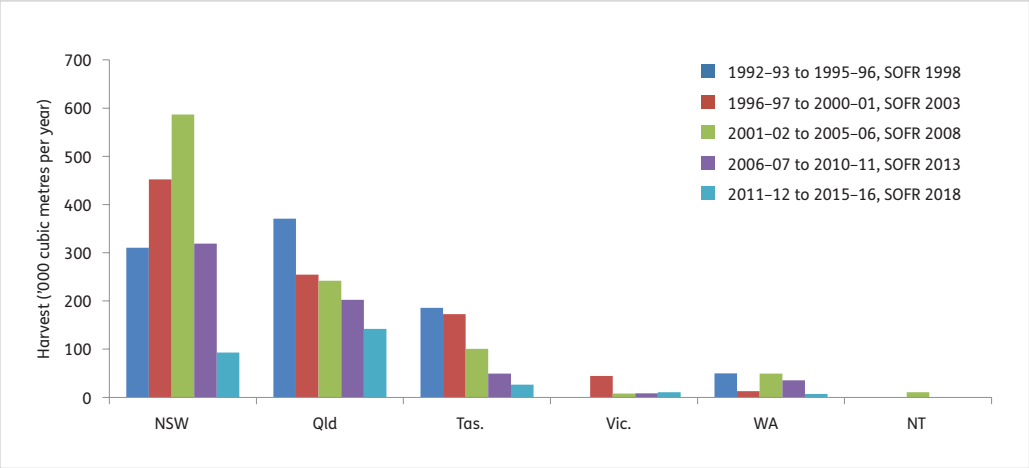
No high-quality sawlogs were produced from plantations in the first reporting period (SOFR 1998).

Victoria has reported no production of high-quality sawlogs from public plantations in all SOFR periods.

Source: ABARES databases, state agencies.

The data used to create this figure, together with other data for Indicator 2.1c, are available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

Figure 2.17: Average annual sawlog harvest from private native forests, by SOFR reporting period



Notes:

Sawlogs harvested from private forests include high-quality and low-quality hardwood sawlog, hardwood 'veneer sawlog' and cypress pine sawlog.

Data are unavailable for the 1992–93 to 1995–96 reporting period for Northern Territory and Victoria.

Data for Tasmania and Western Australia are incomplete for this period.

No sawlogs are harvested from private native forests in the Australian Capital Territory or South Australia.

Source: ABARES databases, state agencies.

The data used to create this figure, together with other data for Indicator 2.1c, are available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

PFT (2005) previously estimated wood supply from private native forest in Tasmania, but that estimate is no longer current. Dare and Eversole (2013) report the future harvesting intent of Tasmanian non-industrial private forest owners, while Wilson (2012) provides some updated forest inventory data for private forests in Tasmania.

A 2009 national assessment of the role, value and potential of private native forests (Parsons and Pritchard 2009) estimated the contribution of private native forests to regional wood supply at a state level. There has been no similar national assessment of private native forests since 2009. The assessment by Parsons and Pritchard (2009) found that, despite adequate information on the area of private native forests, little information is available on their quality, condition, value, current management regime and future management intent. It also found that, although a proportion of landowners (varying by region) want to manage their forests to provide wood and other products and services in the long term, there is insufficient information nationally and regionally to assess whether the rate of wood harvest from private native forests is sustainable. These limitations on information continue to remain an impediment regionally and nationally for regional forest industry planning (Burns et al. 2015). However, the contribution to regional economies, communities and industry that can be made by harvesting wood products from private native forest was recognised in Commonwealth of Australia (2015, 2016a).

Jay et al. (2009) and Thompson and Connell (2009) discuss the sustainability of forestry on private native forests in northern New South Wales, and more broadly in Australia. An assessment of the sustainability of wood supply from private forests in north-east New South Wales (EPA 2013a) found that, over time, the quality of the wood resource from private native forests in the region would decline due to selective harvesting of high-quality trees and the failure to apply silvicultural practices to maintain and promote future high-quality sawlog resources.

Pulplogs from public and private native forests

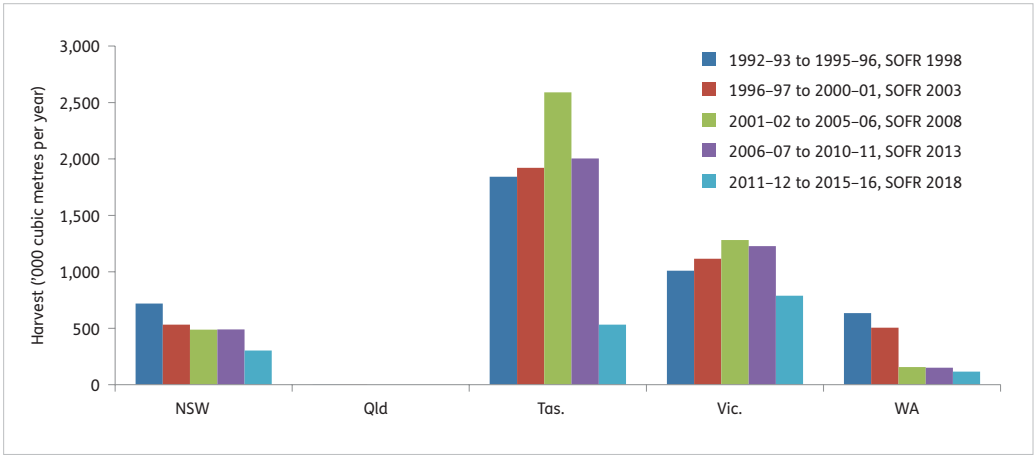
Sustainable wood yields on public land are calculated based on the production of high-quality sawlogs and veneer logs (logs for production of sliced veneer). Pulplogs, together with low-quality sawlogs and other wood products, are usually a residual product of sawlog and sliced veneer log harvesting, and sustainable yields are not determined specifically for pulplogs, peeler logs (logs for production of peeled veneer) or other wood products (an exception is the treatment of bole logs in Western Australia, see above).

During the SOFR 2018 reporting period 2011–12 to 2015–16, the volume of pulplogs harvested from multiple-use public native forests decreased substantially in Tasmania (73%) and significantly, but to a lesser extent, in New South Wales (38%), Victoria (36%) and Western Australia (24%), compared to the SOFR 2013 reporting period 2006–07 to 2010–11 (Figure 2.18). No pulplogs have been harvested from public native forests in Queensland since the SOFR 2003 reporting period of 1996–97 to 2000–01, and Queensland export of native forest woodchips ceased from Queensland forests in 1997–98.

While Tasmania has historically been Australia's major provider of pulplogs from private native forests, harvest volumes from this source decreased by 90% in the SOFR 2018 reporting period (Figure 2.19). The decreases in pulplogs harvested from both multiple-use public native forest (Figure 2.18) and private native forest (Figure 2.19) in Tasmania during the SOFR 2018 reporting period were due to changes in overseas markets, policies associated with the 2013 Tasmanian Forest Agreement process, reduced access to pulp wood export facilities, and cessation of harvesting on some large private forest estates.

Pulplogs harvested from private forests decreased in New South Wales (74%) and Victoria (41%) in the SOFR 2018 reporting period; and increased slightly in Western Australia. No pulplogs have been harvested from private native forests in Queensland or the Northern Territory in any of the SOFR reporting periods.

Figure 2.18: Average annual pulplog harvest from multiple-use public native forests, by SOFR reporting period



Notes:

Pulplog includes logs sold for pulp or equivalent, and for woodchip.

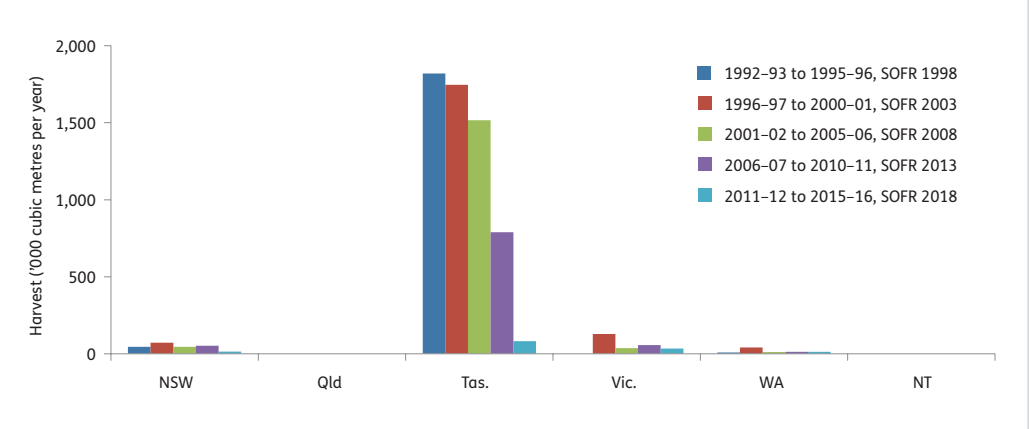
Data have been converted from tonnes to cubic metres. There was a very small amount of pulplog harvest reported for the 1992–93 to 1995–96 reporting period for Queensland, but none for subsequent reporting periods.

Data previously unavailable for the 1992–93 to 1995–96 reporting period for Tasmania are now included.

Source: ABARES databases, state agencies.

The data used to create this figure, together with other data for Indicator 2.1c, are available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

Figure 2.19: Average annual pulplog harvest from private native forests, by SOFR reporting period



Notes:

Data are unavailable for the 1992–93 to 1995–96 reporting period for all states and territories other than New South Wales and Tasmania, and limited data are available for Western Australia for this period.

Data have been converted from tonnes to cubic metres. Pulplog includes logs sold for pulp or equivalent, and for woodchip.

Source: ABARES databases, state agencies.

The data used to create this figure, together with other data for Indicator 2.1c, are available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

Other wood products

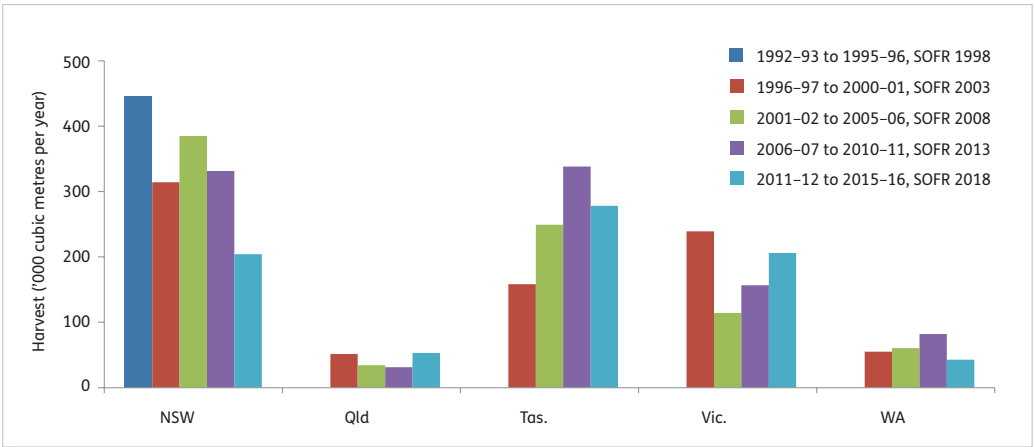
The supply of other wood products, such as low-quality sawlogs, girders, poles, piles, other logs that are not sawlogs or pulplogs, as well as wood used in mines, split and round posts, bush sawn/hewn timber and sleepers (but excluding fuelwood logs and firewood), varies by jurisdiction. In multiple-use public native forests, harvesting is often opportunistic and can occur in association with harvesting of high-quality sawlogs and pulplogs, as a follow-up to high-quality wood product harvesting, or be confined to low-volume or non-sawlog areas suiting the production of these other wood products. These products are a major resource in New South Wales, Tasmania and Victoria. Figure 2.20 shows average annual harvest volumes for these products from multiple-use public native forests, by jurisdiction. Limited data are available on harvest rates for these products from private forests. Fuelwood and firewood are treated separately from these products, and are discussed separately below[110].

National overview of wood and wood products from native forests

This section presents information at the national level and discusses trends on the volume and value[111] of wood and wood products from native forests.

The quality of SOFR 1998 data on the harvesting of wood products was limited in terms of data accuracy, consistency and completeness, and was only adequate for the harvest of sawlogs. The *Australian Forest and Wood Product Statistics* (AFWPS) series, published by ABARES and its precursors, and available from 1996–97 and thus covering the last four SOFR reporting periods, provides data of better quality on the types, volume and value of wood products harvested from native forests. The AFWPS series provides data on four wood and wood product categories: total wood products, sawlogs and peeler logs, pulplogs, and other log products (which includes fuelwood logs and firewood).

Figure 2.20: Average annual harvest of 'other wood products' from public native forests, by SOFR reporting period



Notes:

Data are unavailable for the SOFR 1998 reporting period 1992–93 to 1995–96 for all states other than New South Wales. Figures for all periods are from native multiple-use public forests for all states, except for Queensland in the SOFR 2018 period, which relate to Queensland's Defined Forest Area and include timber harvested from leasehold land and freehold land where trees are owned by the State through a forest consent ('profit a prendre') agreement.

'Other wood products' are products that are not included under high-quality sawlogs and veneer logs, special-species timbers or pulplogs; they include lower grades of sawlog and peeler logs but not firewood and fuelwood.

Poles, piles and girders are included other than in New South Wales where these products are reported as high-quality sawlogs (Figure 2.9).

Source: ABARES databases, state agencies.

The data used to create this figure, together with other data for Indicator 2.1c, are available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

[110] "Other wood products" excludes fuelwood logs and firewood, whereas "Other log products" includes fuelwood logs and firewood.

[111] Data for log value represent the value as received at the mill door.

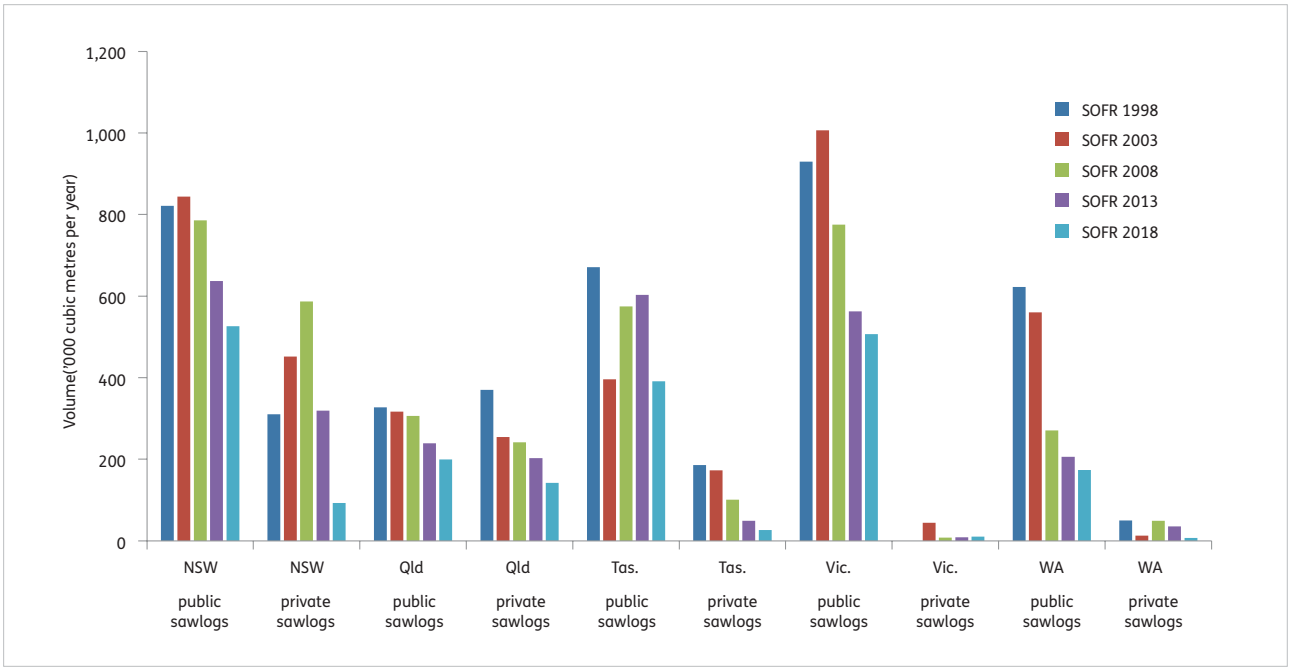
Figure 2.21 presents the average annual volume of sawlogs harvested from public and private native forests by jurisdiction across the five SOFR reporting periods. Sawlog harvest occurred in public and private native forests in New South Wales, Queensland, Tasmania, Victoria and Western Australia during these reporting periods. In addition to the significant supply from multiple-use public forests, private native forests have been an important source of sawlog supply in New South Wales, Queensland and Tasmania, but a relatively minor source in Victoria and Western Australia.

In the Northern Territory, small volumes of wood products were harvested from private native forests (primarily from Indigenous owned private land) during the SOFR 2008 reporting period 2001–02 to 2005–06. Sales of commercial sawlogs were recorded in the Northern Territory for this period at an annual average of 11 thousand cubic metres (Figure 2.17), with a high of 25 thousand cubic metres in 2005–06, but no commercial sales have been recorded in other SOFR reporting periods. There is no harvesting of wood and wood products on public forest tenures in the Northern Territory.

Commercial harvesting of wood products from native forests is not permitted in the Australian Capital Territory and South Australia.

Figure 2.22A–D and Figure 2.23A–D show the average annual volume and value, respectively, of wood and wood products from native forests for the SOFR 2003, SOFR 2008, SOFR 2013 and SOFR 2018 reporting periods, separately for five states. The four panels in each figure show respectively total native forest production, production of sawlog and peeler logs, production of pulplogs, and production of other log products.

Figure 2.21: Average annual volume of sawlogs harvested from public and private native forests, by SOFR reporting period



Notes:

Public and private sawlogs are reported based on public or private ownership of the extracted wood, noting that ownership of wood on leasehold land can vary within and across jurisdictions.

Public sawlogs include sawlogs extracted from multiple-use forests, other Crown land, Commonwealth land and leasehold forest where the Crown owns the timber rights. All sawlogs harvested from private land are treated as private sawlogs, including those harvested to supplement public forest harvest.

Sawlogs harvested from public and private native forests include high-quality and low-quality hardwood sawlog, hardwood 'sliced veneer sawlog' and cypress pine sawlog.

Peeler logs, poles, girders and piles are not included in the figures.

Data are unavailable for the SOFR 1998 reporting period 1992–93 to 1995–96 for private forest sawlogs in Victoria, and data for Tasmanian and Western Australia private forests in the SOFR 1998 reporting period was incomplete.

No sawlogs are harvested from public and private native forests in the Australian Capital Territory or South Australia. Sawlog production from private forests in the Northern Territory is minimal (see Figure 2.17).

Source: ABARES databases, state agencies.

The data used to create this figure, together with other data for Indicator 2.1c, are available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

Nationally, the annual average volume of wood products harvested from native forests fell from 10.4 million cubic metres during the SOFR 2003 reporting period to 4.4 million cubic metres during the SOFR 2018 reporting period (a 58% decrease). This fall was due primarily to a decrease in the national average annual pulplog harvest, from 6.1 million cubic metres in the SOFR 2003 reporting period, to 1.9 million cubic metres in the SOFR 2018 reporting period (a 69% decrease). The national average annual sawlog harvest (including peeler logs) fell from 4.1 million cubic metres in the SOFR 2003 reporting period, to 2.1 million cubic metres in the SOFR 2018 reporting period (a 48% decrease).

During the SOFR 2003, SOFR 2008 and SOFR 2013 reporting periods, the state with the highest national average total volume and value of wood products from native forests was Tasmania, with 41–47% of total national volume, and 35–39% of total national value (Figures 2.22a, 2.23a). These high levels were due primarily to the production of high pulplog volumes associated with the harvesting of sawlogs in Tasmania.

Outcomes of both the Tasmanian Forest Agreement process in 2013, and the consequent 2013 World Heritage Area extension, as well as disruption in the markets for exports of pulpwood (pulplogs and woodchips) from Tasmania, and changes in the management of major private forest estates, resulted in significant declines in the volume and value of wood products from native forests in Tasmania during the SOFR 2018 reporting period 2011–12 to 2015–16. The total average annual volume of wood products harvested in Tasmania was 3.5 million cubic metres during the SOFR 2013 reporting period 2006–07 to 2010–11, and decreased to 1.1 million cubic metres in the SOFR 2018 reporting period. The average annual value of wood products harvested in Tasmania was $213 million during the SOFR 2013 reporting period, and decreased to $72 million in the SOFR 2018 reporting period. Policy, market and management intent changes in Tasmania during 2013 therefore contributed to an average annual volume reduction of 2.4 million cubic metres and an annual average value reduction of $141 million in harvested wood products from native forest, between the SOFR 2013 and SOFR 2018 reporting periods.

Nationally, over the four SOFR reporting periods, the highest sawlog harvest volume was in New South Wales, followed by Victoria. Together, these jurisdictions accounted for more than half of the total sawlog volume harvested from native forests in all four SOFR reporting periods.

Except for Tasmania, sawlog harvests generally decreased across consecutive SOFR periods (Figure 2.21). In Tasmania, the sawlog and peeler harvest increased from the SOFR 2003 reporting period across the two subsequent SOFR reporting periods (SOFR 2008 and SOFR 2013), then decreased to below the SOFR 2003 level.

Tasmania and Victoria harvest the majority of native forest pulplogs in Australia. Taken together, these two states accounted for more than 80% of the national average annual pulplog harvest in the SOFR 2003, SOFR 2008 and SOFR 2013 reporting periods, and 77% of the national average annual pulplog harvest during the SOFR 2018 reporting period.

Tasmania exported most of its pulplogs (generally more than 90%) during the four SOFR reporting periods, as there was little local processing capacity. By contrast, Victoria's pulplog harvest has been used in the domestic production of paper and hardboard[112] (50%, 35%, 38% and 67% during the SOFR 2003, SOFR 2008, SOFR 2013 and SOFR 2018 reporting periods, respectively), with the remainder being exported as woodchips. During the four SOFR reporting periods, the pulplog harvest from native forests in Western Australia was all exported as woodchips. All of the pulplog harvest from native forests in New South Wales was exported, except for a small volume used to manufacture hardboard. Queensland did not produce pulplogs from native forests as the tree species harvested were generally not suitable.

The annual Tasmanian pulplog harvest during the SOFR 2018 reporting period (0.61 million cubic metres) was 17% of the annual pulplog harvest reported for Tasmania during the SOFR 2003 reporting period (3.7 million cubic metres). This volume decrease led to an 81% decrease in annual pulplog harvest value, from $157 million to $29 million annually[113].

During the SOFR 2018 reporting period, Tasmania's contribution to the total national production of wood products from native forests was 24% by volume, below the contributions of New South Wales (25%) and Victoria (32%). In value terms, Tasmania's contribution to total national production was 18%, also below the contributions of New South Wales (30%) and Victoria (29%).

All the above five states produce other log products from native forest, such as fuelwood, poles and piles[114]. Between the 2013 and 2018 SOFR reporting periods, the joint contribution of New South Wales and Western Australia increased from 61% to 74% of total national production of other log products. Wood for domestic firewood and industrial fuelwood represent a high proportion of other log products produced in both states.

In New South Wales, poles and piles represent a high proportion of other log products from that state (27%, 18%, 25% and 32% in the SOFR 2003, SOFR 2008, SOFR 2013 and SOFR 2018 reporting periods, respectively); these are reported as high-quality products for sustainable yield calculations (see Figure 2.9). New South Wales also generally produces more than half of Australia's poles and piles (49%, 53%, 58% and 69% in the SOFR 2003, SOFR 2008, SOFR 2013 and SOFR 2018 reporting periods, respectively).

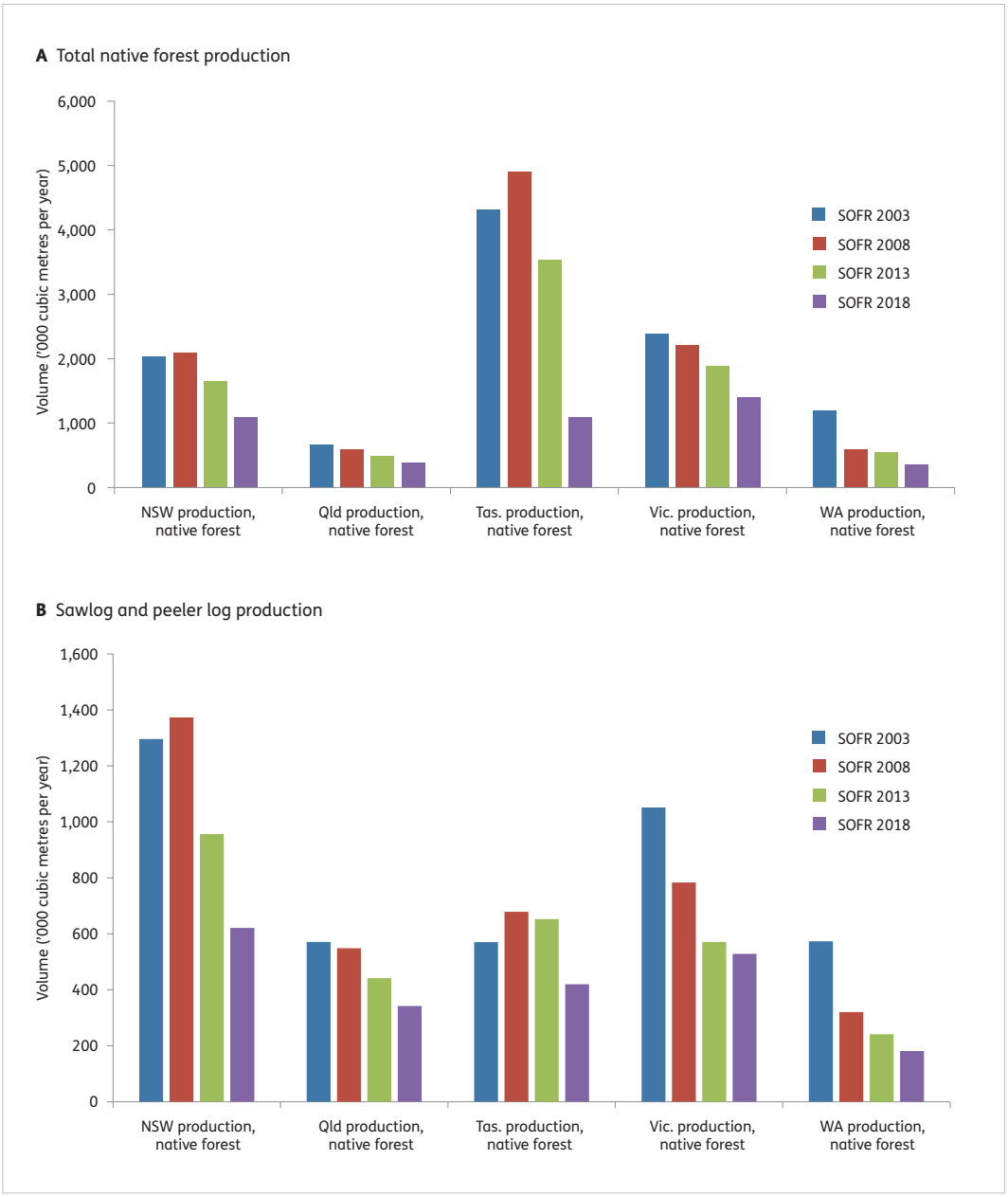
Poles and piles are high-value products, and so the value of other log products has increased significantly in New South Wales over the four SOFR reporting periods compared to other states (Figure 2.23). Queensland also produces poles and piles, and the value of these products has also contributed to the increasing value of other log products over the four SOFR reporting periods for that state.

[112] Hardboard manufacturing in Victoria stopped in 1998.

[113] Dollar figures are actual figures, not corrected or indexed.

[114] 'Other log products' includes fuelwood logs and firewood, whereas 'Other wood products' excludes fuelwood logs and firewood. Girders may be included in the statistics for poles and piles.

Figure 2.22: Average annual volume of wood and wood products from native forests, by SOFR reporting period



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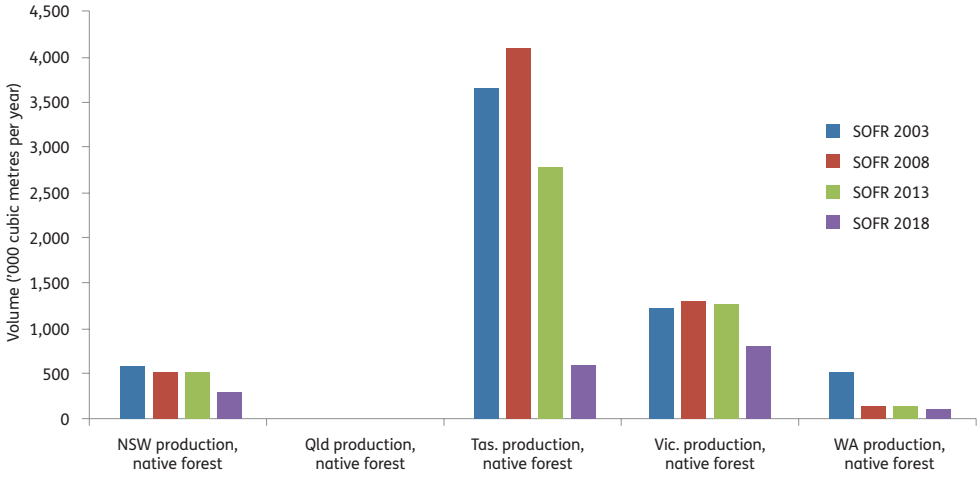
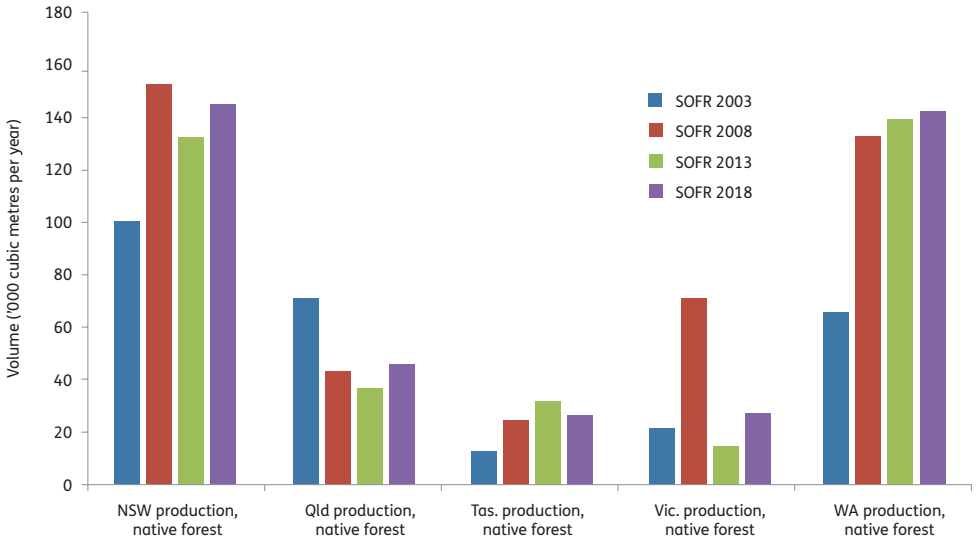
C Pulplog production



D Production of other log products



Notes:

Total native forest production is the sum of the production of sawlog and peeler log, pulplog, and other log products.

Sawlog includes all categories of domestically used or exported sawlogs and veneer logs.

Sliced peeler logs for the domestic market are grouped with sawlogs even though they can be a mix of sawlog or pulplog quality; this log category is only recorded as a separate product category in Tasmania.

Exported peeler logs are split into exported sawlog or exported pulplog based on quality, and these logs are reported as sawlog and peeler log, and pulplog, respectively.

Pulplogs are logs used in domestic hardboard or paper production, or exported as pulplogs or woodchips.

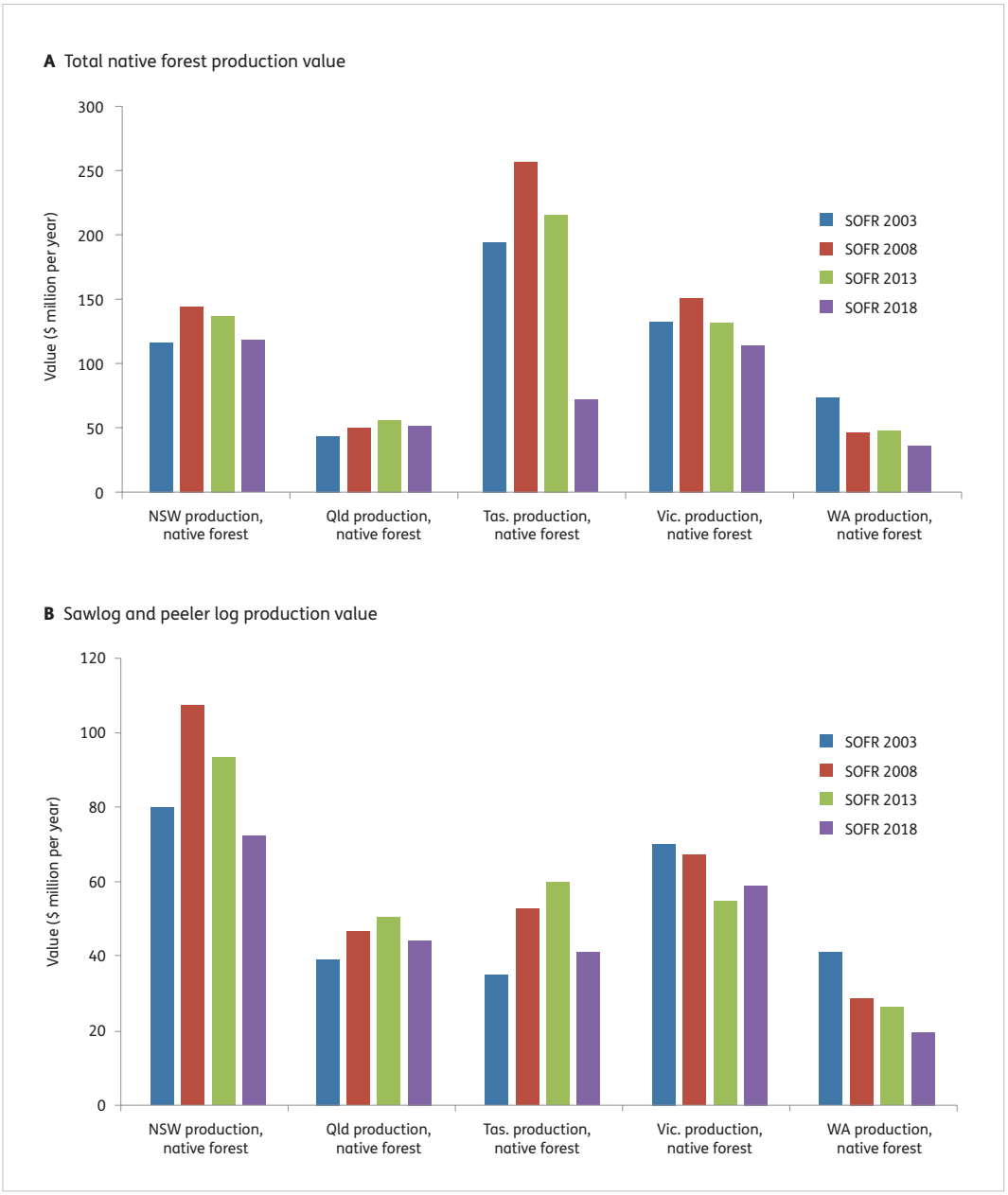
Other log products includes sleeper logs, poles, piles, fencing, mining timber, other log types not included elsewhere, and fuel logs for industrial and domestic use (firewood).

Data from Northern Territory are not shown because the quantities harvested are small.

Source: ABARES databases.

The data used to create this figure, together with other data for Indicator 2.1c, are available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

Figure 2.23: Average annual value of wood and wood products from native forests, by SOFR reporting period



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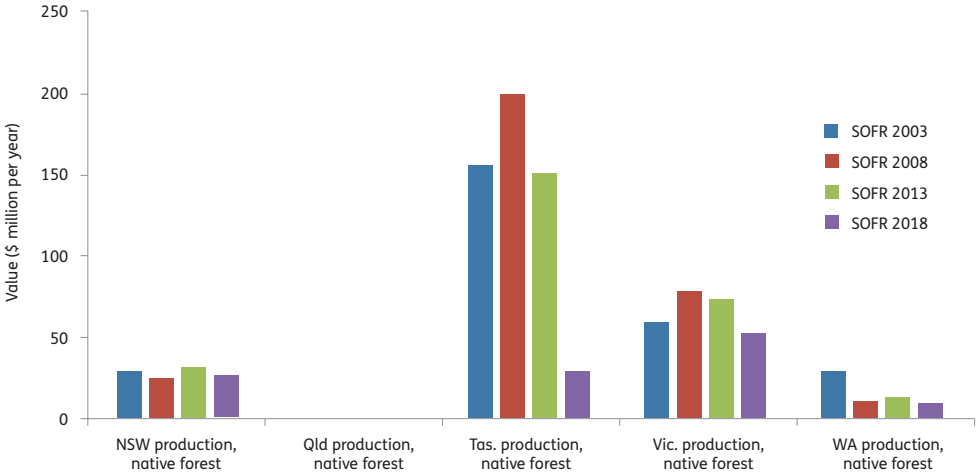
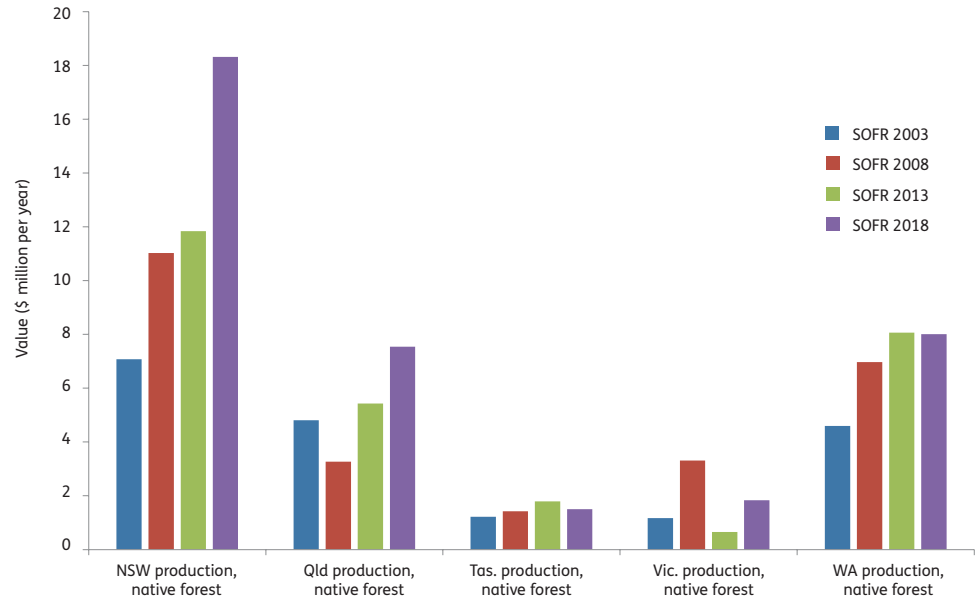
C Pulplog product value



D Other log product value



See notes under Figure 2.22A–D.

Source: ABARES databases.

The data used to create this figure, together with other data for Indicator 2.1c, are available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

Logs harvested from plantations and native forests

Figure 2.24 shows the annual harvest volumes of different log types from Australia's native forests and plantations from 2000–01 to 2015–16. A total of 4.1 million cubic metres of native forest logs (sawlogs, pulplogs and other logs, including native forest softwood logs), 9.8 million cubic metres of plantation hardwood logs (sawlogs, pulplogs and other logs), and 16.2 million cubic metres of plantation softwood logs (sawlogs, pulplogs and other logs) were harvested in 2015–16.

Of the logs harvested from native forest, 52% by volume were sawlogs and 44% by volume were pulplogs.

Approximately 60% by volume of the total plantation log harvest was used for sawn timber, and 39% by volume was used for pulp, in the period 2011–16. However, of the total plantation hardwood log volume harvested, only 2% was sawlogs and 98% was pulplogs.

A very small amount of other logs (poles, piles, fencing and other logs not elsewhere included) account for the remaining total log harvest in native forests and plantations.

Over the period 2000–01 to 2015–16, the sawlog and pulplog harvest from native forests declined due to changes in land use and land tenure, and market decisions, while the harvest from plantations increased as plantations matured (Figure 2.24). The most substantial change in Australia's log harvest during this period was an increase in plantation hardwood pulplog harvest from 0.9 to 9.6 million cubic metres per annum. This increase was offset by a decrease in the harvest of native forest pulplogs over the same period, from 7.0 to 1.8 million cubic metres per annum. The plantation softwood sawlog harvest increased from a low of 7.2 million cubic metres in 2000–01 to a peak of 10.0 million cubic metres in 2015–16. The plantation softwood pulplog harvest increased from 4.7 million cubic metres to a peak of 5.9 million cubic metres over the same period.

The contribution of plantations to Australia's total log harvest has increased steadily from 55% in 2000–01 to 86% in 2015–16, and averaged 84% across the SOFR 2018 reporting period of 2011–12 to 2015–16 (Table 2.13). Native forests remain the main source of hardwood sawlogs, producing 92% of Australia's total harvest in the SOFR 2018 reporting period of 2011–12 to 2015–16 despite the native forest sawlog harvest volume decreasing over this period from 3.9 to 2.1 million cubic metres; this is because most hardwood plantations are not managed to produce sawlogs, or are not able to produce sawlogs. Plantation-grown hardwood sawlogs generally cannot be used to make the same feature-grade sawn timber products as can be made from native forest hardwood sawlogs.

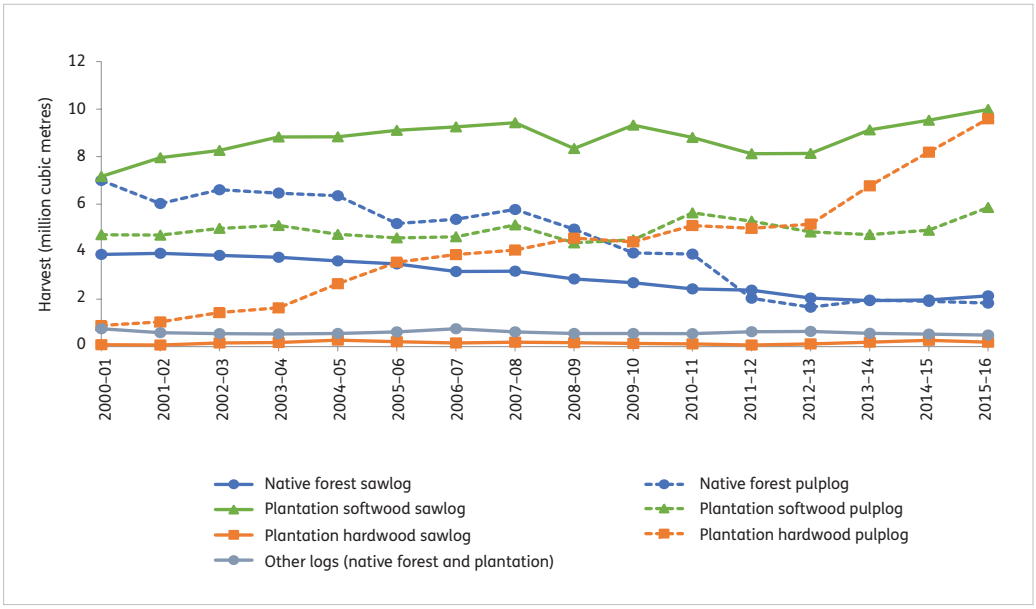
The reduction in total native forest log harvest between 2000–01 and 2015–16 occurred in both the public and private native forest production estates (Figure 2.25). Over this period, the total log harvest from multiple-use public native forests decreased from 8.1 to 3.7 million cubic metres; and from private native forests from 3.0 to 0.5 million cubic metres, predominantly caused by a drop in the harvest of sawlogs in New South Wales, Queensland and Tasmania (Figure 2.17) and in the harvest of pulpwood in Tasmania (Figure 2.19).

Native forests accounted for 16% of Australia's total log supply by volume over the SOFR 2018 reporting period (Table 2.13). This continues a declining trend since the SOFR 2008 reporting period, as plantations continued to increase their proportional contribution to total sawlog production (81% by volume in 2011–12 to 2015–16) and total pulplog production (86% in 2011–12 to 2015–16). Softwood sawlogs

Martin Mutendeudzi

Unloading hardwood pulplogs, Eden, NSW.

Figure 2.24: Annual harvest of sawlogs and pulplogs from Australia's native forests and plantations, 2000–01 to 2015–16

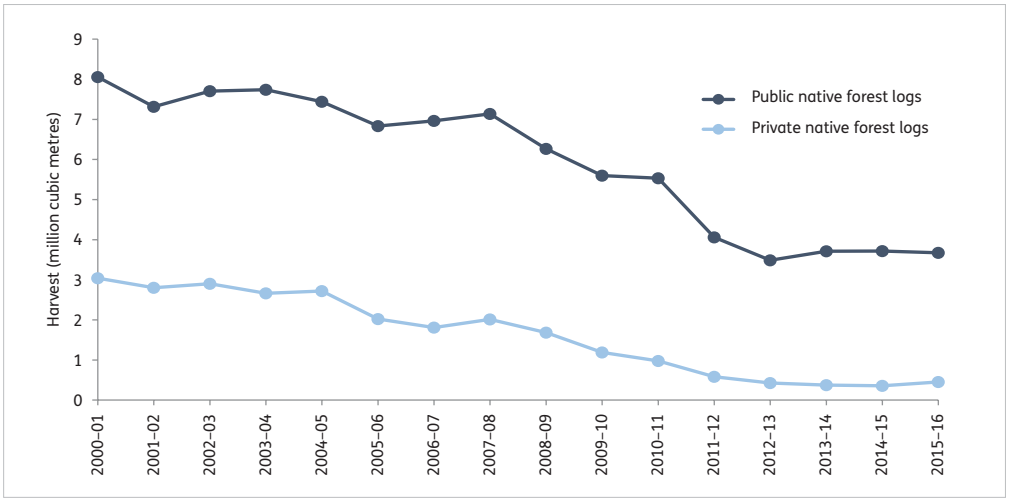


Note: Native forest sawlog includes native cypress pine sawlogs.

Source: ABARES (2017c).

The data used to create this figure, together with other data for Indicator 2.1c, are available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

Figure 2.25: Annual log harvest from Australia's native forests, 2000–01 to 2015–16



Notes: Public native forest logs are predominately sourced from multiple-use public native forest. Logs are also sourced from tenures where the Crown (state and territory governments) owns and/ or manages the tree resource (e.g. leasehold land).

Private native forest logs are logs sourced from private and leasehold land where the owner is not the Crown.

Source: ABARES (2017c).

The data used to create this figure, together with other data for Indicator 2.1c, are available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

Table 2.13: Proportions of log harvest volumes derived from various sources, 2001–02 to 2015–16

Wood harvest type	Source	2001–02 to 2005–06 (SOFR 2008) %	2006–07 to 2010–11 (SOFR 2013) %	2011–12 to 2015–16 (SOFR 2018) %
Total	Native forest	39	29	16
	Plantation	61	71	84
Total	Sawlog	48	45	44
	Pulplog	50	53	54
Total native forest	Sawlog	37	37	50
	Pulplog	61	61	45
Total plantation	Sawlog	57	51	44
	Pulplog	43	49	56
Total sawlog[a]	Native forest	30	24	19
	Hardwood	28	22	17
	Softwood	2	2	1
Total sawlog[a]	Plantation	70	76	81
	Hardwood	1	1	1
	Softwood	69	75	80
Total hardwood sawlog	Native forest	95	95	92
	Plantation	5	5	8
Total softwood sawlog	Native forest	3	2	2
	Plantation	97	98	98
Total pulplog	Native forest	47	34	14
	Hardwood	47	34	14
Total pulplog	Plantation	53	66	86
	Hardwood	16	31	49
	Softwood	37	35	37
Total hardwood pulplog	Native forest	75	52	22
	Plantation	25	48	78

[a] Total sawlog includes native hardwood, native softwood (cypress pine), and plantation hardwood and softwood sawlog.
Totals may not tally due to rounding. Values are annual averages for the period.
Source: ABARES (2017c).

This table, together with other data for Indicator 2.1c, is available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

continue to be predominantly produced from plantations (98% in 2011–12 to 2015–16), whereas hardwood sawlogs continue to be predominantly supplied from native forests (92% in 2011–12 to 2015–16).

Forecast national native forest log availability

The five states that harvest high-quality sawlogs from public native forests provide forecasts of the sustainable yields of high-quality sawlogs from public native forests. Figure 2.26 shows the national forecasts calculated from these state data and other data (see Burns et al. 2015 and notes to Figure 2.26), compared with the forecast of this parameter published in SOFR 2013. Table 2.14 shows the same data expressed as the proportion of the 1992–96 sustainable yield. In the SOFR 2018 reporting period, the sustainable yield of high-quality sawlogs was reduced to 47% of the sustainable yield reported in the SOFR 1998 reporting period (1992–93 to 1996–96), and is forecast to reduce to 37% of this value in later SOFR reporting periods (Table 2.14).

Nationally, sustainable yield is forecast to continue to decline to around 38% of the level reported in SOFR 1998 by the period of 2030–34. After that time, sustainable yield is forecast to increase (Figure 2.26; Table 2.14). These forecasts assume the ongoing satisfactory management of risks from bushfire, disease and climate impacts, and no further reductions in net harvestable area (see Indicator 2.1a) as would result from further reservation or from application of stricter code prescriptions.

The New South Wales and Western Australia sustainable yield forecasts contributed similarly to the SOFR 2013 and SOFR 2018 national forecast totals. In contrast, the forecasts from Tasmania and Victoria were lower for the SOFR 2018 national forecast than for SOFR 2013 national forecast, as a consequence of the Tasmanian Forest Agreement 2013 outcomes (FPA 2017a) and increased code prescriptions applying to Leadbeater's possum and old-growth forests in Victoria (VicForests 2017); these decreases were offset by an increase in the allowable harvest in Queensland arising from a Queensland government policy change in 2012, with these changes extending past 2025.

Table 2.14: Average annual sustainable yield of sawlogs from native public production forests across 5-year SOFR reporting periods to 2016, then 5-year forecast periods to 2054

Period	1992–96	1996–01	2001–06	2006–11	2011–16	2015–19	2020–24	2025–29	2030–34	2035–39	2040–44	2045–49	2050–54
Data type	Actual					Forecast							
Average annual sustainable yield ('000 cubic metres)	3,164	2,902	2,098	1,684	1,486	1,224	1,145	1,123	1,113	1,126	1,142	1,176	1,168
Average annual sustainable yield as proportion of average annual sustainable yield for period 1992–96 (%)	100	92	66	53	47	39	36	35	35	36	36	37	37

Notes:
'Actual' data from Figure 2.8 ('Average annual harvest and sustainable yield for multiple-use public native forests in Australia, by SOFR reporting period').
'Forecast' data are the SOFR 2018 forecast shown in Figure 2.26 (refer to notes in that Figure).
Data or forecasts do not include any supplementation with high-quality sawlogs from public hardwood plantations.
The 1992–96 reporting period for Victoria includes an adjustment to C+ sawlogs to express these as a D+ equivalent.
This table, together with other data for Indicator 2.1c, is available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

Figure 2.27 shows forecasts of potential future log availability from the sum of multiple-use public, leasehold and private native forest from 2015–19 to 2050–54, separately by log type. Native forest hardwood pulplog availability is forecast to average 2.7 million cubic metres annually during 2015–19, increasing gradually over the remaining periods, and average approximately 3.0 million cubic metres per year in 2050–54 (Figure 2.27). The forecast shown on Figure 2.27 combines both the decrease in sustainable yield of native forest sawlogs from multiple-use public forests over the forecast period (Figure 2.26, Table 2.14) with a forecast increase in availability of high-quality native sawlogs from private and leasehold forests. However, the actual supply of sawlogs from private and leasehold forests will also depend on market forces and the objectives and goals of private and public owners.

Forecast national plantation log availability

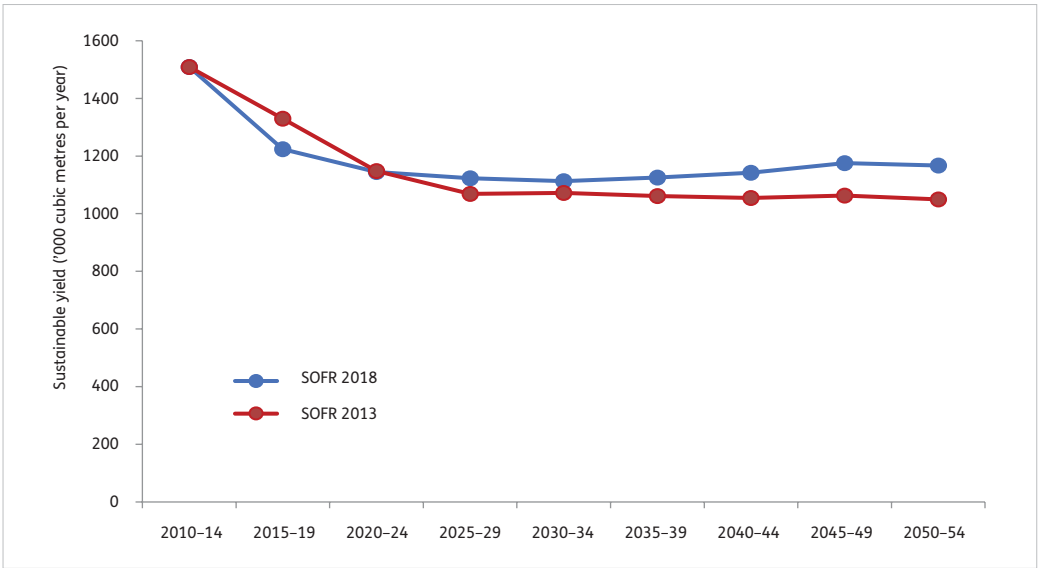
Commercial plantations are primarily located in 15 National Plantation Inventory (NPI) regions in Australia (Figure 2.28), and have been established mainly to produce timber and other wood-based products. Commercial plantation estates are managed as businesses, so the timing and volume of log harvests is determined mainly by market forces, rotation length and thinning regimes. The Western Australia, Green Triangle and Tasmania NPI regions each contain plantation estates of more than 200 thousand hectares.

ABARES (2016a) forecast potential future log availability from existing plantations to 2055–59 (Table 2.15), based on data collected from the 15 NPI regions in 2014–15. The forecasts are based on the assumption that most harvested areas will be replanted with the same type of plantation species. For each given type of plantation, log availability forecasts take into account the area of existing plantations by year of establishment and the assumed production period (rotation), silvicultural regimes (including thinning), and growth rate. Market demand and supply will influence the actual volumes that are harvested at a particular time, and plantation managers will adjust silvicultural regimes, scheduling and operational management accordingly to meet market demand.

The potential annual average plantation log availability is forecast to peak at 29.7 million cubic metres in both the 2015–19 and the 2040–44 periods, with lower availability between these periods (Table 2.15). Plantation log availability is forecast to decline towards the end of the forecast period, and reach an annual average of 26.3 million cubic metres in 2055–59.

Total plantation hardwood log availability is forecast to trend downwards over the period 2015–19 to 2055–59, from an annual average of 12.9 million cubic metres in 2015–19 to an annual average of 9.1 million cubic metres in 2055–59 (Table 2.15). The actual plantation hardwood log harvest in 2015–16 was 24% lower than the 2015–19 forecast hardwood log availability, which suggests a potential short-term increase in hardwood log availability before the long-term downward trend.

Figure 2.26: Forecast sustainable yield of high-quality native forest sawlogs from public production forest in Australia, 2010–14 to 2050–54



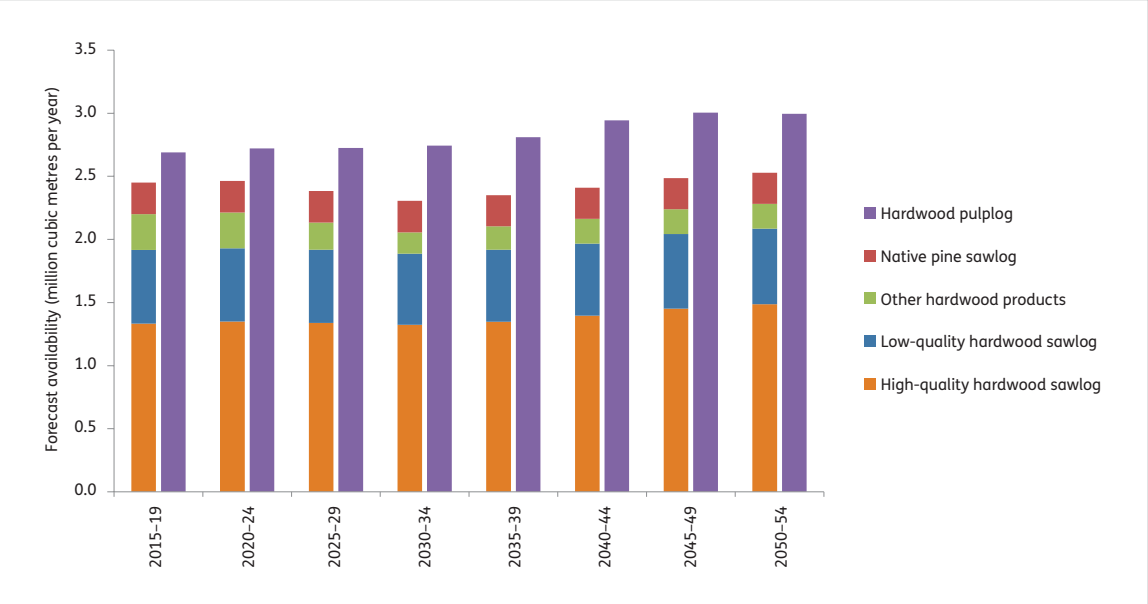
Notes: Forecasts of sustainable yield from public native forests are based on state agency data or information, and do not include any supplementation with high-quality sawlogs from public hardwood plantations. Forecasts include yields of both hardwood and cypress pine from public native forests.

The forecast undertaken for SOFR 2013 included data from Forests NSW (2010) and VicForests (2011b), and for Queensland included allowable cut estimates to 2025 but no harvesting after that date, and did not include changes resulting from the Tasmanian Forest Agreement 2013. The SOFR 2013 forecast for 2045–49 was extended to 2050–54 using these inclusions and exclusions for comparison with the updated forecast presented in SOFR 2018.

The updated forecast (SOFR 2018) is based on Burns et al. (2015) and ABARES (in preparation); it includes data from the Conservation Commission of Western Australia (CCWA 2013, applying the allowable cut level), Forests NSW (2010), Forestry Tasmania (2014b), adjustments reported in VicForests (2017), and an allowable cut forecast from Queensland's 'Defined Forest Area' estate (described in the Queensland section associated with Figure 2.13) that extends past 2025 (Burns et al. 2015). Source: ABARES database. Data used in Burns et al. (2015) and ABARES (in preparation).

The data used to create this figure, together with other data for Indicator 2.1c, are available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

Figure 2.27: Forecast log availability from native forest on public, leasehold and private land in Australia, 2015–19 to 2050–54



Notes:

Native pine sawlog is cypress pine sawlog.

Other hardwood product includes poles, piles, girders and other logs. Miscellaneous wood products such as firewood, industrial fuelwood, sleeper logs and fencing material are not included in the forecast projections.

Low-quality hardwood sawlogs are sawlogs not included in the high-quality category

High-quality hardwood sawlogs are hardwood logs graded to standards used by state agencies.

Source: ABARES (in preparation).

The data used to create this figure, together with other data for Indicator 2.1c, are available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

Harvesting softwood sawlogs, Bombala, NSW.

Plantation hardwood pulplog availability is forecast to follow a similar trend to total plantation hardwood availability, peaking at an annual average of 12.5 million cubic metres in 2015–19, and trending downwards to an annual average of 8.1 million cubic metres in 2055–59 (Table 2.15). In 2015–19, the Western Australia, Green Triangle and Tasmania NPI regions are forecast to be the main hardwood pulplog-producing regions, accounting for 31%, 28% and 21%, respectively, of the national total availability of plantation hardwood pulplogs (Figure 2.29). Despite minor changes in their relative contributions to plantation hardwood pulplog availability, these three NPI regions are forecast to remain as the major producing NPI regions across the entire forecast period.

To date, increases in plantation hardwood area have not led to substantial increases in harvested sawlog volume, because hardwood plantations are primarily managed for pulplog production. However, plantation hardwood sawlog availability is forecast to follow an increasing trend over the period 2015–19 to 2055–59 (Table 2.15, Figure 2.30), contrary to the decreasing trend of forecast total hardwood log availability. Annual average plantation hardwood sawlog availability in 2015–19 is forecast to be 0.408 million cubic metres, and increase to a peak annual average of 0.994 million cubic metres in 2055–59 (Table 2.15, Figure 2.30).

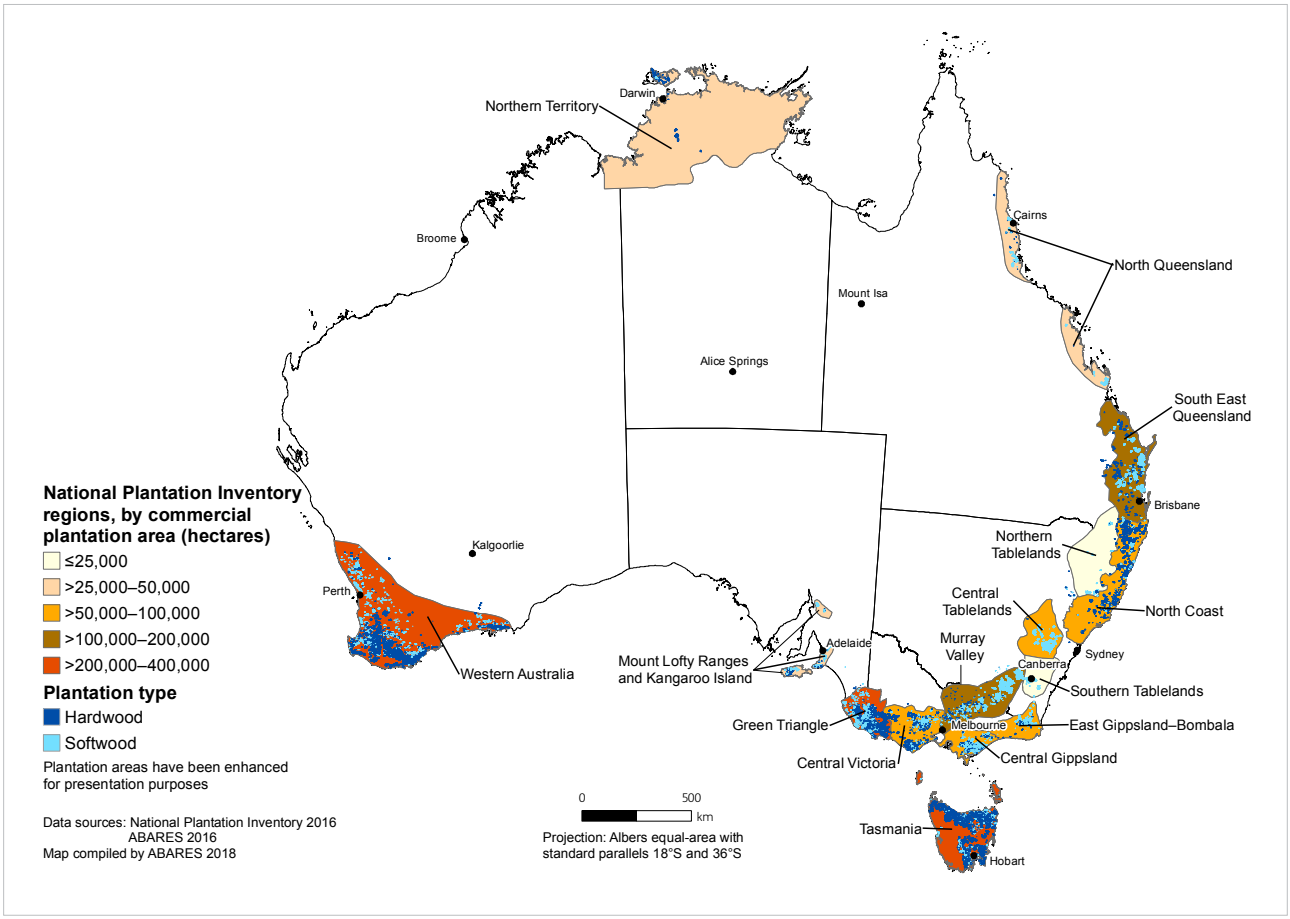
In 2015–19, the Tasmania and North Coast NPI regions are forecast to be the main sources of plantation hardwood sawlog availability, accounting for 27% and 14%, respectively, of the national total availability (Figure 2.30). After 2015–19, Tasmania's contribution to plantation hardwood sawlog availability is forecast to increase substantially, and peak at 62% of the national total availability in 2045–49. Sawlog estimates include peeler logs, high-grade and low-grade sawlogs and posts and poles.

Plantation softwood log availability is forecast to remain relatively stable over the forecast period, with an annual average 16.8 million cubic metres in 2015–19, peaking at an annual average of 18.9 million cubic metres in 2035–39, and averaging 17.2 million cubic metres annually in 2055–59 (Table 2.15). The upturn in 2035–39 is driven mostly by an increase in the forecast availability of plantation softwood sawlogs.

Most of the sawn timber used for housing and general construction in Australia is derived from plantation softwood sawlogs. The availability of plantation softwood sawlogs is forecast to average 12.1 million cubic metres per year in 2015–19, and increase to a peak annual average of 14.3 million cubic metres in 2035–39 (Table 2.15). The Green Triangle, Murray Valley and South East Queensland NPI regions are forecast to produce the majority of the plantation softwood sawlogs available over the entire forecast period, contributing an average of 26%, 18% and 16%, respectively, of the national total availability (Figure 2.31).

Plantation softwood pulplog availability is forecast to average 4.7 million cubic metres annually in 2015–19, and to vary around an annual average of 4.4 million cubic metres per year

Figure 2.28: Commercial plantations and National Plantation Inventory regions



Source: ABARES, National Plantation Inventory.

A higher resolution version of this map is available via www.doi.org/10.25814/5be3bc4321162

Table 2.15: Forecast potential annual average plantation log availability, Australia, 2015–19 to 2055–59

	Volume ('000 cubic metres)								
Log type	**2015–19**	**2020–24**	**2025–29**	**2030–34**	**2035–39**	**2040–44**	**2045–49**	**2050–54**	**2055–59**
Hardwood									
Pulplog	12,466	10,326	11,424	9,283	8,875	11,361	7,715	8,880	8,129
Sawlog	408	293	715	904	785	866	780	863	994
Subtotal	**12,874**	**10,619**	**12,139**	**10,186**	**9,659**	**12,227**	**8,496**	**9,743**	**9,123**
Softwood									
Pulplog	4,726	4,759	4,215	4,228	4,540	4,224	4,520	4,563	4,509
Sawlog	12,099	11,662	11,731	12,278	14,316	13,249	13,491	12,877	12,709
Subtotal	**16,825**	**16,421**	**15,946**	**16,506**	**18,856**	**17,473**	**18,011**	**17,440**	**17,218**
Total	**29,699**	**27,040**	**28,085**	**26,692**	**28,515**	**29,699**	**26,507**	**27,183**	**26,342**

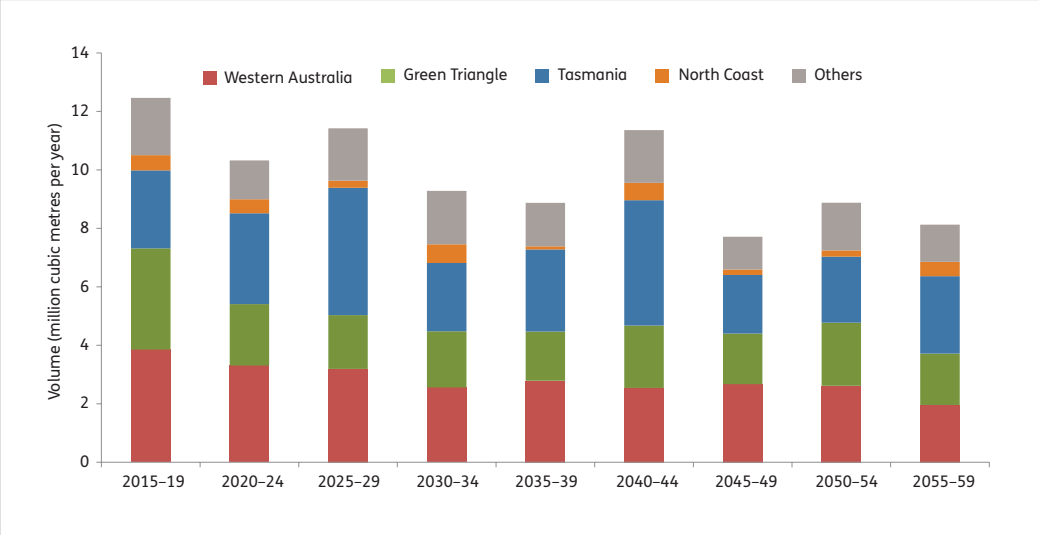
Notes: Sawlogs include all quality classes of plantation sawlogs.
Totals may not tally due to rounding.
Source: ABARES (2016a).

This table, together with other data for Indicator 2.1c, is available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

over the remaining periods to 2055–59 (Table 2.15). The Green Triangle, Murray Valley and Tasmania NPI regions are forecast to be the main softwood pulplog-producing regions over the entire forecast period, contributing an average of 25%, 24% and 14%, respectively, of the national total availability (Figure 2.32).

Compared to forecasts in *Australia's plantation log supply 2010–2054* (Gavran et al. 2012), the 2015–19 to 2055–59 average total plantation log availability forecast published in ABARES (2016a) is 10% lower. The overall plantation hardwood log availability forecast is 21% lower for the period 2015–19 to 2055–59; decreases in forecast availability of hardwood pulplogs and sawlogs are due to plantation growers and managers revising downwards their yield estimates since 2012, and to the removal of plantation area now deemed unproductive or where leases for plantation land were not renewed with landowners. The overall plantation softwood log availability forecast is 2% lower for the period 2015–19 to 2055–59; the forecast plantation softwood sawlog availability is 7% higher, and the forecast plantation softwood pulplog availability is 21% lower, partly resulting from some companies entering new markets for lower-grade softwood logs since 2012.

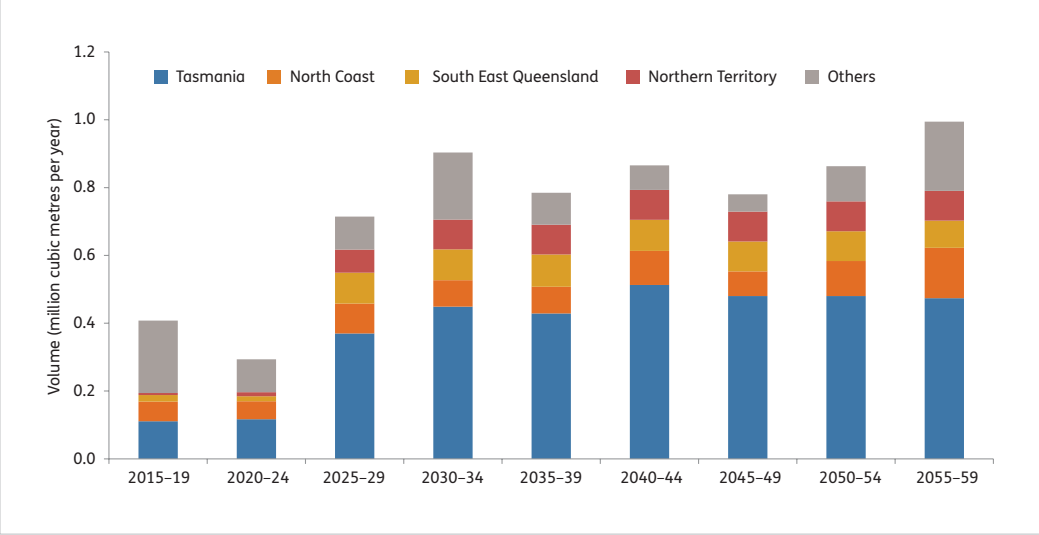
Figure 2.29: Forecast availability of plantation hardwood pulplogs, by National Plantation Inventory region



Source: ABARES (2016a).

The data used to create this figure, together with other data for Indicator 2.1c, are available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

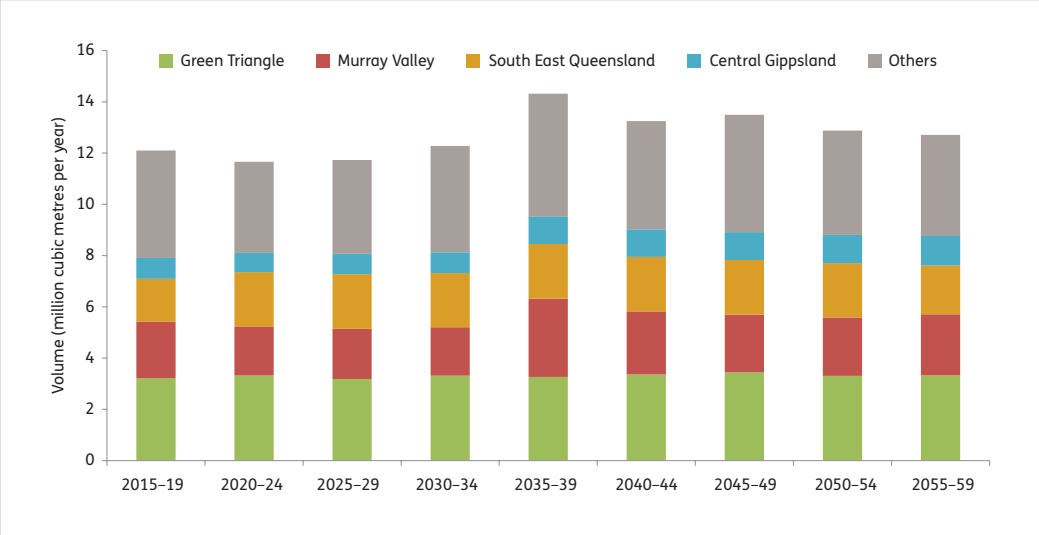
Figure 2.30: Forecast availability of plantation hardwood sawlogs, by National Plantation Inventory region



Source: ABARES (2016a).

The data used to create this figure, together with other data for Indicator 2.1c, are available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

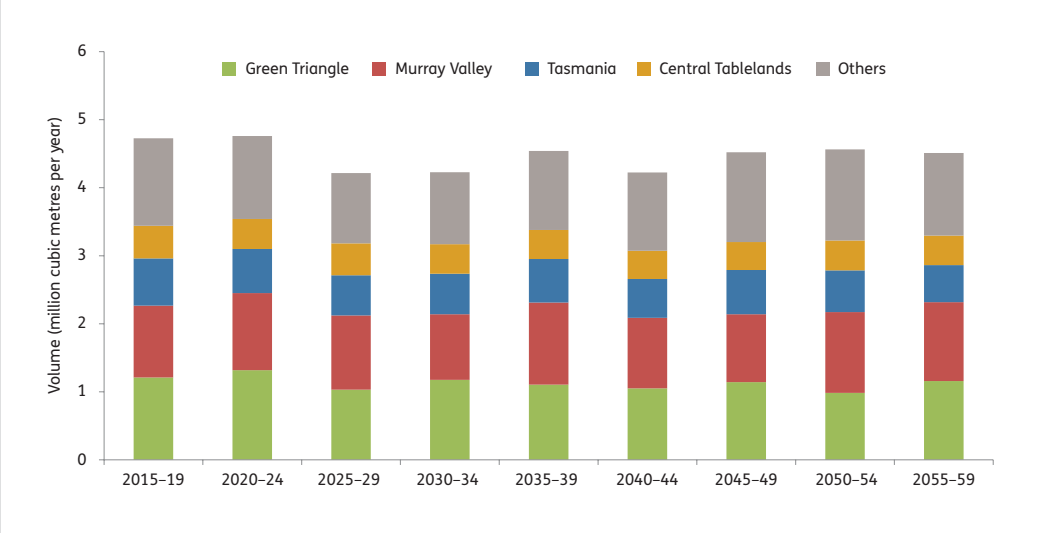
Figure 2.31: Forecast availability of plantation softwood sawlogs, by National Plantation Inventory region



Source: ABARES (2016a).

The data used to create this figure, together with other data for Indicator 2.1c, are available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

Figure 2.32: Forecast availability of plantation softwood pulplogs, by National Plantation Inventory region



Source: ABARES (2016a).

The data used to create this figure, together with other data for Indicator 2.1c, are available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

Indicator 2.1d

Annual removal of non-wood forest products compared to the level determined to be sustainable

Rationale

This indicator assesses the sustainability of the harvest of non-wood forest products. These products can represent a significant asset base supporting the livelihoods of regional and remote communities.

Key points

- Australia produces a wide range of non-wood forest products (NWFPs) derived from forest fauna, flora and fungi. High-value NWFPs include wildflowers, seed, honey, and aromatic products derived from sandalwood.
- State and territory governments regulate the removal of NWFPs in their respective jurisdictions, including through the issue of permits and licences. Commonwealth legislation, such as the *Environment Protection and Biodiversity Conservation Act 1999*, also regulates the removal of certain NWFPs.
- Data on annual removals and sustainable yields are limited for many NWFPs, but are available for some of the more commercially significant NWFPs. Data are presented on the harvest or production of tree ferns in Tasmania, eastern grey kangaroo and wallaroo in Queensland, Bennett's wallaby and brushtail possum in Tasmania, and honey nationally.
- Indigenous Australians rely to varying degrees on the use of NWFPs for customary purposes (e.g. food and medicine) and commercial purposes (e.g. art and craft).

Non-wood forest products (NWFPs) are products of biological origin, other than wood, that are derived from forests. Examples include wildflowers, tree ferns, seeds, bark, animal meat and skins, honey and mushrooms. A more comprehensive list is provided in Table 2.15 of SOFR 2013.

For convenience, certain wood products, such as wood carvings and aromatic items produced from sandalwood (*Santalum* spp.), are included in this indicator. Sandalwood is also discussed in Indicator 2.1c. Water and carbon values derived from forests are discussed under Criteria 4 and 5, respectively, and the economic value and use of NWFPs are reported in Indicator 6.1b.

The Australian, state and territory governments have regulations to limit and control the removal of plant and animal products from forests. Most commonly, these involve the issue of permits or licences for harvesting and hunting activities (Box 2.1). The species and allowable rates of extraction vary by jurisdiction. For example, in the Northern Territory magpie geese (*Anseranas semipalmata*, a forest-dwelling species) are abundant[115] and were harvested under permit in 2015 and 2016 for commercial purposes[116], but they are not harvested in southern states where they are less common (Nye et al. 2007) and listed as threatened or endangered[117].

The Australian Government has legislated measures to protect threatened species nationally through the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), which also regulates, among other things, the ecologically sustainable use of wild native plants and animals that are exported.

Limited quantitative data are available to report the harvest of NWFPs and the sustainability of this harvest. The following text is an overview, with examples of some higher-value products for which data exist. Data on volumes and values of products are covered in Indicator 6.1b.

[115] denr.nt.gov.au/land-resource-management/magpie-goose-management

[116] Unpublished permit data provided by the Northern Territory Department of Land Resource Management (from September 2017, the Department of Environment and Natural Resources).

[117] Magpie geese are protected in all jurisdictions of Australia, including the Northern Territory where the species is protected under the Territory Parks and Wildlife Conservation Act (PWSNT 2009). Magpie geese are listed as vulnerable in NSW, threatened in Victoria and endangered in South Australia. The species is listed as a marine protected species under the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth) (www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=978).

Box 2.1: State and territory legislation relevant to the harvesting of non-wood forest products

Australian Capital Territory

The *Nature Conservation Act 2014* requires that licences be obtained to take protected fauna or flora.

New South Wales

The *National Parks and Wildlife Act 1974* protects all native fauna (mammals, birds, reptiles and amphibians) and flora. A licence is required to take protected fauna or flora. Regulation of non-native fauna is under the control of the *Non-Indigenous Animals Act 1987*. The *Threatened Species Conservation Act 1995* and the *Environmental Planning and Assessment Act 1979* also have provisions relevant to the harvesting of non-wood forest products. The *Threatened Species Conservation Act 1995* was replaced by the *Biodiversity Conservation Act 2016* on 03 December 2016.

Northern Territory

The *Territory Parks and Wildlife Conservation Act* requires that a permit is obtained to take protected fauna or flora, unless the activity is exempt. The Territory Parks and Wildlife Conservation Regulations manage the use of native flora and fauna, and the Department of Land Resource Management[118] regulates this permit system. If the integrity of a species is beginning to be compromised by commercial use, a management plan is required. Such management plans are in place for cycads, crocodiles and the magpie goose[119].

The Northern Territory's 'Balanced Environment Strategy'[120] covers the development of management plans for sustainable use of wildlife and other environmental assets, aiming to ensure the protection of natural resources while supporting economic outcomes.

Queensland

The *Forestry Act 1959* provides for forest reservations, and the management, silvicultural treatment and protections of State forests, including the sale of state owned forest products and quarry material. Forest products includes timber and non-wood products such as honey, seeds and flowers. The *Forestry Act 1959* applies to state forests, timber reserves, leasehold lands, reserves, public lands and certain freehold lands.

The *Nature Conservation Act 1992* is the principal legislation that provides for the protection of native flora and fauna. Appropriate authorisations or permits under the Act are required prior to any taking or interfering with protected flora and fauna, unless the activity is exempt.

South Australia

The *National Parks and Wildlife Act 1972* provides the state's legislative framework for the conservation of wildlife and flora in their natural environment. Protected animals include indigenous and migratory birds, mammals and reptiles. A permit is needed to take any protected species, except where the relevant minister declares otherwise based on a threat to crops or property, or declares an open hunting season for protected animals of specified species. A permit is needed to take native plants on any public land, as well as certain native plants on private land.

Tasmania

Wildlife in Tasmania (defined as all living creatures except stock, dogs, cats, farmed animals and fish) is protected by the *Wildlife Regulations Act 1999*. Open season may be declared by the Minister for Environment, Parks and Heritage for particular species of wildlife, including wallabies, possums, deer, wild ducks and mutton-birds.

A permit is required to take native plant species listed as endangered, vulnerable or rare under the *Threatened Species Protection Act 1995*. Harvesting of tree ferns is regulated by a management plan implemented under *Tasmania's Forest Practices Act 1985* (FPA 2017b).

Victoria

In Victoria, wildlife (defined as vertebrate species Indigenous to Australia, some non-native game species, and terrestrial invertebrate animals that are listed under the *Flora and Fauna Guarantee Act 1988*) is protected under the *Wildlife Act 1975*. A licence or authorisation is needed to take, destroy or disturb wildlife or flora listed as protected under the *Flora and Fauna Guarantee Act 1988*.

Continued

[118] From 12 September 2016, the Department of Environment and Natural Resources.

[119] See www.environment.gov.au/biodiversity/wildlife-trade/publications/mgt-program-saltwater-crocodile-nt-2014-2015, www.environment.gov.au/biodiversity/wildlife-trade/publications/management-program-cycads-nt-2009-2014 and denr.nt.gov.au/land-resource-management/magpie-goose-management

[120] nt.gov.au/__data/assets/pdf_file/0010/363772/balanced-environment-strategy.pdf; but see denr.nt.gov.au/environment-information/environmental-regulatory-reform/environmental-regulatory-reform-program

Continues

Western Australia

The *Conservation and Land Management Act 1984* and the *Wildlife Conservation Act 1950*[121] provide for the conservation and protection of all native flora and fauna in Western Australia through a system of licensing for commercial use, area-specific and species-specific management, and monitoring. The taking of kangaroos for commercial purposes requires the issue of a licence under the Wildlife Conservation Regulations 1970. A management plan governs the commercial harvesting of protected flora in Western Australia (DEC 2013b).

Ilona Stobutzki

Harvesting sandalwood, Kalgoorlie, Western Australia.

[121] This Act was replaced by the *Biodiversity Conservation Act 2016* in December 2016.

[122] From July 2017, Parks and Wildlife Service within the Western Australian Department of Biodiversity, Conservation and Attractions.

[123] From July 2017, Sustainable Timber Tasmania.

[124] More recently, Australian sandalwood (*Santalum spicatum*) plantations have been established in Western Australia, mainly in the wheat belt, as part of measures to control groundwater salinity, while Indian sandalwood (*S. album*) has been planted in Australia by private investment schemes since 2006. Some harvest of plantation sandalwood has occurred in Western Australia. This indicator covers products from native forests.

Plant products

In general, factors that influence the sustainability of the harvest of native plant products include the plant part that is harvested; the plant's reproductive strategy, habitat specificity and growth rates; other uses for the land on which the plant grows (such as wood production or grazing); harvest methods; remoteness from human settlement; and land-use context or environmental factors (such as climate change). It is feasible to undertake sustainability assessments based on quantitative data for some products, such as sandalwood and tree ferns. For other products, quantitative assessments are not feasible, and sustainability of harvest is addressed through the application of regulatory systems (summarised in Box 2.1), backed up by population monitoring.

In Tasmania, the only trunked tree fern that may be harvested is soft tree fern (also known as manfern, *Dicksonia antarctica*) (FPA 2017b). Harvesting of tree ferns in Tasmania for the past five years averaged 13 thousand stems per year (Figure 2.33), which is a small proportion of the estimated total of 130 million *D. antarctica* individuals in Tasmania. Tree ferns are supplied to domestic and export markets. Each tree fern taken must be tagged so that buyers can verify that it has been taken legally. The number of tree fern tags issued has declined substantially since 2002–03 (Figure 2.33), due to loss of export markets, a reduction in forestry operations, and fewer operating tree fern harvesters (FPA 2017b).

Seed and wildflowers are important NWFPs, particularly in Western Australia. Wildflower and seed industries in Western Australia are based on a combination of horticulture and native resources from forest and non-forest vegetation on public and private lands. A substantial proportion of the wildflowers harvested in Western Australia is exported (DEC 2013b).

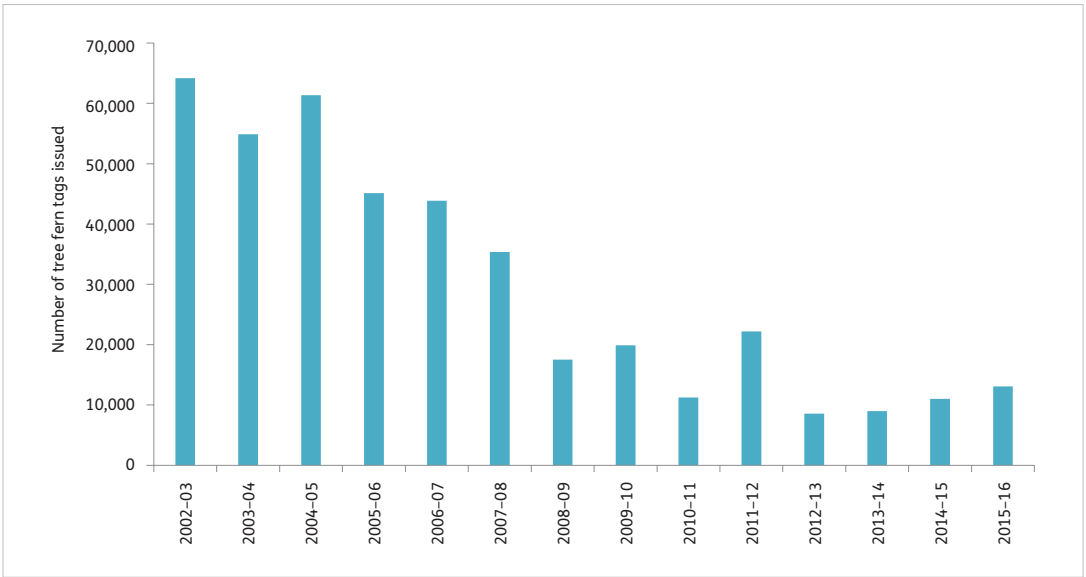
In Western Australia, the Department of Parks and Wildlife[122] manages wildflower and seed harvesting in accordance with a management plan for commercial harvesting of protected flora on public and private land (DEC 2013b). The Australian Government has approved the management plan for the purpose of the EPBC Act (DPaW 2016c).

Collecting seed of forest species is also important in other states and territories, for use in native forest regeneration, plantation establishment, propagating nursery stock, revegetation and environmental plantings. Collection is regulated and reported by relevant public authorities.

Forestry Tasmania[123] reported collection of an average of 787 kg per year of native tree seed from 2011–12 to 2015–16, which is 87% less than in the previous five-year period (FPA 2017a). The decrease was due to a reduction in the area of forest harvesting for which seed to undertake regeneration was required.

Sandalwood has been harvested from native forests in Australia since the early 19th century[124]. The wood is used in a range of products, such as incense, and for carving, and sandalwood oil is distilled from the heartwood. Almost all sandalwood products produced in Australia are derived from the native forest resource of Australian sandalwood (*Santalum spicatum*) in Western Australia (the largest producer), or northern sandalwood (*S. lanceolatum*) in northern

Figure 2.33: Tree fern harvesting in Tasmania



Source: FPA (2012, 2016a).

The data used to create this figure, together with other data for Indicator 2.1d, are available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

Queensland. Indicator 6.1b reports value, export amounts and domestic consumption of sandalwood.

In Western Australia, the allowable harvest level of sandalwood from native forests is governed by the *Sandalwood (Limitation of Removal of Sandalwood) Order 1996* which provides for the harvest of up to 1,500 tonnes per year each of green and dead sandalwood. This was reviewed in 2015 and the allowable harvest volumes of green and dead sandalwood were reduced to 1,350 tonnes each (DPaW 2015b). In comparison, the actual volumes harvested in 2013–14 were 1,117 tonnes of green wood and 983 tonnes of dead wood (DPaW 2015b). Indicator 2.1c provides further details.

In Queensland, sandalwood is a protected plant under the *Nature Conservation Act 1992* so licences are required for its harvest. In the absence of data on growth rates and the extent of the species, the permitted level of harvest is restricted to levels harvested historically, which averages 200 to 300 tonnes per year. Harvesting from state forests and timber reserves must follow environmental management standards specified in a code of practice (DNPRSR 2014).

Animal products

Mammals, reptiles, amphibians, birds, and insects and other invertebrates provide a range of NWFPs, such as meat, eggs, skins, fibres, honey and other bee products. In addition, many animal species provide important ecosystem services; for example, bees and other insects pollinate flowering plants.

Taking native animals from Australian forests is either prohibited or is subject to regulations enforced by government agencies in all jurisdictions. Harvesting for meat and skin products is largely restricted to species that are considered to be common, and in most cases requires a permit. Permits are usually only issued after a detailed sustainability analysis based on population monitoring. These analyses take into account factors such as local population levels (including trends in population numbers), reproduction rates, and population pressures such as disease or habitat loss. Harvesting of feral pest species does not require such sustainability analyses, since there are management targets for controlling their populations.

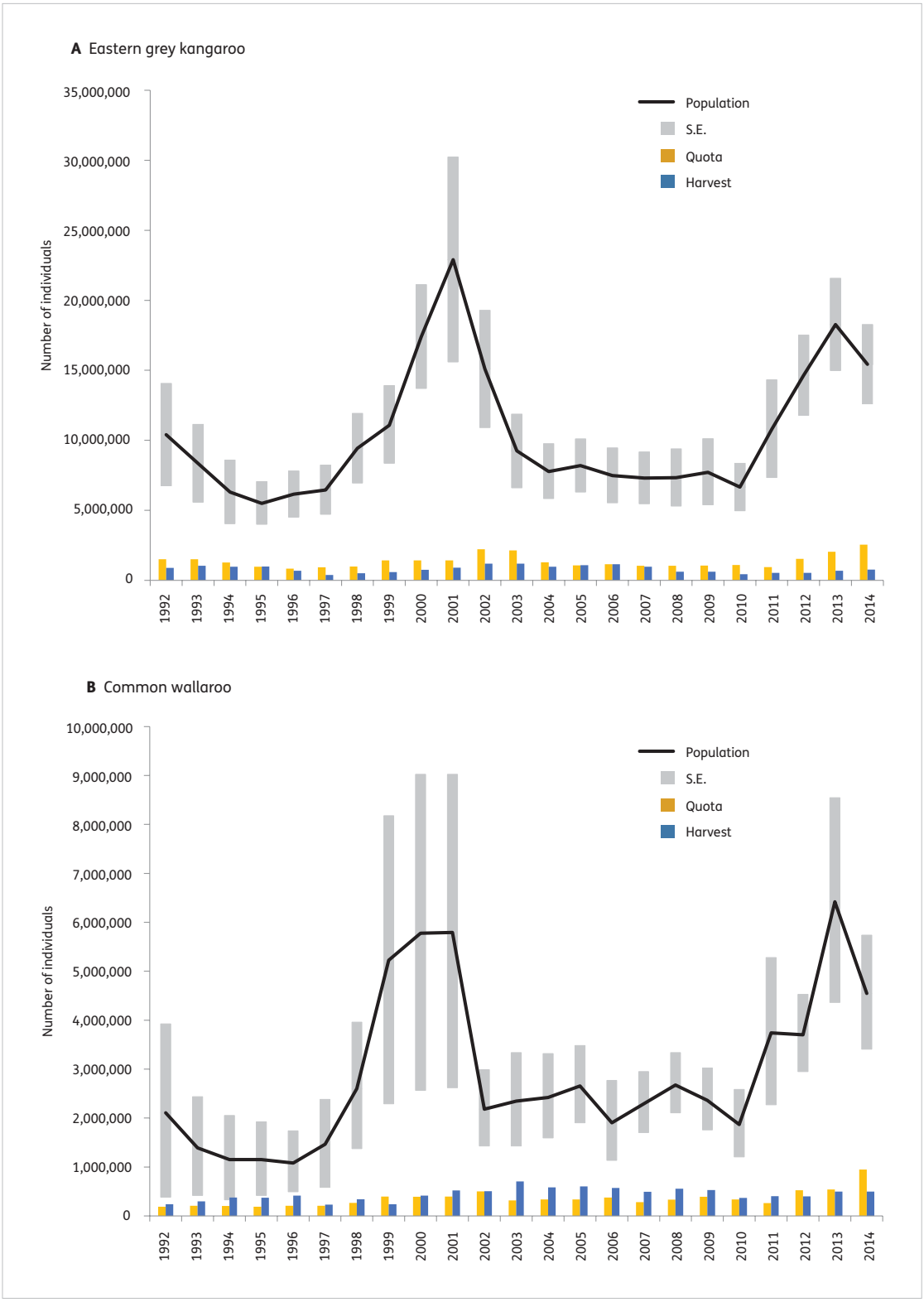
Kangaroos (common wallaroo or euro, *Macropus robustus*; eastern grey kangaroo, *M. giganteus*; red kangaroo, *M. rufus*; and western grey kangaroo, *M. fuliginosus*) are harvested commercially for meat and skins in New South Wales, Queensland, South Australia and Western Australia. Bennett's wallaby (*M. rufogriseus*) and Tasmanian pademelon (*Thylogale billardierii*) may be harvested commercially in Tasmania. These species dwell both in forests and in non-forested areas. They are common and not considered threatened or endangered. Commercial harvesting of other kangaroo and wallaby species is not permitted.

The commercial kangaroo industry has management goals based on principles of sustainability (DSEWPaC 2011b). Annual quotas are set for each species by the relevant state agencies and endorsed by the Australian Government under delegated authority provided by approved species management plans. The annual harvest quotas vary from year to year, based on consideration of population trends, previous harvests and seasonal conditions[125]. In some states, subquotas are set regionally and allocated to individual property holders on a permit basis. In all states, commercial harvesting is done under a strict code of practice (NRMMC 2008)[126] and a tag must be attached to each carcass before it can be processed.

[125] www.qld.gov.au/environment/plants-animals/wildlife-permits/macropods-quotas

[126] www.environment.gov.au/biodiversity/wildlife-trade/publications/national-codes-practice-humane-shooting-kangaroos-and-wallabies

Figure 2.34: Long-term population, quota and harvest data for eastern grey kangaroo and common wallaroo in Queensland, 1992–2014



S.E., standard error

Notes:

Harvest data is combined commercial harvest and take from damage mitigation permits. Commercial harvest quotas are based on survey estimates from the previous year.

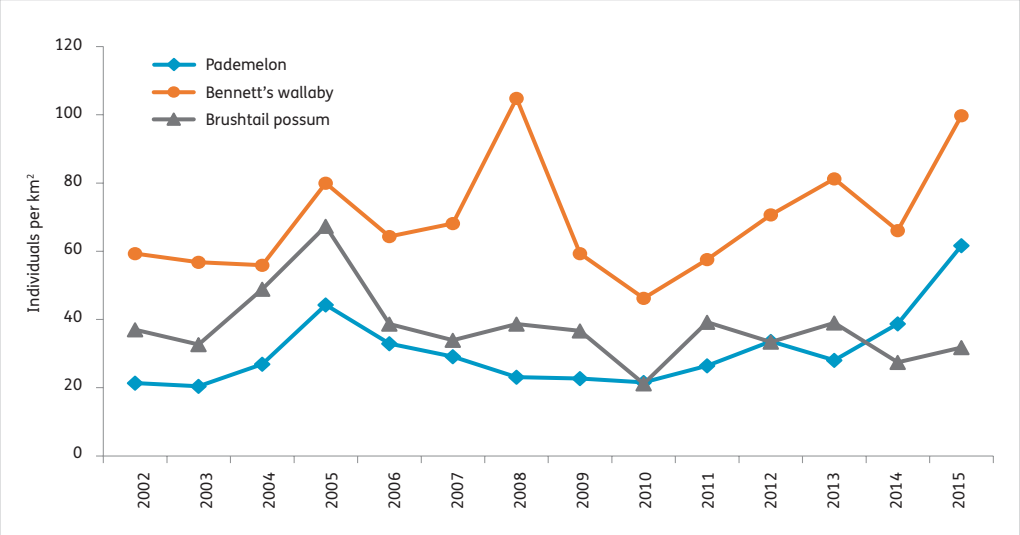
Source: Replotted from data in Queensland Department of Environment and Heritage (2015).

The abundance of Tasmanian pademelon and Bennett's wallaby is monitored annually in Tasmania (Figure 2.35) . Recreational or commercial hunter's licences must be obtained to take these species. The number of commercial game licences issued has changed little over the past decade, but has declined substantially in the longer term (Figure 2.36) . The number of commercial licences is a small proportion of the number of licences issued for non-commercial shooting of wallabies (shooting to reduce populations that are damaging agricultural and forestry crops). The number of non-commercial licences has increased marginally over the past five years, and significantly in the longer term (Figure 2.37).

The abundance of red kangaroos, eastern grey kangaroos and common wallaroos is monitored in Queensland by aerial survey. Harvest quotas are set at 10–20% of the population per region. Figure 2.34 shows data from long-term monitoring of macropod populations, and quotas and harvest levels, for eastern grey kangaroo and common wallaroo in Queensland to 2014. The majority of harvesting occurs in the central harvest zone in Queensland, with smaller harvests in the eastern and western zones (Queensland Department of Environment and Heritage 2015); the eastern zone includes relatively more forest.

The abundance of Tasmanian pademelon and Bennett's wallaby is monitored annually in Tasmania (Figure 2.35)[127]. Recreational or commercial hunter's licences must be obtained to take these species. The number of commercial game licences issued has changed little over the past decade, but has declined substantially in the longer term (Figure 2.36)[128]. The number of commercial licences is a small proportion of the number of licences issued for non-commercial shooting of wallabies (shooting to reduce populations that are damaging agricultural and forestry crops). The number of non-commercial licences

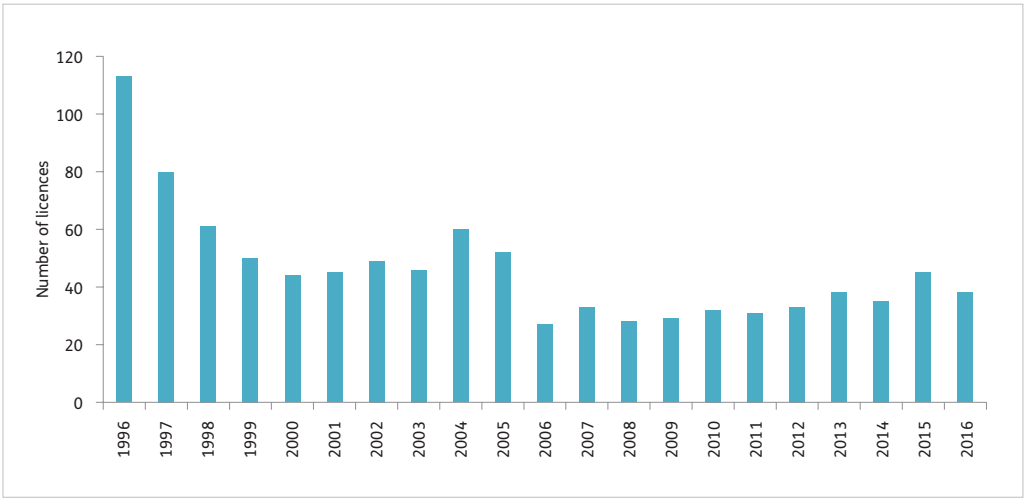
Figure 2.35: Population density of macropods in Tasmania from annual spotlight surveys, 2002–15



Source: DPIPWE (2015a).

The data used to create this figure, together with other data for Indicator 2.1d, are available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

Figure 2.36: Wallaby hunting commercial game licences sold, Tasmania, 1996–2016



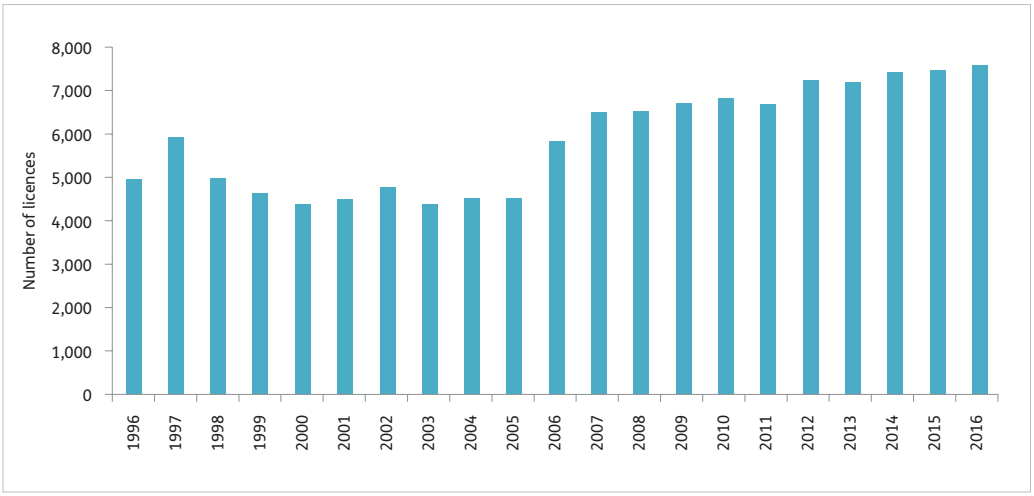
Source: FPA (2012, 2017a).

The data used to create this figure, together with other data for Indicator 2.1d, are available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

[127] www.environment.gov.au/biodiversity/wildlife-trade/natives/wild-harvest/kangaroo-wallaby-statistics/wallaby; www.environment.gov.au/biodiversity/wildlife-trade/natives/wild-harvest/kangaroo-wallaby-statistics/kangaroo-tas

[128] The number of licences issued is not a direct indicator of the number of animals taken, because a wallaby hunting licence does not specify the number of animals a licence holder may take. Instead, the Tasmanian wallaby harvest is monitored using property-specific take figures from wallaby crop protection permit holders (dpipwe.tas.gov.au/wildlife-management/management-of-wildlife/game-management/game-hunting-requirements).

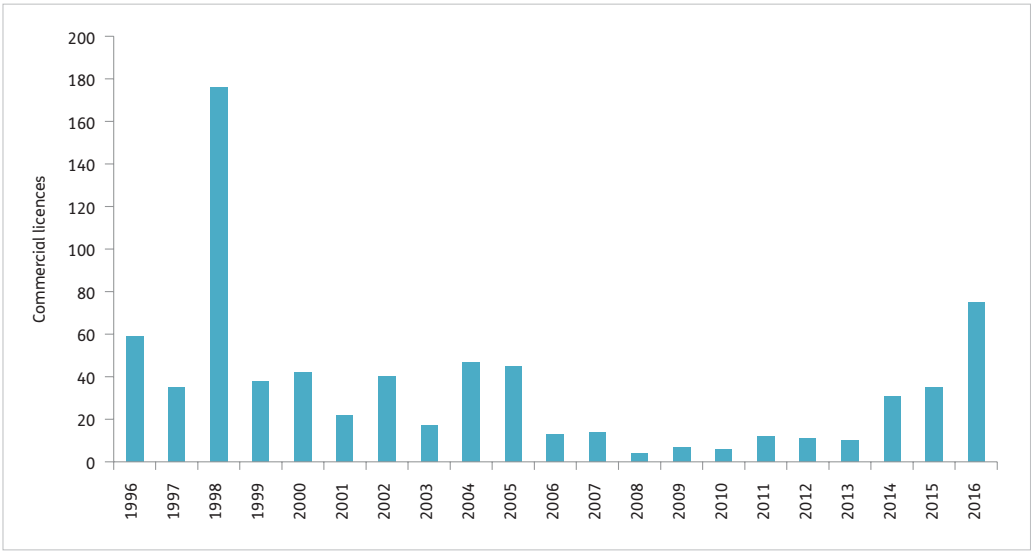
Figure 2.37: Wallaby hunting non-commercial game licences sold, Tasmania, 1996–2016



Source: FPA (2012, 2017a).

The data used to create this figure, together with other data for Indicator 2.1d, are available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

Figure 2.38: Licences for commercial harvest of common brushtail possums in Tasmania



Source: FPA (2012, 2017a).

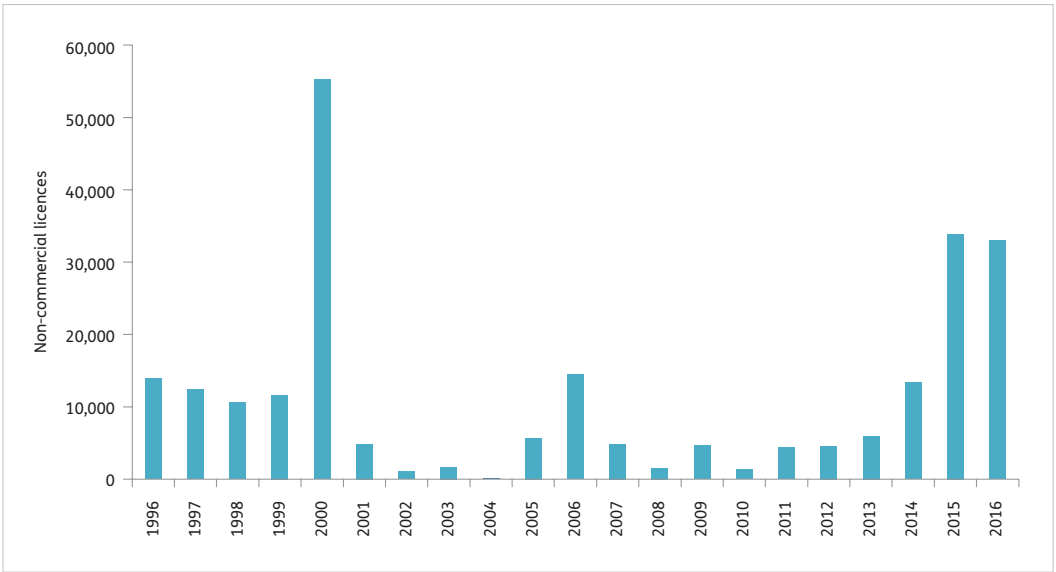
The data used to create this figure, together with other data for Indicator 2.1d, are available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

has increased marginally over the past five years, and significantly in the longer term (Figure 2.37).

Common brushtail possums (*Trichosurus vulpecula*) are harvested in Tasmania for skin and meat (Figure 2.38) in accordance with a management plan approved under the EPBC Act (DPIPWE 2015b). Considerably more possums are killed without commercial harvest, to protect agricultural and forestry crops from damage (Figure 2.39). Commercial hunters must be licenced, are limited to a quota and must comply with a code of practice when shooting the possums (DPIPWE 2012). Commercial hunting is not permitted in forests reserved for conservation. The species population is monitored annually (Figure 2.35). At no time has any level of harvest been shown to endanger regional possum populations (DPIPWE 2015a).

Forest-dwelling exotic fauna species are also harvested in Australia for meat and skins. Many of these, such as pigs, goats and water buffalo, are officially declared pests that damage forests. In these cases, the harvesting rate is usually determined by forest management considerations rather than ecological sustainability criteria. Deer are harvested for venison and antlers from forests in New South Wales, Tasmania and Victoria. In Tasmania, annual harvest of male deer during 1996–2015 varied from a low of 544 animals in 1999 to a peak of 1,996 animals in 2015 (FPA 2017a).

Figure 2.39: Licences for non-commercial harvest of common brushtail possums in Tasmania



Source: FPA (2012, 2017a).

The data used to create this figure, together with other data for Indicator 2.1d, are available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

Table 2.16: Proportions of honey production from public and private land, 2014–15

	Proportion of honey production, 2014–15 (%)						
Land tenure	**NSW**	**Vic.**	**Qld.**	**SA**	**Tas.**	**WA**	**Australia**
State forests	26	40	22	0	51	37	25
National parks	14	11	5	7	30	26	12
Other public land	1	8	1	0	0	0	2
Total public land	41	58	28	7	82	63	39
Private land	59	42	72	93	18	37	61
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Totals may not tally due to rounding.

Source: ABARES Australian Honey Bee Industry Survey 2014–15 (van Dijk et al. 2016). This survey sampled registered beekeeping businesses from New South Wales, Victoria, Queensland, South Australia, Western Australia and Tasmania that operated 50 or more hives in 2014–15.

This table, together with other data for Indicator 2.1d, is available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

Apiary products are another important animal NWFP. Commercial beekeeping occurs in all states and territories of Australia, although honey production occurs mainly along the east coast of Australia[129]. Hives are placed in forests based on the availability of flowering tree and understorey resources, as well as in agricultural areas where the bees forage in crops, and in other introduced vegetation and in remnant native vegetation.

Table 2.16 shows that, in all states except South Australia, a proportion of honey production derives from public land; this is generally forest land[130]. A further proportion of honey production comes from non-agricultural private land (van Dijk et al. 2016), much of which will also be forest or woodland.

State and territory governments regulate apiarists by issuing permits and licences for apiary sites and hives. The numbers of permits and licences are based on on-ground constraints such as road access requirements, necessary distances between sites, and flowering intensity, rather than on an assessment of the potential effects on native flora or fauna.

Potential threats to the sustainability of the honey industry include restrictions on access to native flora due to land clearing for agriculture, rural dieback[131] of forest, bushfires and the conversion of State forest land to reserves or national parks where apiaries may be excluded (RIRDC 2007a), as well as external threats such as colony collapse disorder and varroa mite. Changing climate conditions also affect flowering patterns of forest species. Tree plantations, including of eucalypt species, are unlikely to increase substantially the floral resources available to the beekeeping industry (Somerville 2010).

Other important animal NWFPs are wild-collected crocodile eggs and juveniles that are harvested for use in the farmed crocodile industry in northern Australia (see Indicator 6.1b).

[129] www.agrifutures.com.au/farm-diversity/beekeeping-honey-bees/

[130] Other data on honey production are provided in Indicator 6.1b.

[131] Rural dieback is a collective term used to describe the degradation and loss of vigour of trees and native forest ecosystems as a result of changes in hydrology, salinity and nutrient balances; deterioration in soil attributes; increased pest and pathogen impacts; and changed fire regimes.

Rosemary Lott

Textiles hand-dyed by Anindilyakwa Art Centre artists, Groote Eylandt, Northern Territory, using forest plants.

Indigenous harvest, including traditional use

Indigenous peoples harvest forest products for both traditional and commercial purposes. Indigenous NWFPs include bark for painting, plant parts for weavings, pigments and dyes; small-scale commercial bush foods; and subsistence products such as those used for food and ceremonial purposes. For convenience of classification, Indigenous NWFPs also include wooden carvings and sculptures. The sustainable use of NWFPs is extremely important to Indigenous communities in remote regions of Australia; such products often constitute a significant proportion of local customary and non-welfare cash economies.

Despite the importance of the Indigenous NWFP harvest to the livelihoods of many Indigenous communities, little data and few studies are available to assess its size and impact nationally.

One commercial product is Kakadu plum (*Terminalia ferdinandiana*) which is harvested from the wild under a permit system in the Northern Territory and Western Australia. Assessment of demand, relative to the abundance of the tree and quantity of fruit produced, suggests that currently the risk of widespread, uniform over-harvest is low (Gorman et al. 2016), but there is a risk of localised overharvest at accessible high-density sites (Whitehead et al. 2006). Increased market demand could be met sustainably in the short term, if wild harvest was coordinated across a number of regions (Gorman et al. 2016). Further information on commercial harvest of Kakadu plum is provided in Indicator 6.1b.

Indicator 2.1e

The area of native forest harvested and the proportion of that effectively regenerated, and the area of plantation harvested and the proportion of that effectively re-established

Rationale

This indicator is used to assess the success of the re-establishment of forests after harvesting. Re-establishment is critical to the maintenance of the productive capacity of the forest.

Key points

- Effective regeneration of harvested multiple-use public native forest was reported for New South Wales, Queensland, Tasmania, Victoria and Western Australia for various time periods in the range 1993–94 to 2015–16.
  - Across the period 2011–12 to 2015–16, the annual average proportion of harvested multiple-use public native forest that was effectively regenerated, as assessed against stocking standards, was reported as 79% in New South Wales, 100% for Queensland, 95% for Tasmania and 92% for Victoria. For Western Australia, adequate regeneration was reported, with more detailed reporting to be provided in the mid-term performance review of the *Forest Management Plan 2014–2023*.
  - Factors contributing to low regeneration rates in Victoria and New South Wales included drought, fire, poor seed reserves, and difficulties in carrying out regeneration burns or mechanical disturbance.
- Re-establishment of commercial plantations is also assessed against stocking standards.
  - The average rate of commercial plantation re-establishment between 2011–12 and 2015–16 was 38,500 hectares per year. The average area proportion of re-established commercial plantation that met stocking standards over this period varied between 93% and 99% between jurisdictions. Data are also available separately for public and private plantations.
- Tasmania also reported compliance with regeneration standards for harvesting of private native forests, and compliance with stocking standards for re-establishment of public and private plantations, using performance rating systems developed with the Tasmanian Forest Practices Authority.

The term 'forest regeneration' usually refers to new trees that establish in a forest after harvesting, fire, or other disturbance agents (e.g. wind or flood damage) have removed some or all trees from the forest overstorey. Regeneration can occur naturally or through human management intervention (e.g. burning, mechanical disturbance, sowing seed).

Regeneration is a targeted outcome of harvesting under many of the silvicultural systems used in native forests. State jurisdictions apply codes of forest practice and other regulatory instruments to ensure the effective regeneration and/or restocking of harvested multiple-use public native forests to specified stocking standards. Some states also apply codes of practice and regulations to private native forests.

Where specified regeneration and restocking standards are not achieved, remedial action is carried out by the grower or manager, including by state government agencies on multiple-use public native forests. This indicator provides annual information on the area regenerated after harvesting, the proportion of the total area of harvesting that this represents, and the success of the regeneration effort.

For public and private plantations, this indicator reports where possible on the area planted, or re-planted after final harvesting, and the success of the planting or re-planting effort. Codes of practice apply to commercial plantations, and remedial action is carried out by the grower or manager where specified restocking standards are not achieved. National

data have been collated to report on plantation establishment and its performance against stocking standards for the SOFR 2018 reporting period 2011–12 to 2015–16. Separate data are also available from restocking or re-planting audits carried out in Tasmania on public and private native forests and plantations.

Native forest regeneration

Ensuring effective regeneration of native forest after timber harvesting is a fundamental requirement of sustainable forest management, since regeneration determines the long-term productivity, growth, dynamics and composition of forest stands. Managers of multiple-use public forests are required by codes of forest practice, silvicultural manuals or guidelines, and other regulatory instruments to assess quantitatively the effective regeneration (by stocking, density, or species composition) of areas harvested for timber production, and to report the results publicly[132].

Depending on the state, effective regeneration is judged by a combination of meeting a regeneration standard that prescribes the required stocking, and meeting specified silvicultural regeneration goals and objectives based on sustainable forest management objectives. For example, some of the silvicultural treatments applied to certain forest types promote the establishment of a cohort of trees for the next harvest. The guidelines, goals, and objectives also consider both sustainable use and conservation requirements.

The states have established standards for the effective regeneration of multiple-use public native forests; some also have standards for private forests. Regeneration is usually assessed 1–3 years after harvesting, although the period is longer in some jurisdictions. Further follow-up treatments to promote regeneration, or supplementary planting with local tree species, are carried out if regeneration standards are not met at the first assessment. The definitions of, and standards for, effective regeneration vary between jurisdictions, but all aspire to stocking the site in a way that accords with silvicultural manuals or guidelines, goals and objectives.

Regional differences in forest type, climatic and biophysical conditions, and management objectives mean that each state has its own method for assessing the success or effectiveness of regeneration, and its own range of silvicultural techniques to ensure regeneration after harvesting (see Indicator 2.1a). Assessment techniques are similar across jurisdictions for even-aged native forests, but for multi-aged forests (in which a single stand may contain trees of markedly different growth stage, age and height) are more variable across jurisdictions.

Retention of seed trees, use of prescribed fire, and mechanical site disturbance are variously employed to encourage regeneration in multiple-use public native forests. These methods are sometimes combined with aerial sowing of seed collected from the harvest site (or from a similar local area termed a 'seed zone') before harvesting of trees. Other silvicultural systems require adequate on-site regeneration to be present in the harvesting area before wood harvesting takes place; shelterwood and native cypress pine silvicultural systems are examples. Promotion of a subsequent regeneration event is not a priority where young regrowth stands are thinned.

In New South Wales, effective regeneration in multiple-use public native forests for the period 2001–02 to 2015–16 (covering the SOFR 2008, SOFR 2013 and SOFR 2018 reporting periods) was generally above 70% (see Table 2.17). In the three years when regeneration rates were below 70% (2001–02, 2006–07 and 2012–13), the impact of drought was a significant factor in the reduced regeneration of some of these forests (successful regeneration requires adequate soil moisture for seedling establishment). Wildfires also affected regeneration on harvested areas in some of these forests. In the SOFR 2018 reporting period 2011–12 to 2015–16, effective annual regeneration in multiple-use public native forests varied from 69% to 91%. Annual averages for the three SOFR reporting periods from 2001–02 varied from 79% to 85% (Table 2.17).

In New South Wales, a sampling process to assess effective regeneration with commercial species is undertaken in areas where regeneration is a targeted outcome from wood harvesting, where the site-based assessment determines a risk of regeneration failing, or where forests are of types harvested with silvicultural systems that require post-harvest regeneration assessments. A regeneration threshold of 65% of assessed plots in any given harvest area is considered adequate stocking. The stocked proportion of areas that do not meet the 65% threshold are not specifically reported, but these areas are listed for further assessment and potential remedial actions. Additional silvicultural treatment is undertaken when regeneration standards are not met, and the outcome of such treatment is not included in the effective regeneration data reported in Table 2.17. The proportion effectively regenerated is the area effectively regenerated compared to the area harvested[133]. The sampling approach for determining the proportion of harvested area effectively regenerated is consistent for all years reported. The Forestry Corporation of New South Wales[134] (FCNSW) is planning to move towards remote assessments using drones in future to allow census recording (rather than sampling) of regeneration success.

In Victoria, the area of multiple-use public native forest treated and regenerated after wood harvesting has been reported since 1993–94, covering all five SOFR reporting periods (Table 2.18). Prior to 2001, there was a 4–5 year lag between reporting regeneration treatment and assessment of effectiveness. Since 2004, results have been reported annually, with effectiveness assessed sooner (from 2007, up to 3 years after treatment). A harvested coupe that does not meet the minimum standard is further treated, followed by a re-survey for the effectiveness of regeneration 18–30 months after the additional treatment, with the goal that over time all the harvested area is effectively restocked

[132] There is no native forest harvesting in the Australian Capital Territory or South Australia, and very limited native forest harvesting in the Northern Territory.

[133] More precisely, the proportion effectively regenerated is the area effectively regenerated where regeneration is a targeted outcome compared to the area harvested where regeneration is a targeted outcome: see Table 2.17.

[134] Until January 2013, Forests NSW.

Table 2.17: Area proportion of harvested multiple-use public native forest effectively regenerated, New South Wales, 2001–02 to 2015–16

Year	Total area planned for harvest (hectares)[a]	Net area harvested (hectares)[b]	Net area harvested where regeneration is a targeted outcome (hectares)[c]	Net area effectively regenerated where regeneration is a targeted outcome (hectares)[d]	Proportion effectively regenerated (%)
2001–02	50,351	n.r.	n.r.	n.r.	68[e]
2002–03	49,062	n.r.	n.r.	n.r.	87[e]
2003–04	45,746	n.r.	n.r.	n.r.	86[e]
2004–05	42,923	29,009	3,990	3,312	83
2005–06	43,709	23,569	5,045	3,733	74
2006–07	44,806	24,422	3,709	2,337	63
2007–08	52,960	26,677	5,418	5,093	94
2008–09	27,952	18,127	3,616	2,929	81
2009–10	38,499	16,603	3,845	3,653	95
2010–11	27,484	14,067	5,382	4,951	92
2011–12	28,054	23,080	7,837	6,034	77
2012–13	31,221	30,941	5,812	4,010	69
2013–14	23,807	18,167	6,365	4,965	78
2014–15	22,235	22,660	6,975	5,650	81
2015–16	17,878	13,837	4,106	3,736	91
Annual average for each SOFR reporting period					
2001–02 to 2005–06	46,358	n.r.	n.r.	n.r.	80
2006–07 to 2010–11	38,340	19,979	4,394	3,792	85
2011–12 to 2015–16	24,639	21,737	6,219	4,879	79

n.r., not reported.

[a] Total area planned for harvest (see also Table 2.5, Indicator 2.1a).

[b] Net area harvested is the actual area harvested as reported in the FCNSW Forest Resource Event Database from 2004–05 onwards. Annual reporting prior to this time only reported the area planned for harvest in harvest units operated in during that financial year.

[c] Regeneration targets are not required when thinning existing growing stock or releasing advanced growth.

[d] In harvested areas where regeneration is a targeted outcome, FCNSW uses a sampling process to assess regeneration success. A similar sampling process is also used to monitor regeneration where an initial site-based assessment determines there is a risk of regeneration failing.

[e] Area proportion data supplied by New South Wales.

Source: Forestry Corporation of NSW.

This table, together with other data for Indicator 2.1e, is available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

(VicForests 2011a). Harvested coupes are transferred from the commercial harvesting agency (VicForests) back to the custodial managing agency (Department of Environment, Land, Water and Planning, DELWP[135]) once the coupe has been adequately regenerated and meets coupe regeneration handover guidelines.

Table 2.18 shows, for reporting years 1993–94 to 2015–16, the area of harvested multiple-use public native forest in Victoria that received an initial regeneration treatment, the area that met the standard and so was assessed as effectively regenerated (including previously treated areas that were supplementary seeded or further treated), and the ratio between these two areas, which is the proportion effectively regenerated. Effective annual regeneration varies from 44% to 125%, with a long-term average success rate of 84% (the inclusion of re-treated areas explains why this value can exceed 100% in some years: see notes below Table 2.18). Annual averages for the five SOFR reporting periods varied from 72% to 92%. Low regeneration occurred in years affected by drought, bushfire, low availability of viable seed, or an inability to carry out adequate regeneration burns or mechanical disturbance. Higher levels of regeneration occurred in years with favourable conditions for regeneration establishment, or where regeneration of areas from previous years has reached a standard that can be assessed as effectively regenerated. Harvest coupes that have not reached the regeneration standards at the first attempt are increasingly difficult to regenerate.

In Western Australia, the *Forest Management Plan 2014–2023* (CCWA 2013) and previous forest management plans (CALM 1994; CCWA 2004) that cover all the main wood production areas in the state's south-west, together with supporting guidance documents such as the silvicultural guidelines, require that regeneration success and effective stocking rates be monitored in publicly owned native forests and pine plantations. In mixed-age jarrah (*Eucalyptus marginata*) forest, the regeneration stocking target is that no more than 5% of the area regenerated annually will require remedial action because it is understocked. In karri (*E. diversicolor*) forest, the regeneration stocking rates within harvested even-aged forest are also assessed after the first winter, and infill planting is undertaken if the stocking of patches falls below agreed standards. The average annual area

[135] Until January 2015, the Department of Environment and Primary Industries.

Table 2.18: Area of multiple-use public native forest treated for regeneration and area effectively regenerated, Victoria, 1993–94 to 2015–16

Reporting year	Total harvested area treated for regeneration (hectares)	Total area effectively regenerated (hectares)	Proportion of total harvested area effectively regenerated (%)
1993–94	9,328	6,987	75
1994–95	6,742	5,902	88
1995–96	8,961	8,046	90
1996–97	6,650	5,050	76
1997–98	5,590	5,140	92
1998–99	6,730	5,820	86
1999–2000	7,714	6,939	90
2000–01	8,119	6,988	86
2001–02	6,964	6,129	88
2002–03	5,810	4,984	86
2003–04	5,817	4,968	85
2004–05	4,556	2,655	58
2005–06	4,749	2,112	44
2006–07	4,545	4,062	89
2007–08	4,997	3,367	67
2008–09	4,466	3,050	68
2009–10	4,263	5,311	125
2010–11	4,804	4,137	86
2011–12	4,298	4,055	94
2012–13	3,327	3,397	102
2013–14	2,981	2,242	75
2014–15	4,331	3,459	80
2015–16	4,820	5,194	108
Annual average for each SOFR reporting period			
1993–94 to 1995–96	8,344	6,978	84
1996–97 to 2000–01	6,961	5,987	86
2001–02 to 2005–06	5,579	4,170	72
2006–07 to 2010–11	4,615	3,985	87
2011–12 to 2015–16	3,951	3,669	92

Notes:

There is a time lag between regeneration treatment and assessment of the success of the regeneration. In addition, areas not effectively regenerated are subject to subsequent remedial action (e.g. by supplementary seeding), but areas of follow-up treatment in a year are not included in the figures for the total harvested area treated for regeneration in that year. Consequently, the total area effectively regenerated in a year may relate both to areas harvested in that year and to areas harvested in previous years, and can be higher than the total area treated for regeneration in that year.

Silvicultural guidelines were amended in 2013, but with no significant changes to guidelines applying to regeneration stocking.

Source: SOFR 2013, Victorian Department of Economic Development, Jobs, Transport and Resources, VicForests.

This table, together with other data for Indicator 2.1e, is available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

harvested and regenerated has declined from 11,471 hectares in the period 2001–02 to 2005–06 (SOFR 2008 reporting period) to 6,768 hectares in the period 2011–12 to 2015–16 (SOFR 2018 reporting period) (Table 2.19).

Key performance indicators have been developed for public reporting of the timeliness and effectiveness of regeneration, and are audited and reported by the Conservation Commission of Western Australia (CCWA 2012, Key Performance Indicator 10, *Effectiveness of regeneration of native forest and plantation*). Effectiveness of karri and jarrah regeneration, as well as re-establishment of *Pinus* plantations, is reported in this Key Performance Indicator. Silvicultural guidelines are reviewed and updated in response to outcomes of monitoring regeneration success (Burrows et al. 2011).

Table 2.19 summarises the effectiveness of regeneration after harvesting in multiple-use public native forests in Western Australia covering the last three SOFR reporting periods. Jarrah regeneration was 100% for all the years reported, and karri regeneration varied from 97% to 100% (CCWA 2012). Western Australia has experienced 100% or nearly 100% effective regeneration of harvested multiple-use public native forest for all years reported until 2009–10 (SOFR 2008 and SOFR 2013 reporting periods). Assessments undertaken by Western Australia but not reported here indicate adequate regeneration was achieved in areas sampled for karri and jarrah forest during the period 2010 to 2015 (DBCA, personal communication).

Table 2.19: Area of multiple-use public native forest effectively regenerated, Western Australia, 2001–02 to 2015–16

Reporting year	Total area harvested (hectares)[a]	Proportion of harvested area effectively regenerated (%)[b]
2001–02	16,630	100.00
2002–03	13,950	100.00
2003–04	9,725	100.00
2004–05	9,610	99.94
2005–06	7,440	99.94
2006–07	9,670	99.98
2007–08	8,820	99.90
2008–09	7,640	100.00
2009–10	10,660	99.65
2010–11	6,140	n.r.
2011–12	7,490	n.r.[c]
2012–13	7,780	n.r.[c]
2013–14	6,730	n.r.[c]
2014–15	5,480	n.r.[c]
2015–16	6,360	n.r.[c]
Annual averages for SOFR reporting periods		
2001–02 to 2005–06	11,471	100.0
2006–07 to 2010–11	8,586	99.9
2011–12 to 2015–16	6,768	n.r.[c]

n.r., not reported in this format

[a] Total forest area harvested is the gross harvested area and includes jarrah forest harvested to a range of silvicultural objectives, but excludes areas cleared for mining.

[b] Proportion of harvested area effectively regenerated, based on harvested areas where the silvicultural objectives of the silvicultural systems require regeneration establishment in the harvested area and follow-up assessment for effectiveness, and calculated as the weighted average of regeneration success reported for karri and jarrah regeneration for that year. Regeneration success can relate to areas harvested 18–30 months previously.

[c] Western Australia reported that, across these years, adequate regeneration was achieved in all areas of harvested karri within 18 months, and in most areas of harvested jarrah within 30 months. More detailed reporting will be provided in the mid-term performance review of the Forest Management Plan 2014–2023.

Source: CCWA (2012), Western Australian Department of Environment and Conservation, Western Australian Department of Biodiversity, Conservation and Attractions.

This table, together with other data for Indicator 2.1e, is available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

In Tasmania under the Tasmanian Forest Practices Code 2015 (FPA 2015b), which applies to public and private native forests and plantations, sowing and planting mixtures applied to native forests must approximate the natural composition of the canopy trees of the forest before wood harvesting. The code also requires that regeneration surveys in eucalypt forest be conducted one year after clearfelling or two years after partial harvesting. The stocking standard is based on the number and spatial distribution of acceptable seedlings, saplings or trees that occur within the area being assessed, and prescriptions are tailored to each forest type and silvicultural system. Where surveys show that survival is less than the prescribed stocking, additional treatment measures to increase stocking to the prescribed stocking are applied.

Forestry Tasmania reports annually on the level of regeneration achieved in all harvested native forest areas in multiple-use public forests. Each year from 1998–99 to 2015–16, covering four SOFR reporting periods (SOFR 2003 to SOFR 2018), Forestry Tasmania exceeded its regeneration success target of 85% of the regenerated area meeting prescribed stocking standards (Table 2.20). In the majority of reporting years, greater than 90% of the regenerated area met the stocking standard, and Forestry Tasmania averaged 93–96% effective annual regeneration for the four SOFR reporting periods.

Tasmania is the only state or territory to report compliance with regeneration standards for wood harvesting from both public and private native forests. In 2003–04, the Tasmanian Forest Practices Authority (FPA) introduced a performance rating system to measure compliance with regeneration standards for public and private native forest and plantations. The performance rating system had a maximum possible rating of 'four', and a minimal compliance rating of 'three' was considered acceptable. In 2014–15, the rating system was changed to 3.0 as both the acceptable level and maximum rating. Each year, a random sample of Forest Practices Plans were included in annual assessment programs run by the FPA.

Table 2.21 presents the results for regeneration of native forest across management tenures from 2003–04 to 2015–16, separately for private industrial managers, private independent managers and state forest. During the period from 2003–04 to 2013–14, operations in state forests averaged a rating of 3.6, with a minimum of 3.4. A rating of 3.0 was recorded for operations in state forests in 2014–15 under the new rating system, and a rating of 2.3 was recorded in 2015–16.

For the period 2004–05 to 2013–14, operations under private industrial forest managers averaged 3.5, with the rating for one year (2004–05) of 2.6 being below the minimum acceptable compliance level. Operations under private

Table 2.20: Area of regenerated multiple-use public native forest meeting stocking standards, Tasmania, 1998–99 to 2010–11

Reporting year	Regeneration year		Total area harvested and regenerated (hectares)	Total area that achieved standard (hectares)	Proportion of total area that achieved standard (%)
	Eucalypt clearfelling and partial logging	Rainforest/ blackwood swamp			
1998–99	1995–96	1993–94	4,006	3,815	95
1999–2000	1996–97	1994–95	5,466	5,184	95
2000–01	1997–98	1995–96	4,145	4,011	97
2001–02	1998–99	1996–97	4,808	4,568	95
2002–03	1999–2000	1997–98	4,148	3,837	93
2003–04	2000–01	1998–99	5,526	5,141	93
2004–05	2001–02	1999–2000	6,569	6,526	99
2005–06	2002–03	2000–01	7,226	6,942	96
2006–07	2003–04	2001–02	9,445	9,244	98
2007–08	2004–05	2002–03	10,207	10,010	98
2008–09	2005–06	2003–04	7,522	7,002	93
2009–10	2006–07	2004–05	6,882	6,220	90
2010–11	2007–08	2005–06	7,820	6,888	88
2011–12	2008–09	2006–07	9,377	9,002	96
2012–13	2009–10	2007–08	9,190	8,639	94
2013–14	2010–11	2008–09	7,414	7,192	97
2014–15	2011–12	2009–10	4,580	3,985	87
2015–16	2012–13	2010–11	2,994	2,994	100
Annual average for each SOFR reporting period					
1996–97 to 2000–01	n.a.	n.a.	4,539	4,337	96
2001–02 to 2005–06	n.a.	n.a.	5,655	5,403	95
2006–07 to 2010–11	n.a.	n.a.	8,375	7,873	93
2011–12 to 2015–16	n.a.	n.a.	6,711	6,362	95

n.a., not applicable
Source: FPA (2017a).

This table, together with other data for Indicator 2.1e, is available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

independent forest managers recorded four years that were below minimum acceptable compliance levels over this period, and an average rating reported as 3.0. A rating of 3.0 was recorded in 2015–16 for operations under private independent forest managers under the new rating system, a substantial improvement on the rating of 1.7 recorded for 2014–15.

In Queensland, single-tree selection silvicultural systems that suit the ecology of the eucalypt and cypress pine forest types have been applied since 2000 to the harvest of wood products from multiple-use public native forests. These systems retain a mix of canopy trees and regeneration of various ages. In these forest types, regeneration is generally established continually and naturally from seed, coppice or lignotubers in the gaps produced by harvesting, associated soil disturbance, and/or post-harvest burning. Effective regeneration is monitored on harvested areas of multiple-use public native forests through the post-harvest audit process conducted by the Queensland Parks and Wildlife Service. Effective regeneration has been reported as being 100% since 2000–01 for three SOFR reporting periods (SOFR 2008, SOFR 2013 and SOFR 2018). The areas harvested and effectively regenerated in the five years from 2011–12 to 2015–16 were 34 thousand, 35 thousand, 35 thousand, 40 thousand and 38 thousand hectares respectively (Table 2.6 in Indicator 2.1a reports annual harvest figures in previous years for multiple-use public native forest in Queensland).

Commercial plantation establishment and re-establishment

The size of Australia's commercial plantation estate depends on the establishment of new plantations on land not previously used for plantation forestry, and the extent to which existing plantations are re-established after clearfell harvesting at the end of a rotation. The decision to re-establish plantations, especially short-rotation hardwood plantations, depends on factors such as site suitability, previous yield, grower intent, market demand and alternative land uses.

Establishment of new commercial plantations in Australia has decreased over the last decade (Figure 2.40), and the total plantation estate decreased marginally between 2011–12 and 2015–16. The average annual rate of commercial plantation establishment during the 2018 SOFR reporting period was 2,000 hectares, a substantial decrease from 48,300 hectares

Table 2.21: Annual performance rating for regeneration in native forest operations, Tasmania, 2003–04 to 2010–11

Reporting year	Private industrial	Private independent	State forest	All tenures
Rating system 2003–04 to 2013–14				
2003–04	3.3	4.0	3.5	3.4
2004–05	2.6	2.9	3.4	3.0
2005–06	3.3	3.5	3.8	3.6
2006–07	3.4	2.4	3.7	3.4
2007–08	3.4	3.0	3.8	3.5
2008–09	3.5	3.1	3.7	3.5
2009–10	3.4	3.0	3.5	3.3
2010–11	3.6	3.5	3.6	3.6
2011–12	3.7	3.0	4.0	3.5
2012–13	4.0	2.5	3.8	3.3
2013–14	4.0	2.8	3.4	3.2
Average	**3.5**	**3.0**	**3.6**	**3.4**
New rating system				
2014–15	3.0	1.7	3.0	2.7
2015–16	–	3.0	2.3	2.8

–, no native forest operations of that type were assessed that year.

Notes:

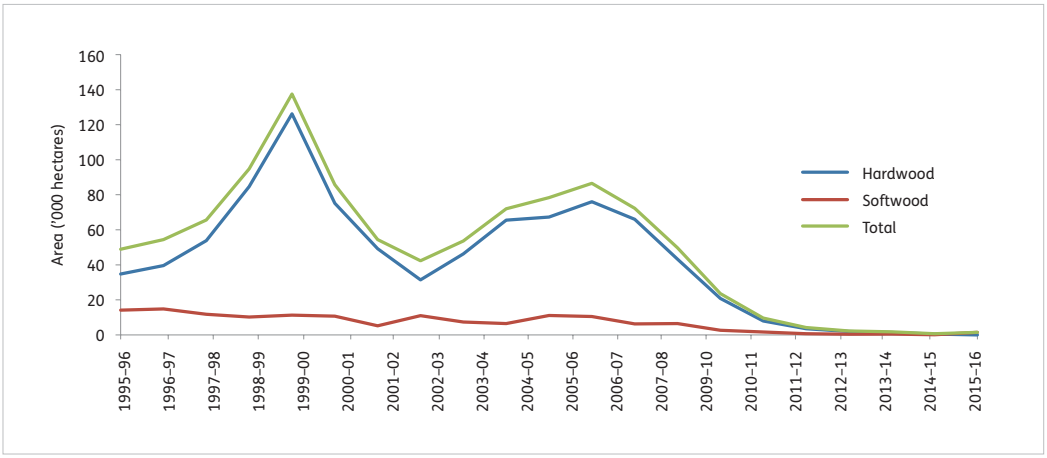
The rating scheme applied from 2003–04 to 2013–14 had a maximum rating of 4.0, with a rating of 3.0 being considered acceptable. A new rating scheme was applied after 2014–15 where the rating of 3.0 was both the acceptable and the maximum rating. The 'all-tenures' (state-wide) performance rating is calculated as the weighted mean of the total sample (FPA 2016a).

Data are for the random sample of Forest Practices Plans that were included in annual assessment program run by the FPA.

Source: FPA (2017a).

This table, together with other data for Indicator 2.1e, is available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

Figure 2.40: New commercial plantation establishment, Australia



Source: ABARES (2016b), Downham and Gavran (2017), National Plantation Inventory.

The data used to create this figure, together with other data for Indicator 2.1e, are available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

per year in the 2013 SOFR reporting period. In commercial plantations, rates of successful establishment are typically above 90%.

Most public and private plantation growers and managers have internal management systems to assess plantation restocking after establishment or re-establishment, and prescribe remedial treatment if needed. SOFR 2013 provided data on historical establishment stocking success for public softwood plantations in New South Wales, South Australia and Western Australia, and public hardwood plantations in New South Wales. For the SOFR 2018 reporting period, ABARES surveyed plantation growers and managers nationally regarding annual plantation re-establishment and the proportion meeting stocking standards. Responses are summarised by jurisdiction in Table 2.22, for public tree ownership in Table 2.23, and for private tree ownership in Table 2.24.

In 2015–16, there were 48,900 hectares of commercial plantation forest area re established in Australia; the average rate of re-establishment between 2011–12 and 2015–16 was 38,500 hectares per year (Table 2.22). Victoria had the largest contribution to Australia's average yearly commercial plantation re-establishment with 11,000 hectares (29%), followed by New South Wales plus the Australian Capital Territory with 10,500 hectares (27%) and Western Australia plus the Northern Territory with 6,200 hectares (16%). The average area proportion of re-established commercial plantation meeting stocking standards over the SOFR 2018 reporting period varied between 93% and 99% across jurisdictions.


Arthur Mostead

Seedlings of blue gum (*Eucalyptus globulus*) for plantation establishment or re-establishment.

Total public plantation re-establishment in Australia averaged 12,600 hectares per year between 2011–12 and 2015–16, with the majority (94%) occurring in softwood plantations (Table 2.23). New South Wales and the Australian Capital Territory together accounted for 9,400 hectares (75%) of Australia's average yearly re-established public plantation area, and Western Australia accounted for 2,200 hectares (17%). The average area proportion of re-established public plantation meeting stocking standards over the SOFR reporting period ranged from 97% in New South Wales and the Australian Capital Territory to 100% in South Australia, Tasmania and Victoria.

Table 2.22: Commercial plantation re-establishment and proportion meeting stocking standards, 2011–12 to 2015–16

Jurisdiction	Re-establishment	2011–12	2012–13	2013–14	2014–15	2015–16	Annual average
NSW and ACT[a]	Total area (ha)	8,500	9,900	9,900	12,100	12,200	10,500
	Stocking standard (%)	99	99	93	99	93	96
Qld	Total area (ha)	4,600	2,800	4,000	5,800	7,500	5,000
	Stocking standard (%)	100	100	99	97	100	99
SA	Total area (ha)	1,600	700	1,400	1,200	4,400	1,800
	Stocking standard (%)	99	100	99	93	100	98
Tas.	Total area (ha)	4,100	2,900	2,300	3,300	7,100	3,900
	Stocking standard (%)	93	97	93	94	97	95
Vic.	Total area (ha)	11,300	9,200	10,700	11,300	12,400	11,000
	Stocking standard (%)	94	96	90	90	98	93
WA and NT[b]	Total area (ha)	8,900	5,700	3,600	7,600	5,400	6,200
	Stocking standard (%)	98	100	100	100	83	97
Australia	Total area (ha)	38,900	31,200	31,900	41,400	48,900	38,500
	Stocking standard (%)	96	98	94	95	95	96

[a] Combined data for New South Wales and the Australian Capital Territory.
[b] Combined data for Western Australia and the Northern Territory.
Notes: Data are re-establishment data as reported by major growers and managers, representing around 70% of the total plantation estate.
Stocking standard results apply only to that proportion of the area re-established for which stocking data were provided.
Proportions are calculated as weighted averages.
Totals may not tally due to rounding. Figures are rounded to the nearest 100 hectares.
Source: ABARES.

This table, together with other data for Indicator 2.1e, is available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

Table 2.23: Public plantation re-establishment and proportion meeting stocking standards, 2011–12 to 2015–16

Jurisdiction	Re-establishment	2011–12	2012–13	2013–14	2014–15	2015–16	Annual average
NSW and ACT[a]	Hardwood (ha)	700	500	400	200	300	400
	Softwood (ha)	7,700	8,500	9,400	9,900	9,200	8,900
	Total area (ha)	8,400	9,000	9,700	10,200	9,500	9,400
	Stocking standard (%)	99	99	91	99	99	97
SA	Hardwood (ha)[b]	0	0	0	0	0	0
	Softwood (ha)	300	200	400	300	300	300
	Total area (ha)	300	200	400	300	300	300
	Stocking standard (%)	100	100	100	100	100	100
Tas.	Hardwood (ha)	600	200	100	100	300	200
	Softwood (ha)	700	600	400	400	0	400
	Total area (ha)	1,200	800	500	500	300	600
	Stocking standard (%)	100	100	100	100	100	100
Vic.	Hardwood (ha)	nd	nd	nd	nd	nd	nd
	Softwood (ha)	17	14	25	22	25	20
	Total area (ha)	17	14	25	22	25	20
	Stocking standard (%)[c]	100	100	100	100	100	100
WA	Hardwood (ha)	0	0	0	0	0	0
	Softwood (ha)	2,300	2,100	2,000	2,100	2,600	2,200
	Total area (ha)	2,300	2,100	2,000	2,100	2,600	2,200
	Stocking standard (%)	nd	nd	nd	nd	nd	nd
Australia	Hardwood (ha)	1,200	800	400	300	600	700
	Softwood (ha)	10,900	11,400	12,200	12,800	12,100	11,900
	Total area (ha)	12,200	12,100	12,600	13,100	12,700	12,600
	Stocking standard (%)	100	100	96	100	100	99

nd, data not supplied.

[a] Combined data for New South Wales and the Australian Capital Territory.

[b] South Australia has only a small area of public hardwood plantation, and for some years data on their re establishment can be included in the softwood plantation re-establishment figures.

[c] Proportions calculated for softwood plantation area only.

Notes:

Data are re-establishment data as reported by major growers and managers, representing around 70% of the total plantation estate. There are no public plantations in Queensland or the Northern Territory.

Stocking standard results apply only to that proportion of the area re-established for which stocking data were provided.

Proportions calculated as weighted averages.

Totals may not tally due to rounding. Figures are rounded to the nearest 100 hectares.

Source: ABARES.

This table, together with other data for Indicator 2.1e, is available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

Total private plantation re-establishment in Australia averaged 25,900 hectares per year between 2011–12 and 2015–16, with 16,800 hectares (65%) occurring in softwood plantations and 9,200 hectares (35%) in hardwood plantations (Table 2.24). Victoria accounted for 11,000 hectares (42%) of Australia's average yearly re-established private plantation area, and Queensland contributed 5,000 hectares (19%). The average proportion of re-established private plantation area meeting stocking standards over the SOFR 2018 reporting period ranged from 92% in Tasmania and Victoria to 99% in Queensland.

Tasmania is the only jurisdiction to report trends in land use following harvest of commercial plantation forests. Table 2.25 provides information on the planned subsequent land use of Tasmanian public and private plantations harvested since 1999–2000. Subsequent land-use options comprise plantation re-establishment, conversion to non-forest land use, and re-establishment of native forest.

During the SOFR 2013 and SOFR 2018 reporting periods, the average annual areas of plantation harvested in Tasmania were similar, at 8,648 hectares and 8,489 hectares, respectively (Table 2.25). However, planned land-use outcomes after plantation harvest were different in the two periods. In the SOFR 2013 reporting period 2006–07 to 2010–11, an annual average of 378 hectares of harvested plantation was converted to non-forest use, whereas in the SOFR 2018 reporting period 2011–12 to 2015–16 an annual average of 1,621 hectares of harvested plantation was converted to non-forest use. This elevated rate of conversion to non-forest use commenced in 2013–14 (Table 2.25).

Table 2.24: Private plantation re-establishment and proportion meeting stocking standard, 2011–12 to 2015–16

Jurisdiction	Re-establishment	2011–12	2012–13	2013–14	2014–15	2015–16	Annual average
NSW	Hardwood (ha)[a]	0	0	0	0	0	0
	Softwood (ha)	100	900	200	2,000	2,700	1,200
	Total area (ha)	100	900	200	2,000	2,700	1,200
	Stocking standard (%)	100	100	100	100	88	94
Qld	Hardwood (ha)	200	100	300	200	300	200
	Softwood (ha)	4,500	2,700	3,700	5,600	7,100	4,700
	Total area (ha)	4,600	2,800	4,000	5,800	7,500	5,000
	Stocking standard (%)	100	100	99	97	100	99
SA	Hardwood (ha)[a]	0	0	0	0	0	0
	Softwood (ha)	1,300	500	1,000	900	4,000	1,500
	Total area (ha)	1,300	500	1,000	900	4,000	1,500
	Stocking standard (%)	99	100	98	89	100	97
Tas.	Hardwood (ha)	1,100	100	100	1,200	5,400	1,600
	Softwood (ha)	1,800	2,000	1,700	1,500	1,400	1,700
	Total area (ha)	2,900	2,100	1,800	2,800	6,900	3,300
	Stocking standard (%)	89	95	89	90	96	92
Vic.	Hardwood (ha)	5,600	2,100	2,800	3,400	2,800	3,300
	Softwood (ha)	5,700	7,100	7,900	7,900	9,600	7,600
	Total area (ha)	11,300	9,200	10,700	11,300	12,400	11,000
	Stocking standard (%)	93	95	88	89	97	92
WA and NT[b]	Hardwood (ha)	6,600	3,600	1,600	5,500	2,800	4,000
	Softwood (ha)[a]	0	0	0	0	0	0
	Total area (ha)	6,600	3,600	1,600	5,500	2,800	4,000
	Stocking standard (%)	98	100	100	100	83	97
Australia	Hardwood (ha)	13,500	6,000	4,800	10,300	11,300	9,200
	Softwood (ha)	13,300	13,100	14,500	17,900	24,900	16,800
	Total area (ha)	26,800	19,100	19,300	28,300	36,200	25,900
	Stocking standard (%)	95	97	94	93	94	95

[a] Annual re-establishment area figures of less than 50 hectares are rounded to zero.

[b] Combined data for Western Australia and the Northern Territory.

Notes:

Data are re-establishment data as reported by major growers and managers, representing around 70% of the total plantation estate. There are no private plantations in the Australian Capital Territory.

Stocking standard results apply only to that proportion of the area re-established for which stocking data were provided.

Proportions are calculated as weighted averages.

Totals may not tally due to rounding. Figures are rounded to the nearest 100 hectares.

Source: ABARES.

This table, together with other data for Indicator 2.1e, is available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

Table 2.26 reports the performance rating for re-establishment of public and private plantations in Tasmania, based on the performance assessment system used by the FPA. Stocking standards specify the minimum levels of growing stock to maintain a plantation. Forestry Tasmania[136] reports annually on the level of restocking achieved for all plantation establishment operations on state forest, with the stocking success of eucalypt plantations being reported two years after planting operations (FPA 2017a). From 2003–04, a compliance rating of 3.0 was considered the minimum acceptable level, with the maximum rating being 4.0. However, in 2014–15 the rating system was changed with 3.0 being both the acceptable level and the maximum rating. Operations on both private industrial and state forest plantations rated highly, with all years rating above the minimum standard of 3.0, at an average of 3.6 and 3.7 for private industrial operations and operations on state forests, respectively. Operations on private independent plantations rated lower, with an average of 3.5 and a range over time of 2.3–4.0.

[136] From July 2017, Sustainable Timber Tasmania.

Table 2.25: Planned subsequent land use (hectares) of harvested plantation forest (public and private), Tasmania, 1999–2000 to 2015–16

		Planned subsequent land use		
Reporting year	Total plantation harvested	Plantation re-establishment	Conversion to non-forest use[a]	Native forest re-establishment[b]
1999–2000	3,650	3,600	50	0
2000–01	5,320	5,230	90	0
2001–02	5,710	5,350	360	0
2002–03	7,870	7,740	130	0
2003–04	8,670	8,250	420	0
2004–05	6,770	6,550	220	0
2005–06	8,100	7,590	510	0
2006–07	9,710	9,450	260	0
2007–08	10,370	9,760	610	0
2008–09	7,870	7,360	400	110
2009–10	8,460	7,940	280	240
2010–11	6,830	6,370	340	120
2011–12	4,203	3,691	350	162
2012–13	4,401	3,827	550	24
2013–14	9,301	7,515	1,496	290
2014–15	9,201	6,847	2,313	41
2015–16	15,337	11,879	3,394	64
Annual average for each SOFR reporting period				
1999–2000 to 2000–01	4,485	4,415	70	0
2001–02 to 2005–06	7,424	7,096	328	0
2006–07 to 2010–11	8,648	8,176	378	94
2011–12 to 2015–16	8,489	6,752	1,621	116

[a] Conversion of harvested plantation forest to non-forest land use primarily applies to private plantations. It is minor in state forest where it is restricted to infrastructure requirements (roads, powerlines and dams); such areas are not reported.

[b] Reflects the reforestation of streamside reserves with native species in plantations established prior to the introduction of the Forest Practices Code in 1987.

Source: FPA (2017a).

This table, together with other data for Indicator 2.1e, is available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

Radiata pine plantations, Glenelg Highway, Victoria.

Table 2.26: Annual assessment performance rating for re-establishment in plantation operations, Tasmania, 2003–04 to 2015–16

Reporting year	Private industrial	Private independent	State forest	All tenures
Rating scheme 2003–04 to 2013–14				
2003–04	4.0	4.0	3.9	4.0
2004–05	3.3	3.6	3.1	3.3
2005–06	3.9	4.0	3.6	3.8
2006–07	3.8	2.5	3.8	3.7
2007–08	3.6	4.0	3.8	3.7
2008–09	3.3	3.3	4.0	3.4
2009–10	3.4	3.0	3.9	3.4
2010–11	3.5	2.3	4.0	3.4
2011–12	3.3	3.5	3.0	3.3
2012–13	3.7	4.0	4.0	3.8
2013–14	4.0	4.0	–	4.0
Average	**3.6**	**3.5**	**3.7**	**3.6**
New rating system				
2014–15	3.0	3.0	–	3.0
2015–16	2.7	2.8	3.0	2.9

–, no plantation operations of that type were assessed that year.

Notes:

The rating scheme applied from 2003–04 to 2013–14 had a maximum rating of 4.0, with a rating of 3.0 being considered acceptable. A new rating scheme applied after 2014–15 where the rating of 3.0 was both the acceptable and the maximum rating. The 'all-tenures' (state-wide) performance rating is calculated as the weighted mean of the total sample (FPA 2016a).

Data are for the random sample of Forest Practices Plans that were included in annual assessment program run by the FPA.

Source: FPA (2017a).

This table, together with other data for Indicator 2.1e, is available in Microsoft Excel via www.doi.org/10.25814/5bda8a9ed76d5

Criterion 2 References

ABARES (Australian Bureau of Agricultural and Resource Economics and Sciences) (2016a). *Australia's plantation log supply 2015–2059*. ABARES, Canberra.

ABARES (Australian Bureau of Agricultural and Resource Economics and Sciences) (2016b). *Australian plantation statistics 2016*. ABARES, Canberra.

ABARES (Australian Bureau of Agricultural and Resource Economics and Sciences) (2017c). *Australian forest and wood products statistics, September and December quarters 2016*. ABARES, Canberra.

Baker SC and Read SM (2011). Variable retention silviculture in Tasmania's wet forests: ecological rationale, adaptive management and synthesis of biodiversity benefits. *Australian Forestry* 74:218–232. doi.org/10.1080/00049158.2011.10676365

Bassett O, Runnalls R, Fagg P, Cumming F and Keppel P (2013). *Review of Commercial Forestry Management in Western Victoria: Timber Resources, Harvest Levels, Silviculture, and Systems and Processes*. Forest Solutions report to the Victorian Department of Environment and Primary Industries, Melbourne.

Burgman M and Robinson AP (2012). *Review of Tasmanian Forest Estate Wood Supply Scenarios. Final Report to the Independent Verification Group, Intergovernmental Agreement*. Version 9.9, March 7, 2012. www.environment.gov.au/system/files/resources/eefde0e6-0f83-486d-b0c3-8b1d25abc497/files/ivgwoodsupplyburgman.pdf

Burns K, Gupta M, Davey S, Frakes I, Gavran M and Hug B (2015). *Outlook scenarios for Australia's forestry sector: key drivers and opportunities*. ABARES report to client prepared for the Department of Agriculture, ABARES, Canberra.

Burrows N, Dell B, Neyland M and Ruprecht J (2011). *Review of Silviculture in Forests of South-west Western Australia*. Report to Department of Environment and Conservation, Conservation Commission of Western Australia, Perth.

CALM (Department of Conservation and Land Management) (1994). *Forest Management Plan 1994–2003*. CALM, Perth.

CCWA (Conservation Commission of Western Australia) (2004). *Forest Management Plan 2004–2013*. CCWA, Perth.

CCWA (Conservation Commission of Western Australia) (2012). F*orest Management Plan 2004–2013 End-of-term Audit of Performance Report*. CCWA, Perth. www.dpaw.wa.gov.au/images/documents/conservation-management/forests/FMP/preparing_FMP_2014-23/20120329_forest_management_plan_20042013_end_of_term_audit_performance_final_30_march_2012_ccwa.pdf

CCWA (Conservation Commission of Western Australia) (2013). *Forest Management Plan 2014–2023*. CCWA, Perth. www.dpaw.wa.gov.au/images/documents/conservation-management/forests/FMP/20130282_WEB_FOREST_MGT_PLAN_WEB.pdf

Commonwealth of Australia (2015). *Meeting future market demand. Australia's forest products and forest industry – A strategic directions issues paper.* Forest Industry Advisory Council, Department of Agriculture, Canberra.

Commonwealth of Australia (2016b). *Transforming Australia's forest products industry: recommendations from the Forest Industry Advisory Council.* Forest Industry Advisory Council, Department of Agriculture and Water Resources, Canberra. www.agriculture.gov.au/forestry/industries/fiac/transforming-australias-forest-industry

Dare M and Eversole R (2013). *Forest owner intent: Harvesting Tasmania's non-industrial private forests – The intent of Tasmania's private forest growers to harvest their forest estate.* Report prepared for Private Forests Tasmania, Institute for Regional Development, Private Forests Tasmania, Hobart. www.pft.tas.gov.au/__data/assets/pdf_file/0006/131946/FOIS-2012_Report_FINAL_MARCH2013.pdf

Davey S and Dunn G (2014). *Australian native forest commerciality.* ABARES Technical Report 14.3, Canberra.

Davey SM (2018a). Regional forest agreements: origins, development and contributions. *Australian Forestry* 81:64-88. doi.org/10.1080/00049158.2018.1458701

Davidson J, Davey S, Singh S, Parsons M, Stokes B and Gerrand A (2008). *The Changing Face of Australia's Forests.* Bureau of Rural Sciences, Canberra.

DEC (Department of Environment and Conservation) (2012b). *Sustained yield information sheet series*. DEC, Perth. www.dpaw.wa.gov.au/images/documents/conservation-management/forests/FMP/preparing_FMP_2014-23/sustained_yield_information_sheets.pdf

DEC (Department of Environment and Conservation) (2013b). *Management of Commercial Harvesting of Protected Flora in Western Australia 1 July 2013 – 30 June 2018*. DEC, Perth. www.environment.gov.au/resource/management-commercial-harvesting-protected-flora-western-australia-1-july-2013-30-june-2018

DEPI (Department of Environment and Primary Industries) (2014d). *Victoria's State of the Forests Report 2013*. DEPI, Melbourne.

DNPRSR (Queensland Department of National Parks, Recreation, Sport and Racing) (2014). *Code of Practice for Native Forest Timber Production on the QPWS Forest Estate 2014.* Queensland Parks and Wildlife Service, the Department of National Parks, Recreation, Sport and Racing, Brisbane. www.npsr.qld.gov.au/managing/pdf/timber-production-qpws-estate.pdf

Downham R and Gavran M (2017). *Australian plantation statistics 2017 update*. ABARES, Canberra.

Downham R and Gavran M (2018). *Australian plantation statistics 2018 update*. ABARES, Canberra.

DPaW (Department of Parks and Wildlife) (2015b). *Review of the Sandalwood (Limitation of Removal of Sandalwood) Order 1996*. DPaW, Perth. www.dpaw.wa.gov.au/images/documents/plants-animals/licences-permits/Flora/sandalwood_oic_review_report_may_2015.pdf

DPaW (Department of Parks and Wildlife) (2016c). *Department of Parks and Wildlife Western Australia 2015–16 Yearbook*. DPaW, Perth. www.dpaw.wa.gov.au/about-us/annual-report-and-yearbook

DPIPWE (Department of Primary Industries, Parks, Water and Environment) (2012). *Code of practice for the field shooting of brushtail possums in Tasmania*. DPIPWE, Hobart. dpipwe.tas.gov.au/Documents/Possum-Code-of-Practice-Aug-2012.pdf

DPIPWE (Department of Primary Industries, Parks, Water and Environment) (2015a). *Annual state-wide spotlight surveys Tasmania 2015, regional summary: priority harvested species*. DPIPWE, Hobart. See for example dpipwe.tas.gov.au/Documents/Spotlight%20Summary%20Report.pdf

DPIPWE (Department of Primary Industries, Parks, Water and Environment) (2015b). *Management Plan for the Commercial Harvest and Export of Brushtail Possums in Tasmania 1st July 2015 – 1st July 2020*. DPIPWE, Hobart. www.environment.gov.au/system/files/resources/98744979-0ea9-4d19-b35a-be3421f0c559/files/tas-brushtail-possums-management-plan-2015-2020.pdf

DSE (Victorian Department of Sustainability and Environment) (2003). *Victoria's State of the Forests Report 2003*. DSE, Melbourne.

DSE (Victorian Department of Sustainability and Environment) (2008). *Victoria's State of the Forests Report 2008*. DSE, Melbourne.

DSEWPaC (Australian Government Department of Sustainability, Environment, Water, Population and Communities) (2011b). *Commercial Kangaroo Harvesting*. Fact sheet, DSEWPaC, Canberra. www.environment.gov.au/biodiversity/wildlife-trade/publications/commercial-kangaroo-harvesting-fact-sheet-2011

DSG (Tasmanian Department of State Growth) (2017). *The Tasmanian Special Species Management Plan.* Department of State Growth, Hobart. www.stategrowth.tas.gov.au/__data/assets/pdf_file/0013/160141/Tasmanian_Special_Species_Management_Plan_October_2017.pdf

EPA (New South Wales Environment Protection Authority) (2013a). *The Private Native Forestry Code Outcomes Monitoring Project.* A report prepared by Paul Killey, NSW Environment Protection Authority, Sydney.

FCNSW (Forestry Corporation of New South Wales) (2016b). *Forest Management Plan for the Coastal Forests of NSW*. FCNSW, Sydney. www.forestrycorporation.com.au/__data/assets/pdf_file/0011/669008/hardwood-forests-forest-management-plan.pdf

Ferguson I, Adams M, Bradshaw J, Davey S, McCormack R and Young J (2003). *Calculating Sustained Yield for the Forest Management Plan 2004–2013*. Stage 3 Report. Western Australian Conservation Commission, Perth.

Ferguson I, Dell B and Vanclay J (2013). *Calculating the sustained yield for the south-west native forests of Western Australia.* Report for the Conservation Commission and the Department of Environment and Conservation of WA by the Independent Expert Panel. Conservation Commission WA, Perth. www.dpaw.wa.gov.au/images/documents/conservation-management/forests/FMP/Sustained_Yield_Independent_Expert_Panel_Report_MARCH2013.pdf

Forest Practices Board (2002). *State of the Forests Report 2002.* Forest Practices Board, Hobart. www.fpa.tas.gov.au/FPA_publications/state_of_the_forests_tasmania_reports

Forest Solutions (2013). *Review of Commercial Forestry Management in Western Victoria: Timber Resources, Harvest Levels, Silviculture, and Systems and Processes*. Report prepared for the Department of Environment and Primary Industries. Department of Environment and Primary Industries and Forest Solutions, Melbourne.

Forestry Tasmania (2007). *Sustainable High Quality Eucalypt Sawlog Supply from Tasmanian State Forest – Review No 3*. Planning Branch, Forestry Tasmania, Hobart.

Forestry Tasmania (2010). *Special Timbers Strategy*. Forestry Tasmania, Hobart.

Forestry Tasmania (2013b). *A Review of the Sustainable Sawlog Supply from the Blackwood Management Zone*. Forestry Tasmania, Hobart. www.sttas.com.au/sites/default/files/media/documents/reviewsustainableblackwoodsupply2013_0.pdf

Forestry Tasmania (2014b). *Sustainable High Quality Eucalypt Sawlog Supply from Tasmania's Permanent Timber Production Zone Land — Review No 4*. Forestry Tasmania, Hobart. www.sttas.com.au/sites/default/files/media/documents/sustainableyieldreport4270314_1.pdf

Forestry Tasmania (2015b). *Special Timbers Resource Assessment on Permanent Timber Production Zone Land.* A report to Department of State Growth and Ministerial Advisory Council Special Timbers Subcommittee, Forestry Tasmania, Hobart. www.stategrowth.tas.gov.au/__data/assets/pdf_file/0006/132378/Special_Timbers_Resource_Assessment_on_PTPZL_Final_Sept.PDF

Forestry Tasmania (2017). *Special Timbers Resource Assessment on Permanent Timber Production Zone Land, Future Potential Production Forest Land, Regional Reserves and Conservation Areas.* A report to Department of State Growth and Ministerial Advisory Council Special Timbers Subcommittee, Forestry Tasmania, Hobart. www.stategrowth.tas.gov.au/__data/assets/pdf_file/0015/152403/Special_Timbers_Resource_Assessment_on_PTPZ_FPPF_RR_CA_Final_2017.PDF

Forests NSW (2010). *Forests NSW yield estimates for native forest regions*. Forests NSW, Pennant Hills. www.forestrycorporation.com.au/__data/assets/pdf_file/0007/439414/Forests-NSW-yield-estimates-for-native-forest-regions.pdf

FPA (Forest Practices Authority) (2007). *State of the forests Tasmania 2006*. FPA, Hobart. www.fpa.tas.gov.au/FPA_publications/state_of_the_forests_tasmania_reports

FPA (Forest Practices Authority) (2012). *State of the forests Tasmania 2012*. FPA, Hobart. www.fpa.tas.gov.au/FPA_publications/state_of_the_forests_tasmania_reports

FPA (Forest Practices Authority) (2015b). *The Forest Practices Code 2015*. FPA, Hobart. www.fpa.tas.gov.au/__data/assets/pdf_file/0020/132455/Forest_Practices_Code_2015.pdf

FPA (Forest Practices Authority) (2016a). *Forest Practices Authority Annual Report 2015–16*. FPA, Hobart. www.fpa.tas.gov.au/__data/assets/pdf_file/0004/141628/2015-16_FPA_annual_report.pdf

FPA (Forest Practices Authority) (2017a). *State of the forests Tasmania 2017.* FPA, Hobart. www.fpa.tas.gov.au/FPA_publications/state_of_the_forests_tasmania_reports and www.fpa.tas.gov.au/__data/assets/pdf_file/0005/163418/State_of_the_Forests_Report_2017_-_erratum_Feb_2018.pdf

FPA (Forest Practices Authority) (2017b). *Tree fern management plan for the harvesting, transporting or trading of* Dicksonia antarctica *in Tasmania.* FPA, Hobart.

FPC (Forest Products Commission) (2016). *Forest Products Commission Annual Report 2015–2016*. FPC, Perth. www.fpc.wa.gov.au/file/2314/download

Gavran M (2013). *Australian plantation statistics 2013 update.* ABARES, Canberra.

Gavran M (2014). *Australian plantation statistics 2014 update.* ABARES, Canberra.

Gavran M, Frakes I, Davey S and Mahendrarajah S (2012). *Australia's Plantation Log Supply 2010–2054*. ABARES, Canberra.

Gorman J, Courtenay K and Brady C (2016). *Production of* Terminalia ferdinandiana *Excell. in Northern Australia.* In: Australian native plants: cultivation and uses in the health and food industries. (Sultanbawa Y and Sultanbawa F, eds.), CRC Press/Taylor & Francis Group, Boca Raton, Florida, pp.89–103.

Jay A, Sharpe D, Nichols D and Vanclay J (2009). *Sustainable Private Native Forestry: A review of timber production, biodiversity and soil and water indicators, and their applicability to northeast NSW.* Rural Industries Research and Development Corporation, Publication No. 09/022 Project No. USC-8A, March. www.agrifutures.com.au/product/sustainable-private-native-forestry-timber-production-biodiversity-and-soil-and-water-indicators-and-their-applicability-to-northeast-nsw/

MIG (Montreal Process Implementation Group for Australia) and NFISC (National Forest Inventory Steering Committee) (2013). *Australia's State of the Forests Report 2013*. ABARES, Canberra. www.agriculture.gov.au/abares/forestsaustralia/sofr and www.agriculture.gov.au/abares/forestsaustralia/sofr/sofr-2013

Montreal Process Working Group (2001). Montreal Process Capacity Building Workshop Summary, August 26–31, 2001, Portland, Oregon. www.montrealprocess.org/documents/meetings/adhoc/2001portland_e.pdf

NRMMC (Natural Resource Management Ministerial Council) (2008). *National Code of Practice for the Humane Shooting of Kangaroos and Wallabies for Commercial Purposes.* Commonwealth of Australia, Canberra. www.environment.gov.au/biodiversity/wildlife-trade/publications/national-code-practice-humane-shooting-kangaroos-and-wallabies-commercial

NSW Government (2014). *Project 2023 — North Coast Resources Review.* New South Wales Department of Trade and Investment, Regional Infrastructure and Services, New South Wales Department of Primary Industries, Sydney. www.crownland.nsw.gov.au/__data/assets/pdf_file/0013/520042/north-coast-timber-supply-summary-north-coast-forestry-resources-review.pdf

NSW Government and Office of Environment and Heritage (2011). *NSW Forest Agreements Implementation Report 2009-2010: Upper North East, Lower North East, Eden and Southern Regions*. A report prepared by the Minister for the Environment as part of the implementation of the NSW forest agreements and integrated forestry operations approvals, Crown Forestry Section, Office of Environment and Heritage, Sydney. www.epa.nsw.gov.au/-/media/F2749F928C9A48E79CC19BB6D6C91A24.ashx?la=en

NSW OEH (New South Wales Office of Environment and Heritage) (2016b). *NSW Report on Native Vegetation 2013–14.* OEH, Sydney. www.environment.nsw.gov.au/resources/nativeveg/nsw-report-native-vegetation-2013-14.pdf

Nye ER, Dickman CR and Kingsford RT (2007). A wild goose chase – temporal and spatial variation in the distribution of the magpie goose (*Anseranas semipalmata*) in Australia. *Emu* 107:28–37. doi.org/10.1071/MU05012

Parsons M and Pritchard P (2009). *The Role, Values and Potential of Australia's Private Native Forests.* RIRDC publication 09/049, Rural Industries Research and Development Corporation, Canberra. www.agrifutures.com.au/product/the-role-values-and-potential-of-australia-s-private-native-forests/

PFT (Private Forests Tasmania) (2005). *Tasmanian Private Property Wood Flow Estimates 2002 to 2031.* Private Forests Tasmania, Hobart. www.stors.tas.gov.au/au-7-0095-01933

Private Forestry Consultative Committee (2002). *Plantations for Australia: The 2020 Vision*. ABARES, Canberra.

PWSNT (Parks and Wildlife Service Northern Territory) (2009). *Management program for the magpie goose (*Anseranas semipalmata*) in the Northern Territory of Australia, 2009–2014.* Department of Natural Resources, Environment, the Arts and Sport, Palmerston, Northern Territory.

Queensland Department of Environment and Heritage (2015). *Queensland commercial macropod management program annual report 2014.* State Government of Queensland, Brisbane.

Queensland Government (1998). *Background to Assessment of Queensland's Ecologically Sustainable Forest Management Systems and Processes – Description Report.* Department of Natural Resources – Resource Management, Department of Communications, Information, Local Government and Planning, Department of Primary Industries – Forestry and Department of Environment and Heritage, Brisbane.

Resource Assessment Commission (1992). *A Survey of Australia's Forest Resource.* Australian Government Publishing Service, Canberra.

RIRDC (Rural Industries Research and Development Corporation) (2007a). *Honeybee R&D Plan 2007–2012*. RIRDC Publication No 07/056, RIRDC Project No AGL-4A. RIRDC, Canberra. www.agrifutures.com.au/product/honeybee-five-year-plan-2007-2012/

Somerville D (2010). *Forestry Plantations and Honeybees.* Rural Industries Research and Development Corporation, Canberra.

Thompson D and Connell M (2009). *Issues in Assessing the Sustainability of Private Native Forestry.* Rural Industries Research and Development Corporation, Publication No. 09/031 Project No. CAR-2A, March. www.agrifutures.com.au/wp-content/uploads/publications/09-031.pdf

Vanclay JK and Turner BJ (2001). *Evaluation of data and methods for estimating the sustainable yield of sawlogs in Victoria.* Department of Natural Resources and Environment, Expert Data Reference Group, Melbourne. www.oren.org.au/issues/forestmanag/Jerryvanclay.pdf

van Dijk J, Gomboso J and Levantis C (2016). *Australian honey bee industry: 2014–15 survey results.* ABARES research report 16.18, ABARES, Canberra.

VicForests (2011a). *Sustainability Report 2010–11.* VicForests, Melbourne.

VicForests (2011b). *VicForests 2011 Resource Outlook.* VicForests, Melbourne.

VicForests (2013). *VicForests 2013 Resource Outlook.* VicForests, Melbourne.

VicForests (2014). *VicForests 2014 Resource Outlook*. VicForests, Melbourne. www.vicforests.com.au/static/uploads/files/resource-outlook-2014-v4-1-final-wflqdiojpmqi.pdf

VicForests (2017). *2016-2017 Resource Outlook*. VicForests, Melbourne. www.vicforests.com.au/planning-1/resource-outlook-2017

Victorian Auditor-General (2013). *Managing Victoria's Native Forest Timber Resources.* Victorian Auditor-General Office, Melbourne, December. www.audit.vic.gov.au/sites/default/files/20131211-Timber-Resources.pdf

Western Australia and Commonwealth of Australia (1999). *Regional Forest Agreement for the South-West Forest Region of Western Australia between the Commonwealth of Australia and the State of Western Australia.* Signed 4 May 1999. www.agriculture.gov.au/SiteCollectionDocuments/rfa/regions/wa/rfa/wa_rfa.pdf

Whitehead P, Gorman J, Griffiths A, Wightman G, Massarella H and Altman J (2006). *Feasibility of Small Scale Commercial Native Plant Harvests by Indigenous Communities.* A report for the RIRDC/Land & Water Australia/FWPRDC/MDBC Joint Venture Agroforestry Program. RIRDC Publication No 04/149. Rural Industries Research and Development Corporation, Canberra. www.agrifutures.com.au/wp-content/uploads/publications/04-149.pdf

Wilkinson G (1994). *Native Forest Silviculture Technical Bulletin No. 5, Silvicultural systems*. Division of Silvicultural Research and Development Forestry Commission, Tasmania.

Wilson J (2012). *Private forest resourcing model 2012: Where are the best locations for a hypothetical Tasmanian wood processing plant?* Private Forests Tasmania, Hobart. www.pft.tas.gov.au/__data/assets/pdf_file/0005/131945/Private_Forest_Resourcing_Model_2012.pdf