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Department of Agriculture, Fisheries and Forestry

ABARES

Australia's State of the Forests Report Synthesis 2023

A five-yearly report prepared by the Montreal Process Implementation Group for Australia and the National Forest Inventory Steering Committee on behalf of the Australian, state and territory governments

AUSTRALIAN BUREAU OF AGRICULTURAL AND RESOURCE ECONOMICS AND SCIENCES

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The logo of the Montreal Process Working Group on Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests is shown on the Cover page and page 39.

Acknowledgement of Country

We acknowledge the Traditional Custodians of Australia and their continuing connection to land and sea, waters, environment and community. We pay our respects to the Traditional Custodians of the lands on which we live and work, their culture, and their Elders past and present.

This publication is printed on FSC-certified paper.

Depot Beach, New South Wales. Photo: Cressida Lehmann

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Strangler Fig, Mapleton Falls National Park, Queensland. Photo: Tony Hunn

Australia's State of the Forests Report Synthesis 2023

Introduction

Australia's forests are recognised and valued for their diverse ecosystems and unique biodiversity, cultural heritage, provision of goods and services such as wood, carbon sequestration and storage, and soil and water protection, and for their aesthetic values and recreational opportunities. They are also subject to a range of pressures, including extreme weather events, drought and climate change; invasive weeds, pests and diseases; changed fire regimes; clearing for agriculture, urban development, mining, or infrastructure; and the legacy of previous land-management practices.

Australia's definition of forest, as used in *Australia's State of the Forests Report* (SOFR), is:

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

The sustainable management and conservation of Australia's forests, which include native forests managed for conservation, production or other purposes, and commercial plantations and other forest, on public or on private land, requires a sound understanding of their extent, type, use and management. The data presented to report on the state of Australia's forests bring together comprehensive information from a wide range of sources of the broad range of values relating to Australia's forests and their management.

The *Australia's State of the Forests Report* series commenced in 1998. Subsequent reports were published in 2003, 2008, 2013 and 2018 using the formal framework of seven criteria and indicators for sustainable forest management established under the Montreal Process. Reporting on Australia's forests via SOFR has now moved to an online-first publishing approach following a consultation process with stakeholders, including state and territory agencies. The online-first approach enables the 44 individual indicators (see page 39) to be updated on the Forests Australia website as new data become available, and replaces the previous process which updated and published all indicators in a single report. The progressive update and rolling publication of indicators will be accompanied by the publication of a five-yearly *SOFR Synthesis* with summaries of the best-available data in the 44 indicators at the time, thereby continuing the five-yearly reporting cycle.

This *SOFR Synthesis 2023* is the first such Synthesis to be prepared. It summarises by themes the data of 25 indicators updated and published on the Forests Australia website in late 2023 and 2024. It also presents data from *Australia's State of the Forests Report 2018* for the other 19 indicators which will be progressively updated and published in 2025. The date-stamp of the indicator data reported in this first SOFR Synthesis varies, but the underlying forest area is mapped as at June 2021, which is consistent with the date of other data reported unless otherwise stated. All data are assembled in the National Forest Inventory, ABARES, unless otherwise stated.

The geographic scope of *Australia's State of the Forests Report* is the extent of forests mapped by Australia's National Forest Inventory. This includes forests in all Australia's states and mainland territories and their close offshore islands, but not external territories such as Norfolk Island, Lord Howe Island, Cocos (Keeling) Islands and Christmas Island. A comprehensive introduction to Australia's forests, including definitions is available at the About Australia's State of the Forests Report webpage.

Australia's forest area

The area, type, tenure and management category of forests provides the base data for describing the state of Australia's forests, and changes over time.

Australia's forest area as at 2021

Australia has 133.6 million hectares of forest, covering 17% of Australia's total land area. This is the seventh largest area of forest in the world by country, and approximately 3% of the world's forest area. Australia's definition of forest recognises the country's unique and diverse forest ecosystems.

In Australia's National Forest Inventory, forests are assigned to three broad categories:

- **Native forest**: 131.5 million hectares of natural forest dominated by native tree species.

  Queensland has the largest area of native forest (51.8 million hectares), with much of the balance in the Northern Territory (23.3 million hectares), Western Australia (20.4 million hectares) and New South Wales (19.9 million hectares).

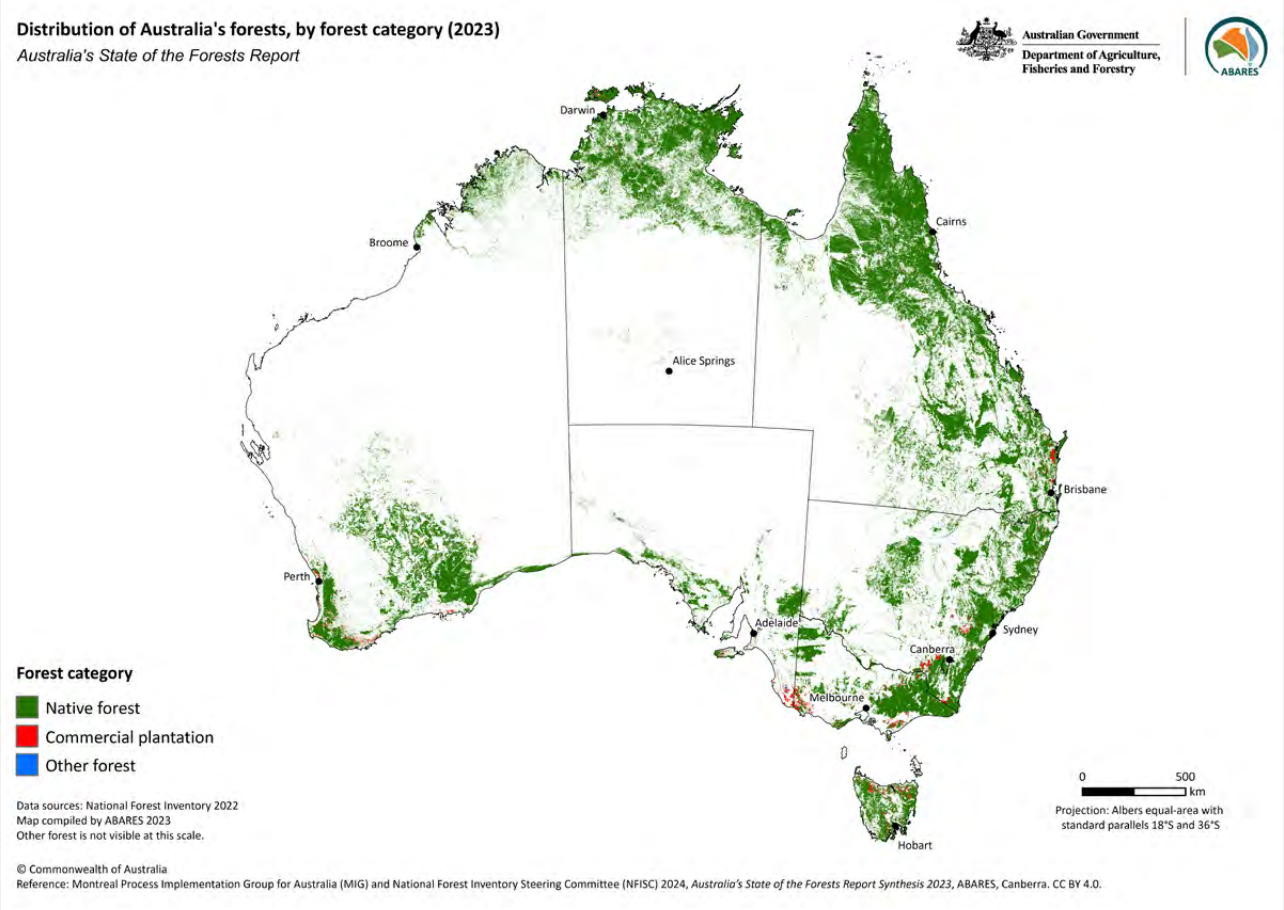
- **Commercial plantation**: 1.82 million hectares of plantations managed commercially to supply logs for the manufacture of wood products.

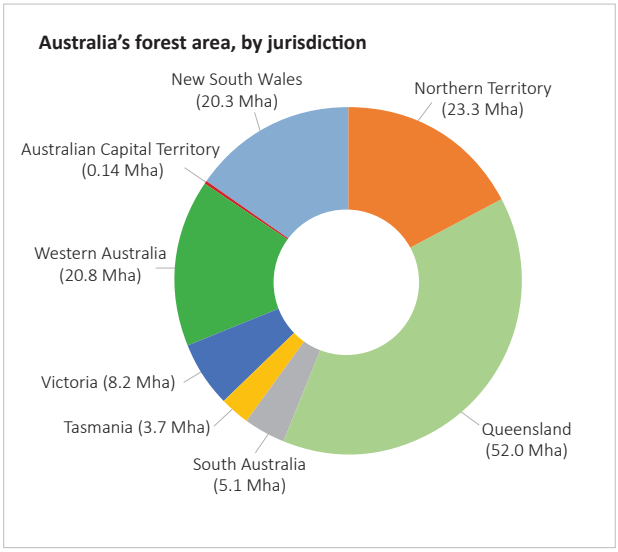
  Victoria has the largest area of commercial plantations (0.40 million hectares), with large areas also in New South Wales (0.37 million hectares), Western Australia (0.32 million hectares), Tasmania (0.29 million hectares) and Queensland (0.21 million hectares).

  The area of commercial plantation reported here differs from the area most recently published by the National Plantation Inventory which is compiled from non-spatial data sources that cannot be integrated with the national spatial (mapped) total forest area dataset that is required to identify the area of all forests in Australia.

- **Other forest**: 0.24 million hectares of planted forest other than commercial plantation, including non-commercial plantations, sandalwood plantation, and environmental plantings.

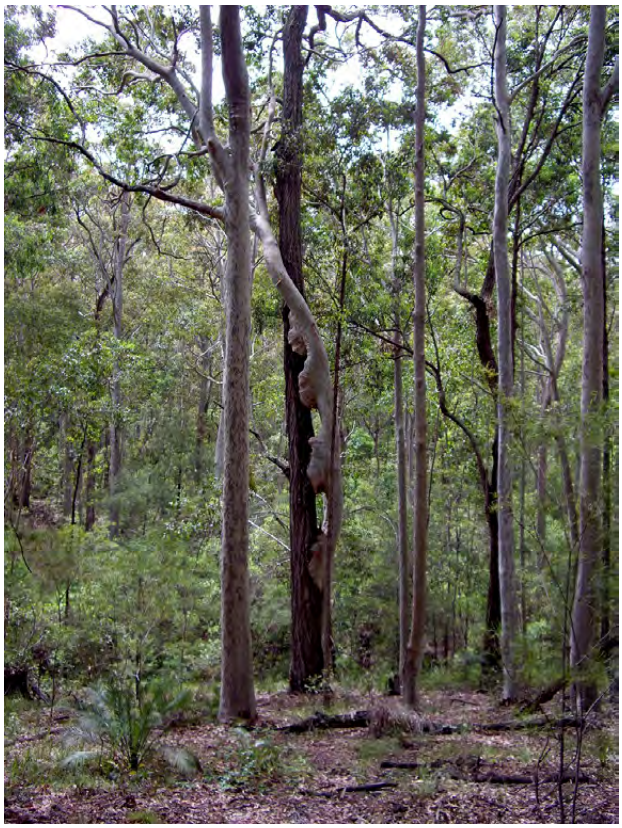
Most forests are in the northern, eastern, south-eastern and south-western regions of Australia, although woodland forests extend into drier areas in many parts of the country.





Mha, million hectares. These forest area values are determined by ABARES by combining spatial (mapped) forest area data from multiple independent sources and validating areas of agreement to produce an accurate spatial dataset.

Source: ABARES, National Forest Inventory 2023.



Caterpillar tree, *Corymbia maculata* near Malua Bay, New South Wales. Photo: Steve Read

Native forest

Australia's native forest is dominated by Eucalypt forest (101.1 million hectares, 77% of total native forest).

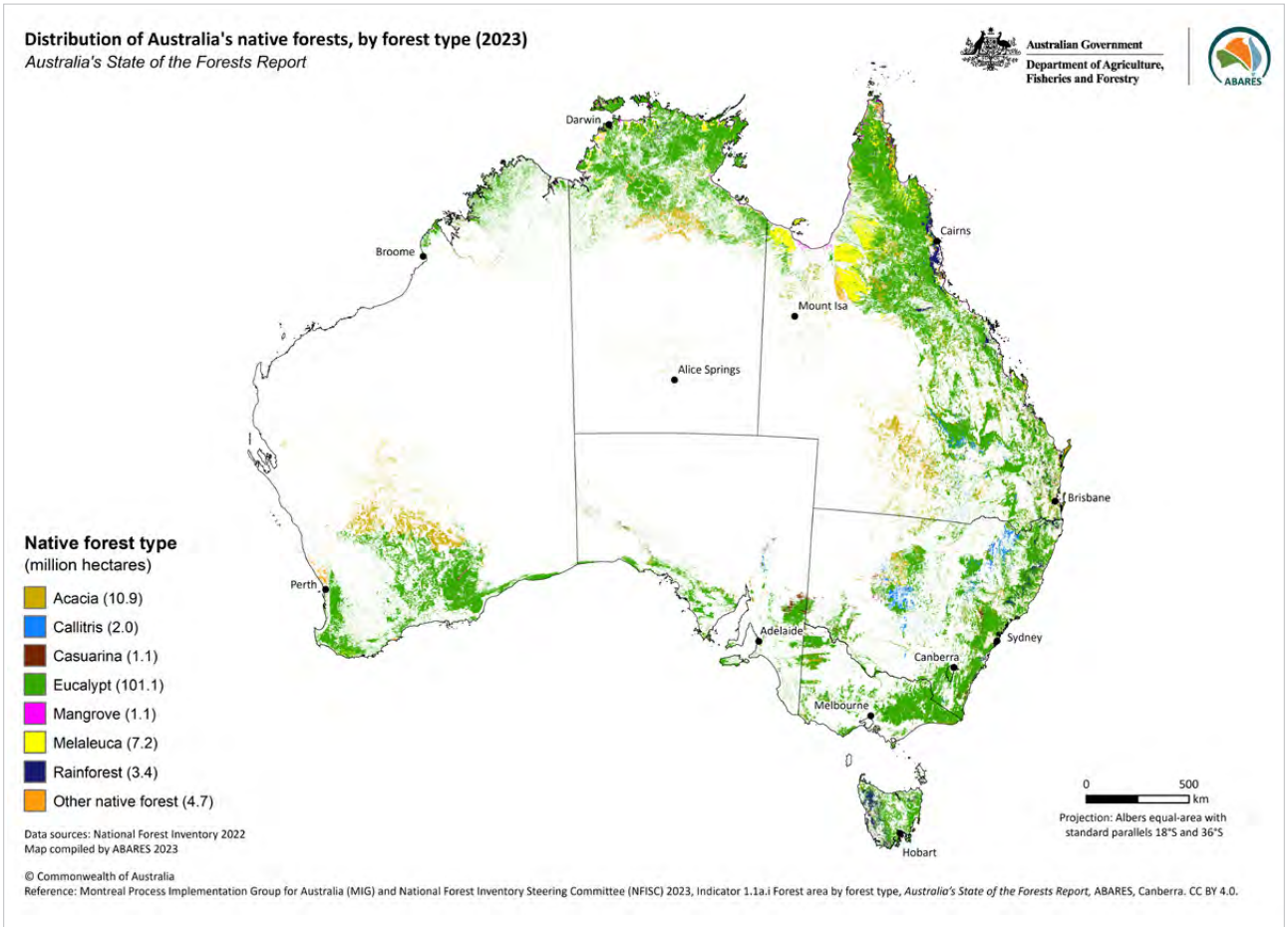
Acacia forest (10.9 million hectares, 8% of total native forest) and Rainforest (3.4 million hectares, 3% of total native forest) also cover significant areas.

More than two-thirds (93.0 million hectares, 71%) of Australia's native forests are woodland forests with a crown cover of 20–50%.

Eucalypt forest is widespread across Australia, and includes the mallee subtype. The largest areas of Acacia forest are in Queensland and Western Australia, the largest areas of Callitris and Casuarina forests are found in New South Wales, and the largest areas of Melaleuca forests occur in Queensland.

Australia's native forest is classified into three crown cover classes:

- **Woodland forest** (20–50% crown cover) covers 93 million hectares of mostly drier areas, mainly in inland regions
- **Open forest** (>50–80% crown cover) covers 34 million hectares and dominates higher rainfall regions in the south-eastern, south-western and northern parts of the country
- **Closed forest** (>80–100% crown cover), which includes Rainforest, covers 2.6 million hectares and is found in western Tasmania, north-eastern Queensland, north-eastern New South Wales and coastal Northern Territory, generally in areas of high rainfall.



Area of native forest, by crown cover class and jurisdiction

	Area (million hectares)				
Jurisdiction	**Woodland forest**	**Open forest**	**Closed forest**	**Unknown cover**	**Total**
ACT	0.0	0.1	0.0	0.0	**0.1**
NSW	9.8	9.0	0.5	0.6	**19.9**
NT	15.3	7.4	0.4	0.2	**23.3**
Qld	41.0	8.5	1.0	1.2	**51.8**
SA	4.6	0.3	0.0	0.0	**4.9**
Tas.	1.5	1.3	0.6	0.0	**3.4**
Vic.	2.9	4.8	0.0	0.1	**7.8**
WA	17.9	2.4	0.0	0.1	**20.4**
Australia	**93.0**	**33.8**	**2.6**	**2.1**	**131.5**

Totals may not tally due to rounding.
Source: ABARES, National Forest Inventory 2023.

Commercial plantation

Australia has 1.82 million hectares of commercial plantations (1.4% of Australia's total forest area), comprising 1.06 million hectares (58%) of softwood plantations and 0.74 million hectares (41%) of hardwood plantations.

Most commercial softwood plantations are in New South Wales (0.31 million hectares, 29% of Australia's total softwood plantation area), Victoria (0.24 million hectares, 22%) and Queensland (0.19 million hectares, 18%).

Commercial softwood plantations are mainly radiata pine (*Pinus radiata*) with smaller areas of other exotic pines and native softwood species.

Most commercial hardwood plantations occur in Tasmania and Western Australia (each with 0.20 million hectares and 27% of Australia's total hardwood plantation area) and Victoria (0.17 million hectares, 23%).

Commercial hardwood plantations are dominated by Tasmanian blue gum (*Eucalyptus globulus*) and shining gum (*E. nitens*) with smaller areas of other eucalypts.

The area of commercial plantation reported here differs from the most recent area published by the National Plantation Inventory which is compiled from non-spatial data sources that cannot be integrated with the national spatial (mapped) total forest area dataset that is required to identify the area of all forests in Australia.

Commercial plantations are discussed further in the Forests managed for wood production theme.

Tenure

Most of Australia's forests are privately managed with 90.8 million hectares (68% of Australia's total forest area) on leasehold (48.0 million hectares, 36%) or privately owned (42.8 million hectares, 32%) tenures.

Forests occur on all of the five national land tenure categories in Australia: Leasehold, Multiple-use public forest, Nature conservation reserve, Other Crown land, and Private. Queensland contains the largest area of leasehold forest, and Queensland and the Northern Territory contain the largest areas of private forest.

Publicly managed forests include forest on nature conservation reserve tenure (22.1 million hectares) and multiple-use public forest (10.7 million hectares). Large areas of forest on nature conservation reserve tenure are found in all jurisdictions except for the Northern Territory, and large areas of multiple-use public forest are found in all jurisdictions except the Northern Territory and South Australia.

Changes in the tenure of forested land from 2016 to 2021 includes the transfer of other Crown land and leasehold tenures to private and a small increase in nature conservation reserve tenure.

Young hardwood plantation, Western Australia. Photo: Adwo - stock.adobe.com

The Indigenous forest estate

The Indigenous forest estate comprises 79.9 million hectares of forest, representing 60% of Australia's total forest area. This is an increase of 10.4 million hectares over the area reported in *Australia's State of the Forests Report 2018*. The increase has occurred in all Indigenous estate categories, mostly through new Indigenous Protected Areas, Indigenous Land Use Agreements, and areas subject to Native Title.

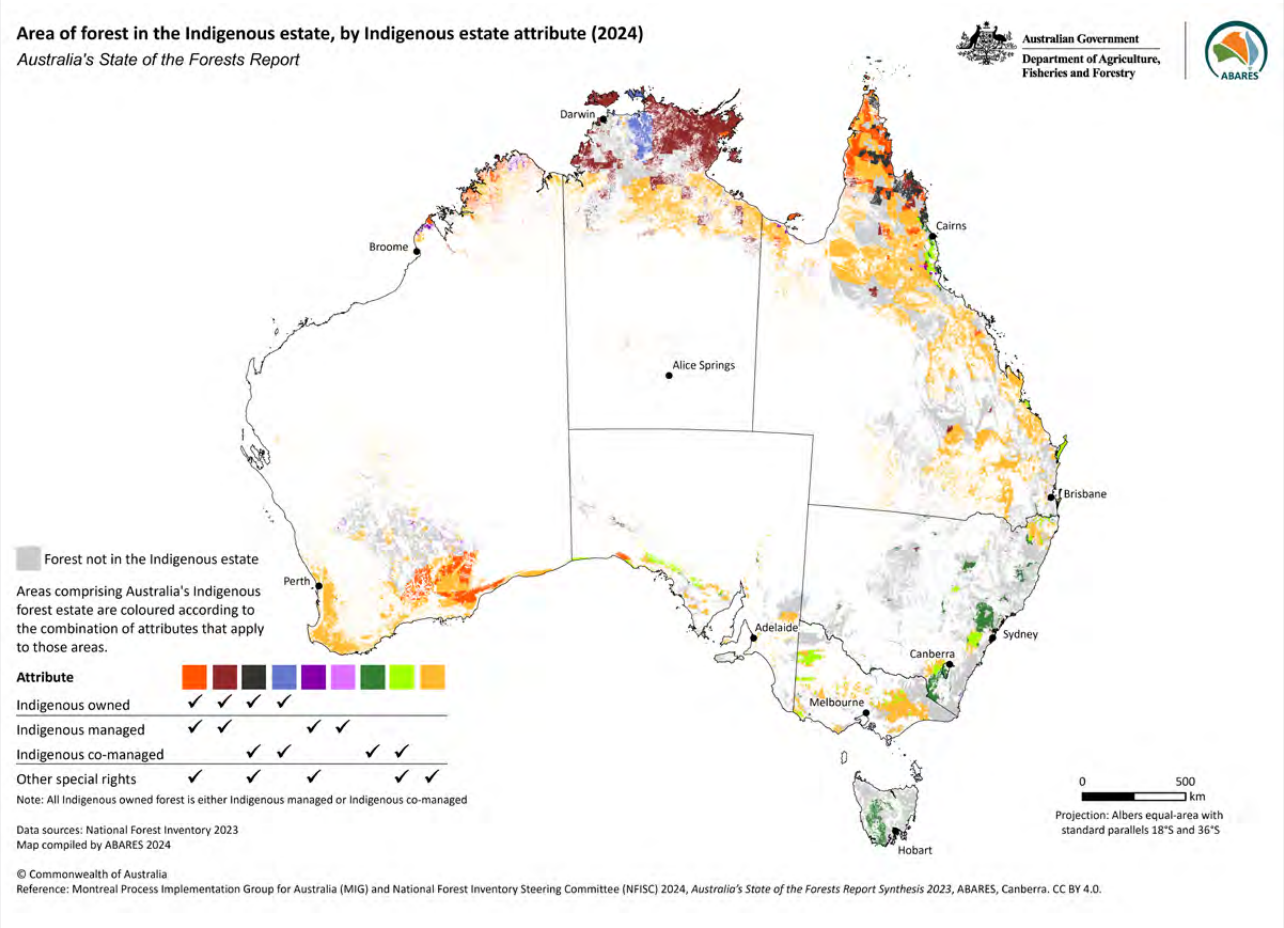
The Indigenous forest estate is the forest over which Indigenous peoples and communities have ownership, management or co-management, and rights of use for customary purposes, and occurs across all public and private tenures. The term 'Indigenous' is used throughout the *Australia's State of the Forests Report* series to encompass all Aboriginal and Torres Strait Islander peoples.

Area of the Indigenous forest estate

Indigenous estate attribute	Area (million hectares)
Indigenous owned	24.2
Indigenous managed *or*	20.7
Indigenous co-managed	10.6
Other special rights	62.4
Total Indigenous forest estate	**79.9**
Total forest	133.6
Proportion of forest in the Indigenous estate	**60%**

Total Indigenous forest estate accounts for areas of overlap that are in more than one attribute.

Source: ABARES, National Forest Inventory 2024 (Forests of Australia (2023), Australia's Indigenous land and forest estate (2024)).



Forest area change over time

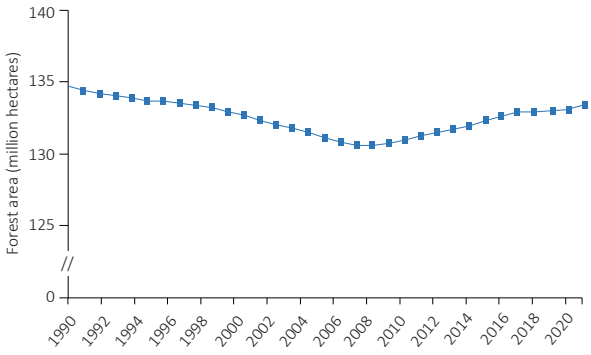
Australia's total forest area increased by 0.75 million hectares over the five-year period from 2016 to 2021, maintaining the increase in total forest area that has been observed since 2008.

The annual change in Australia's forest area is calculated by applying annual forest area change data from Australia's National Inventory Report 2021 to the total forest area figure of 133.6 million hectares determined by ABARES. It is the net result of forest area change processes occurring across the Australian landscape, including:

- natural expansion of forest onto areas of grassland that have not held forest for many years
- clearing of forest for agriculture, urban expansion, mining or other infrastructure; regrowth of forest onto recently cleared land; and re-clearing of regrowth forest (which occurs on some of Australia's grazing lands)
- changes in the area of commercial plantations
- new environmental plantings
- changes in the area of mangroves.

Changes in forest area are not caused by harvesting of native forest or plantations, or by natural disturbances such as fire or cyclones when temporary changes in forest canopy cover are followed by regrowth or regeneration.

Australia's forest area over time, 1990 to 2021



Note break in vertical axis. Data are for years ending 30 June.

Source: National Inventory Report 2021 (DCCEEW 2023), Table 6.2.2; ABARES *Forests of Australia (2023) dataset.*

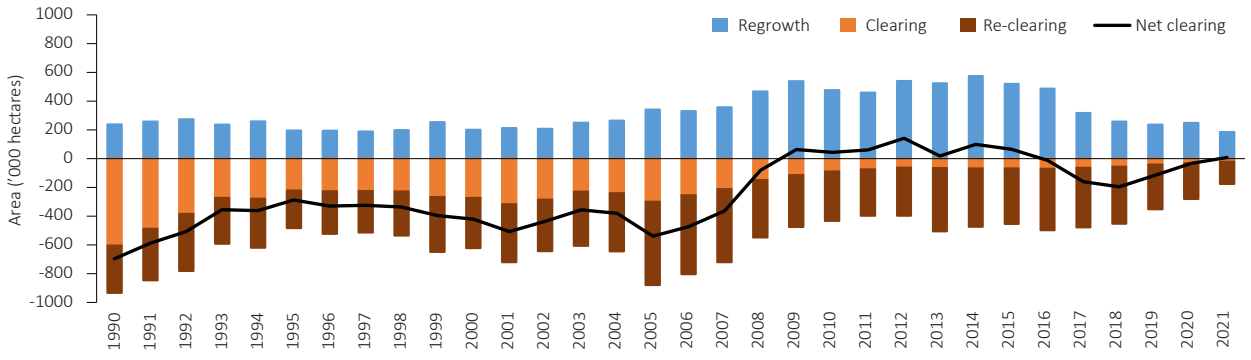
The total area of both primary (first-time) clearing and secondary clearing (re-clearing) of forest has been progressively reducing over time.

In 2020–21, the area of forest cleared (22 thousand hectares) or re-cleared (155 thousand hectares) was exceeded by the area of forest regrowing from previous clearing (185 thousand hectares).

The annual area of net clearing is the sum of these clearing, regrowth and re-clearing processes each year.

For further information on this theme
See Indicator 1.1a and Indicator 6.4a of the *Australia's State of the Forests Report*, available at agriculture.gov.au/abares/forestsaustralia/sofr.

Annual areas of forest cleared, regrown, and re-cleared, 1990 to 2021



Clearing and re-clearing cause a reduction in forest area, while regrowth causes an increase in forest area.

Source: Australia's National Inventory Report 2021 (DCCEEW 2023): annual 'Identified regrowth' figures from Table A5.6.12.1a–b allow comparison to annual clearing and re-clearing figures. Data are for years ending 30 June.

Forest biodiversity and genetic resources

Forest managed for protection of biodiversity

A variety of formal and informal mechanisms are used on public and private land in Australia to protect biological diversity. These range from formal protected areas in the National Reserve System where conservation is the main management objective, such as National Parks and Indigenous Protected Areas, to areas managed in ways that achieve protection of biodiversity as one of several goals, such as private land under conservation covenants.

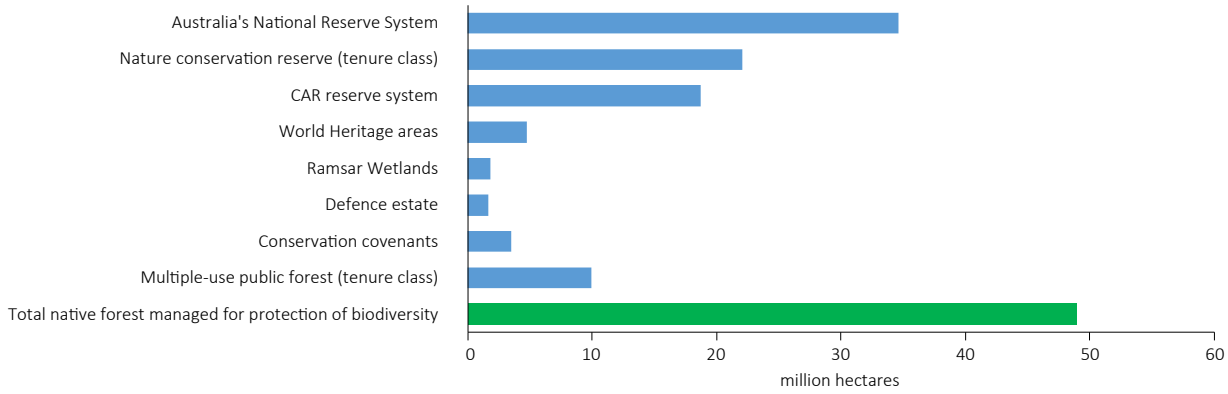
Many areas are protected by more than one mechanism, and spatial intersection of these areas is needed to determine the total area of forest managed for protection in Australia.

A total of 48.9 million hectares (37%) of Australia's native forest is managed for protection of biodiversity. Of this, 34.6 million hectares (26%) is in the National Reserve System.

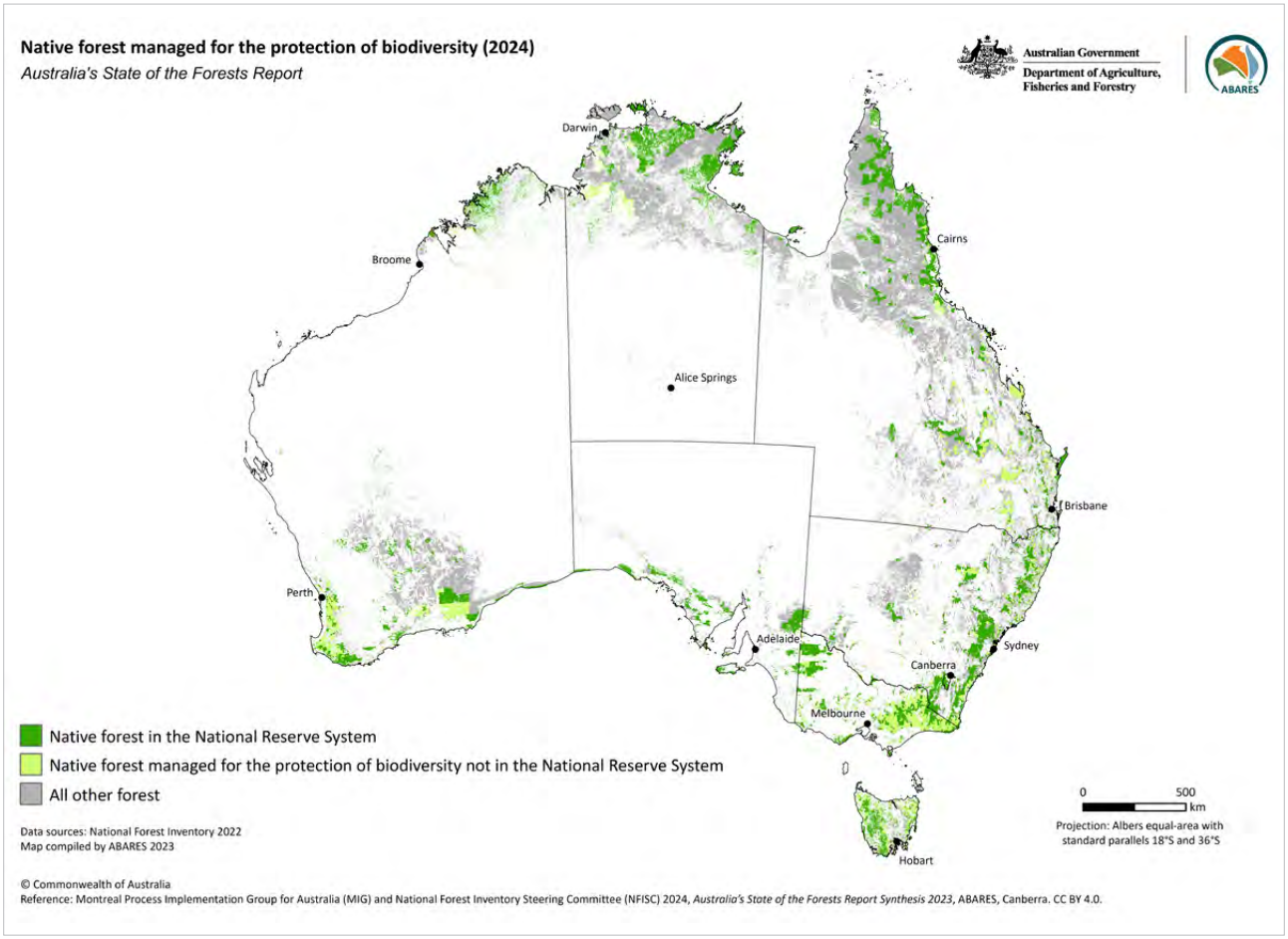
By jurisdiction, the largest area of native forest managed for protection of biodiversity is in Queensland (12.5 million hectares). The jurisdictions with the highest proportion of their total native forest area managed for protection are the Australian Capital Territory (95%), Victoria (86%) and Tasmania (78%).

Fungi on a rotting log, Tasmania. Photo: Claire Howell

Area of native forest managed for protection of biodiversity, 2020–21, by protection mechanism



CAR, comprehensive, adequate, representative.
The total area managed for protection accounts for areas of forest that are protected under more than one mechanism.
Source: ABARES, National Forest Inventory 2023.



Forest biodiversity

There were 1,788 identified native forest-dwelling vertebrate fauna species (animals) and 13,788 identified native forest-dwelling vascular flora species (plants) in Australia, as at December 2021.

Forest-dwelling species are species that use a forest habitat for at least part of their life cycle.

- Across Australia, reptiles and birds are the dominant groups of vertebrates that inhabit forests.
- Flowering plants are the dominant group of flora in Australia's forests, with the largest families being Fabaceae (including peas and wattles) and Myrtaceae (including eucalypts and melaleucas).
- Queensland has the greatest number of forest-dwelling vascular flora (6,401), reflecting the large area and diversity of Queensland forest ecosystems.
- Queensland also has the greatest number of forest-dwelling vertebrates (1,269).

Data on the number of forest-dwelling fauna and flora species in Australia reported here were derived from a single national data source, the Atlas of Living Australia.

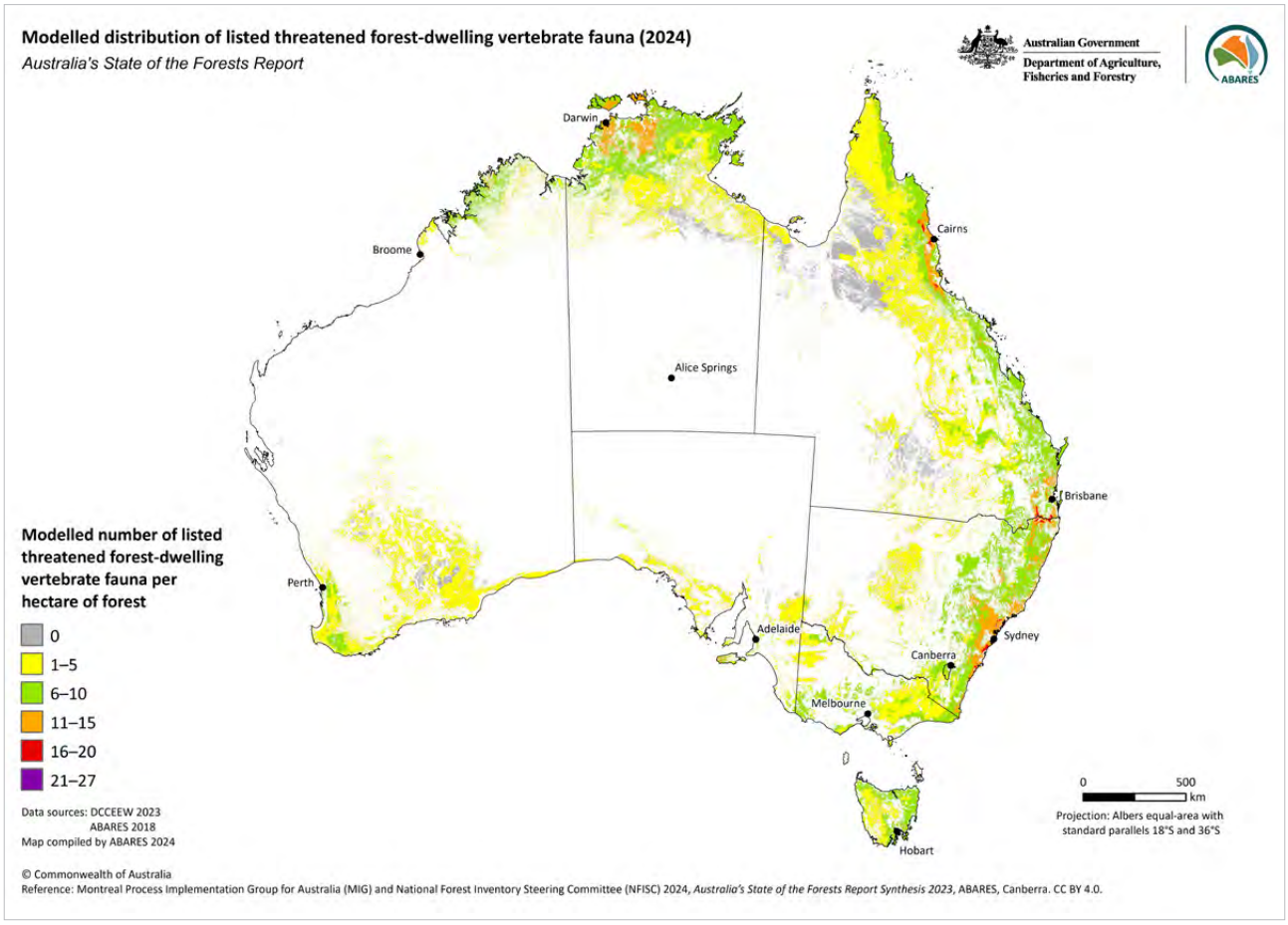
The development of this national methodology and more stringent and consistent quantitative criteria for assessing species as forest-dwelling, makes any comparison with previously reported data not meaningful.

Threatened species in forests

A total of 1,227 native forest-dwelling species were listed as threatened under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), comprising 244 forest-dwelling vertebrate fauna and 983 forest-dwelling vascular flora, as at December 2021.

The modelled number of listed forest-dwelling species per hectare of forest is highest in wetter coastal and hinterland areas. For threatened forest-dwelling fauna, this includes south-east Queensland and northern New South Wales, the wet tropics of far north Queensland, and the West Arnhem Land region of the Northern Territory. These are all areas where species diversity is also high.

Species newly listed in the period 2016–21 are described below.



This map intersects the modelled potential extent (areas where species are known to occur plus areas where species are likely to occur) of threatened forest-dwelling vertebrate fauna listed under the EPBC Act, and the Forests of Australia (2018) dataset. Modelling undertaken by the Australian Government Department of Climate Change, Energy, the Environment and Water.

For forest-dwelling fauna and flora over the period August 2016 to December 2021:

- 31 vertebrate fauna and 68 vascular flora were added to the national list of threatened species, while 6 vertebrate fauna and 7 vascular flora were removed from the list
- 19 vertebrate fauna and 12 vascular flora were uplisted to higher categories, while 7 vertebrate fauna were downlisted to lower categories
- 6 vertebrate fauna (all mammals) were listed as Extinct, however, these species are presumed to have become extinct around the early 1900s following European settlement in Australia.

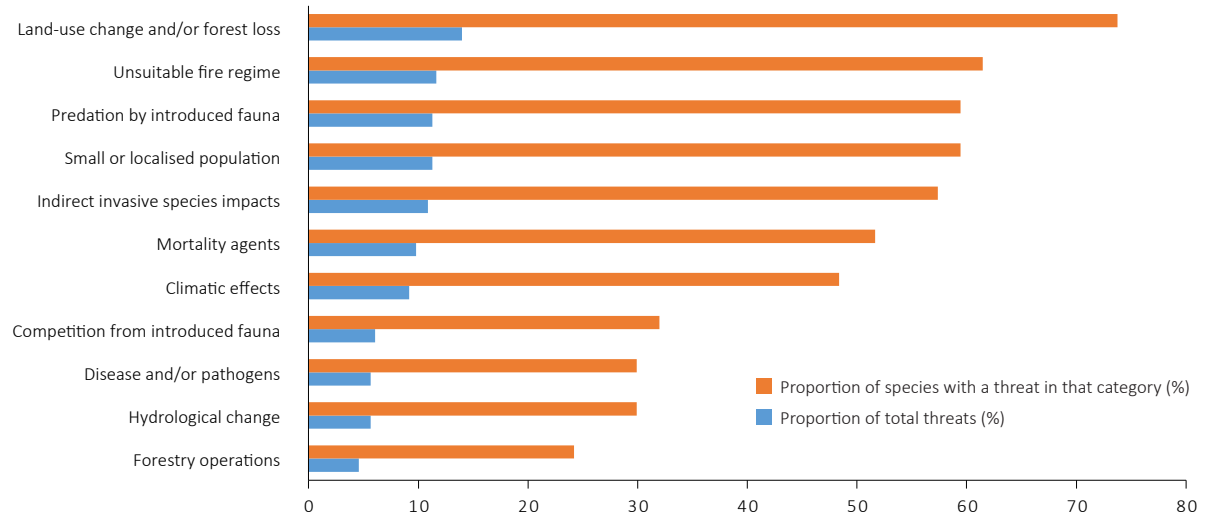
Forestry operations were the least prevalent of the specified threat categories for listed forest-dwelling fauna and flora.

For all species listed for the first time between August 2016 and December 2021, forestry operations were not specified as a primary threat.

The six most common specified threat categories for listed threatened forest-dwelling fauna and flora species are land-use change and/or forest-loss, unsuitable fire regimes, predation and competition by introduced fauna and flora, small or localised population, and mortality agents.

- Threats in each of these six threat categories were identified for 52% or more of threatened forest-dwelling fauna and 50% or more of threatened forest-dwelling flora.
- Together, threats in these six categories comprise 69% of total threats to threatened forest-dwelling fauna, and 78% of total threats to threatened forest-dwelling flora.
- Forestry operations were the least prevalent of the eleven specified threat categories for fauna and flora, comprising 5% of total threats to threatened forest-dwelling fauna and 2% of total threats to threatened forest-dwelling flora. Forestry operations were specified as a primary threat for 22 threatened fauna species and 54 threatened flora species, which together comprise 6% of all threatened forest-dwelling species.

Threat ratings for extant threatened forest-dwelling vertebrate fauna as at 2021



Extant, not extinct. Data are for forest-dwelling vertebrate fauna listed as threatened under the EPBC Act as at 31 December 2021. Threats in up to six separate categories were allotted to each species, based on available conservation documentation.

Source: Australian Government Department of Climate Change, Energy, the Environment and Water.

Specification of a threat category for fauna and flora does not consider the extent to which the threat can be mitigated by management actions.

Over time, there has been a shift in the most common threat categories for listed threatened forest-dwelling fauna and flora.

- Of threatened forest-dwelling fauna initially listed between August 2016 and December 2021, threats due to climatic effects were specified for 84%, compared to 43% of threatened forest-dwelling fauna listed prior to 2016.
- Threats due to climatic effects were specified for 47% of threatened forest-dwelling flora initially listed between August 2016 and December 2021, compared to 13% of threatened forest-dwelling flora initially listed prior to 2016.

Genetic-related threats were identified for 46% of threatened forest-dwelling vertebrate fauna and 72% of threatened forest-dwelling vascular flora listed as at December 2021. This includes threats due to loss of genetic diversity associated with small, isolated, fragmented populations and/or fecundity issues (reduced capacity to reproduce).

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Australian Government's principal environmental legislation. Among other things, it is designed to protect Australia's native species and ecological communities. Regional Forest Agreements (RFAs) are alternative (substitute) mechanisms for providing for protection of environmental values and matters of national environmental significance, including listed threatened species and ecological communities, in RFA regions. The agreements recognise that the states with RFAs provide for the protection of listed threatened species and communities in RFA regions through their forest management systems.

Pencil pine (*Athrotaxis cupressoides*) and myrtle beech (*Nothofagus cunninghamii*) forest, Tasmania. Photo: Claire Howell

Forest genetic resources

The Food and Agriculture Organization of the United Nations (FAO) lists 129 tree species and hybrids as forest genetic resources for Australia. The list includes both native and introduced tree species of commercial value, such as for wood production, as well as valuable tree species of conservation concern.

The 115 native tree species and hybrids on the FAO list have populations conserved in situ in formal and informal reserves, and in protected areas across Australia.

Australia's native and plantation forest genetic resources play an important role in maintaining and improving plantation forest productivity by conserving the original genetic variation in species, and through providing source material from which desirable traits can be observed and selected.

A substantial proportion of the genetic base of Australian native forest trees used in commercial plantations is conserved in forest in reserves. In addition, much of the genetic base has also been brought into seed collections, tree improvement and breeding programs, and seed orchards (plantations specifically planted and managed for seed production).

- Active tree-breeding and improvement programs exist for more than 30 native wood-producing and oil-producing tree species and varieties, with additional species held in seed orchards.
- Other ex situ conservation mechanisms for forest genetic resources include botanic gardens, seed banks, and conservation plantings, and are often used for species for which genetic diversity is threatened in native forests.
- Australia's seed banks hold seed for 127 of the 129 native and non-native species and hybrids listed by the FAO as forest genetic resources for Australia.

For further information on this theme
See Indicator 1.1c, Indicators 1.2a–b and Indicators 1.3a–b of *Australia's State of the Forests Report*, available at agriculture.gov.au/abares/forestsaustralia/sofr.

Toolangi State Forest, Victoria. Photo: Steve Read

Forest condition and function

Forest health

The range of native and established introduced vertebrate pests, insect pests, pathogens and weeds active during the period 2017–21 is comparable with previous reporting periods, but the impact of some has increased.

The impacts of climate change continue, particularly as a result of the combination of higher temperatures and low rainfall in the period 2017–21.

Five introduced vertebrate pests that damage forests are widespread in one or more states and territories: rabbit, feral pig, deer, feral goat and feral horse.

- After the Black Summer fires in 2019–20, there was a marked increase in control operations against feral animals in New South Wales and Victoria to protect native forest regeneration.
- Under specific situations, native vertebrate herbivores can also impact plantations. This includes browsing of seedlings and damage to young trees by wallabies, pademelons and possums, as well as bark stripping and chewing by wallabies and possums.

The scale and impact of plantation insect pests in the reporting period 2017–21 was mostly unchanged from the previous reporting period. However, in instances where change in scale and impact did occur, the change in both metrics was more often an increase than a decrease.

- The most damaging insect species in eucalypt plantations are typically local native species. In the period 2017–21 control operations against defoliating insects in eucalypt plantations were undertaken only in Tasmania and Western Australia. The area proportion of pine plantations damaged from the three main groups of introduced insect pests (*Essigella*, *Ips* and *Sirex*) was generally low.
- Attack by a native longicorn beetle species (*Phoracantha mastersi*) was associated with dying snow gum (*Eucalyptus pauciflora* subsp. *niphophila*) trees in several alpine national parks, with drought conditions coupled with warming temperatures implicated in the event.

The scale and impact of many pathogens in the period 2017–21 was mostly unchanged from the previous reporting period. However, in instances where change in scale and impact did occur, the change was more often an increase in both metrics than a decrease.

- *Phytophthora* species continue to damage native forests; *P. cinnamomi* in southern Australia and *P. multivora* in Queensland.
- Myrtle rust (*Austropuccinia psidii*) continues to cause severe damage to subtropical wet sclerophyll and rainforest communities in New South Wales and Queensland.
- The dry conditions experienced across Australia between 2017 and 2020 were not conducive to the needle-infecting pathogen *Dothistroma septosporum* in *Pinus radiata* plantations. However, these conditions increased the area of *P. radiata* plantations in Victoria and New South Wales with top-death (tip blight) caused by the fungus *Diplodia pinea*.

Over 3,500 introduced plant species are known in Australia. When invasive, these are known as weeds.

- Of the 24 weeds most commonly reported in forests, the Northern Territory has the lowest number present, while New South Wales has the highest.
- The most widespread weed is prickly pear (*Opuntia* spp.), the only weed of the 24 weeds that occurs in forests in all states and territories. Brambles (*Rubus* spp.) and Patterson's curse (*Echium plantagineum*) occur in forests in all states and territories except the Northern Territory.

The drought conditions experienced broadly across Australia from 2017 to 2020 caused a reduction in foliage density. The reporting period 2017–21 was also the hottest five-year period in the past 100 years. The combination of heat and low rainfall impacted forests, including through:

- tree deaths in north-eastern Tasmania in late 2017, large portions of the Murray–Darling Basin region of New South Wales in late 2019, and north-western Northern Territory in 2019–20
- mass deaths of flying foxes in northern Queensland and coastal south-east Australia
- virtual elimination of mistletoe – an important food source for fauna – from eucalypt species in the Cumberland Plains Woodland community in the Sydney Basin
- below-average carbon uptake by forests, as measured by carbon dioxide fluxes at several Terrestrial Ecosystem Research Network monitoring sites.

Climate change has also had a long-term impact through increased tree mortality in northern Queensland tropical rainforests, thus reducing habitat, ecosystem services and the amount of carbon stored in the forests.

Forest fire

The total area of forest in Australia burnt during the period 2016–17 to 2020–21 was 46.9 million hectares (35% of Australia's total forest area). Of this area, 35.6 million hectares (76%) was in the Northern Territory and Queensland, compared to a combined 11.4 million hectares (24%) in all other states and territories.

The total area of fire in forest includes both planned fire and unplanned fire (bushfire).

The annual area of fire in Australia's forests in the five-year period 2016–17 to 2020–21 varied from 21.1 million hectares in the 2019–20 fire season to 10.5 million hectares in 2020–21.

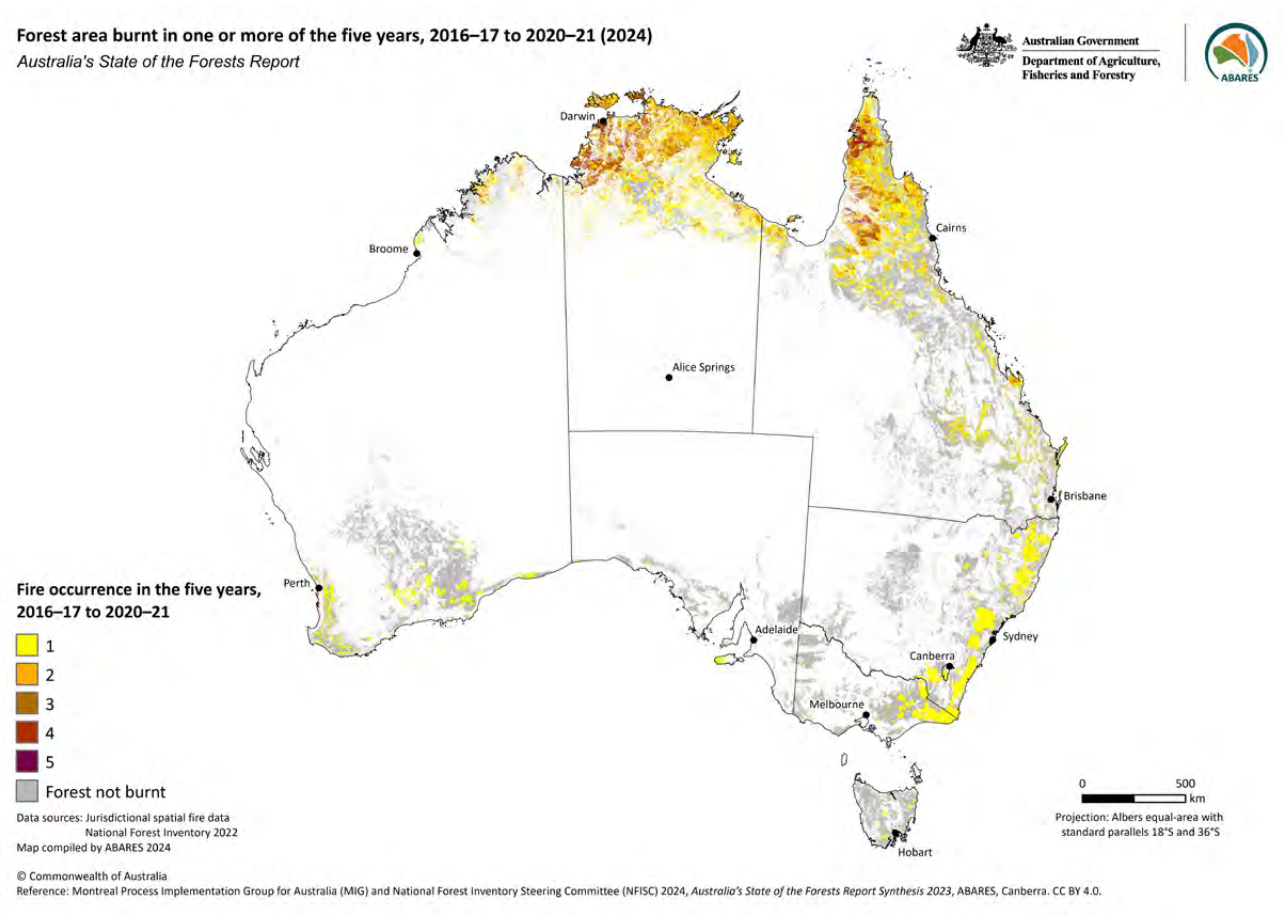
- The Black Summer bushfires in 2019–20 burnt significant areas of forest (8.5 million hectares) along the eastern seaboard in the Australian Capital Territory, New South Wales, Queensland and Victoria, and in South Australia and south west Western Australia.

The total area of forest burnt one or more times during the period 2016–17 to 2020–21 was 46.9 million hectares (35% of Australia's total forest area). The balance of Australia's forest area (65%) did not experience fire in this period.

- South Australia (4% of its forest area) and Tasmania (6%) had the lowest proportions of forest area burnt one or more times during this period.
- The Northern Territory (75%) had the highest proportion of forest area burnt one or more times during this period. Moreover, 44% of the forest area of the Northern Territory burnt two or more times during this five-year period.

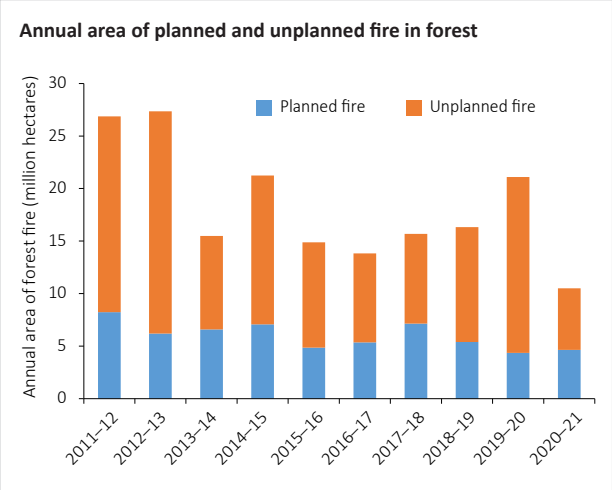
The cumulative area of fire in forest across the five-year period (the sum of the forest fire areas for each of the five years across 2016–17 to 2020–21) was 77.4 million hectares. This highlights the extensive areas that were burnt in more than one of the five years comprising this period.

- The largest cumulative areas of fire in forests were in Queensland and the Northern Territory, which together accounted for 84% of the cumulative area of fire in forest during this period.
- The high fire frequency in northern Australia is driven by vegetation and climatic characteristics where vegetation growth through the wet season is followed by rapid drying in the dry season, with fires often ignited in the subsequent dry season by lightning associated with storm events.



Planned fire is used as a forest management tool in fire-adapted forest types to maintain forest health and ecological processes, to reduce fuel loads and increase the ability to manage bushfires, to protect adjacent vegetation communities that are sensitive to fire, and to promote forest regeneration after harvest.

- Of the cumulative area of fire in Australia's forests in the period 2016–17 to 2020–21, 65% was unplanned fire and 35% was planned fire, as identified by state and territory fire management agencies.
- The fire season with the highest area and proportion that was unplanned fire was 2019–20, driven in part by the large forest areas burnt in the Black Summer bushfires in southern and eastern Australia.



Source: State and territory spatial fire data; ABARES *Forests of Australia (2023)*.

- The area proportion of planned fire in the Northern Territory was larger during the more recent period 2016–17 to 2020–21 than the period 2011–12 to 2015–16.

A cumulative total of 228 thousand hectares of commercial plantation area was burnt during the period 2016–17 to 2020–21, which represents 13% of Australia's commercial plantation area.

- This area burnt comprises unplanned bushfires, post-harvest burns, and low intensity ground-burns to reduce fuel loads.
- Of this cumulative area burnt, 61% (139 thousand hectares) was burnt during 2019–20. During that year, New South Wales (88 thousand hectares), South Australia (18 thousand hectares) and Victoria (10 thousand hectares) had the largest areas of commercial plantation affected by fire.

The National Bushfire Management Policy Statement for Forests and Rangelands outlines Australian, state and territory government objectives and policies for the management of landscape-level fire in Australia's forests and rangelands. The statement was developed by the Forest Fire Management Group – a national body within the Australian Government ministerial council structure – and a set of Objectives and Key Performance Indicators for this policy statement have been developed.

Recovery by lignotubers and epicormic shoots four months after bushfire, northern New South Wales. Photo: Cressida Lehmann

Forest carbon

The total stock of carbon in Australia's forests was 19,417 million tonnes in 2021, a 0.05% increase since 2016. This net change combines losses from decay, fire and other disturbances with gains from forest growth.

The total stock of carbon in harvested wood products was 167 million tonnes in 2021, a 5% increase since 2016, and rising progressively over time.

The forest carbon stock includes carbon in living biomass above and below ground, as well as carbon in dead wood, litter and soil. On average, more than half (53%) of Australia's forest carbon is below-ground, in roots and organic matter in soils.

- Of this total stock of carbon, 99% is in native forests and 1% is in commercial plantations.

The carbon stock in harvested wood products includes 89 million tonnes of carbon in wood products in use, and 79 million tonnes of carbon in wood products in landfill.

Over the period 2001–2021, total forest carbon has varied by less than 0.5% from its long-term average. Forest carbon decreased slowly and progressively from 2001 to 2008 then progressively increased, tracking a similar trend in forest area. A one-year reduction in forest carbon in 2020 reflects the extensive bushfires in southern and eastern Australia that year, but carbon stock recovery had commenced by 2021. Carbon stock can increase more rapidly over time in plantations than in native forests, reflecting the younger age and more rapid carbon assimilation in plantations.

The carbon stock values reported here are drawn from the datasets underpinning National Inventory Report 2021. They are lower in all years of the time series than the values reported in Australia's State of the Forests Report 2018 that were drawn from the datasets underpinning earlier National Inventory Reports, but show similar trends over time. The lower figures reported here for all years in the time series do not represent actual loss of forest carbon, rather recalculations and improvements in the modelling, mostly for soil carbon.

Australia's emissions of greenhouse gases resulting from human activities are reported through the *National Inventory Report* series, using the unit of 'carbon dioxide-equivalent', abbreviated as CO_2-e. Reporting for the land use, land use change and forestry (LULUCF) sector in the National Inventory Reports covers emissions and sequestration associated with management practices that affect carbon stores in vegetation and soils, including forests and forestry.

Emissions from the LULUCF sector have been decreasing since 2006–07, and since 2015–16 the sector has been a net sink, absorbing more carbon dioxide than is emitted. This trend has been driven by:

- a decline in emissions from clearing of forests for agriculture, reported in the 'Forest conversions' component of LULUCF
- the sequestration of carbon in regrowing forests exceeding emissions from harvesting events, both reported in the 'Forest remaining Forest' component of LULUCF.

Harvested native forests provided a net sink of 35.7 million tonnes carbon dioxide-equivalent in 2021. This figure is equivalent to 8% of Australia's total greenhouse gas emissions in 2021. The net sink in harvested wood products was 4.9 million tonnes carbon dioxide-equivalent in 2021.

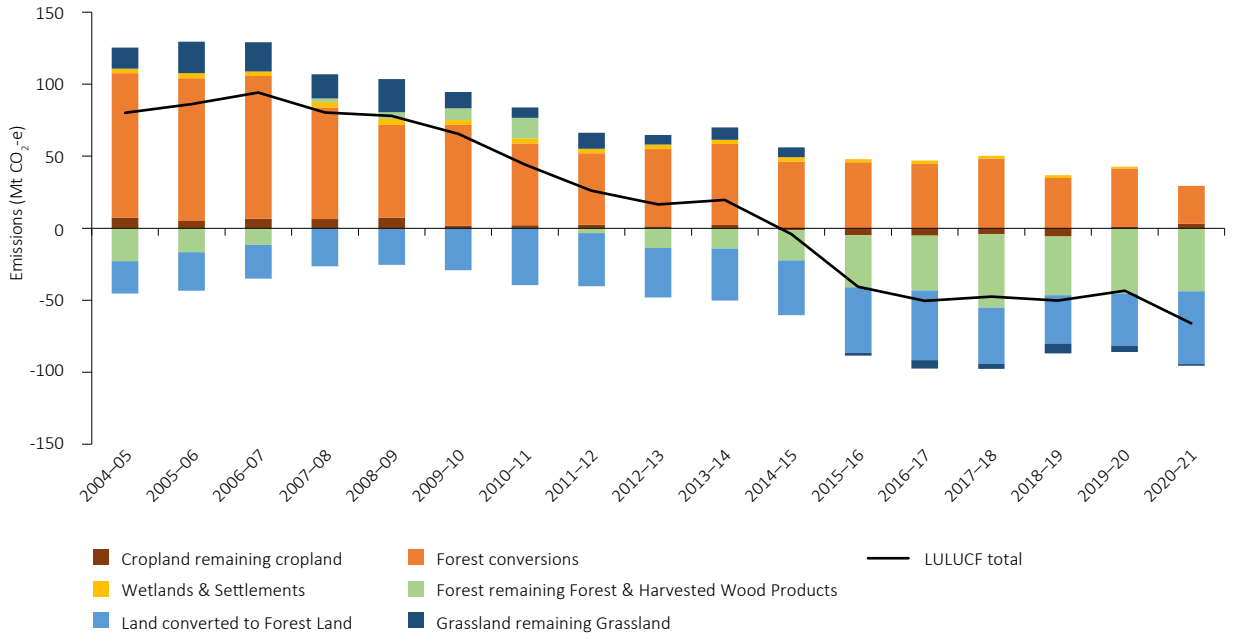
- The rate of sequestration of carbon in forest regrowing from previous harvest will reduce over time as existing regrowth forests mature, and as fewer regrowth forests are created by harvesting.

Carbon stored in forests and harvested wood products, 2001 to 2021

	Carbon (million tonnes)				
Forest category	**2000–01**	**2005–06**	**2010–11**	**2015–16**	**2020–21**
Native forests	19,339	19,157	19,094	19,178	19,205
Plantations	118	161	190	208	186
Other forests	9	12	16	22	26
Forests total	**19,465**	**19,330**	**19,299**	**19,408**	**19,417**
Wood products in use	70	76	80	84	89
Wood products in landfill	54	65	71	75	79
Total wood products	**123**	**140**	**150**	**159**	**167**
Total forests and wood products	**19,589**	**19,470**	**19,450**	**19,567**	**19,585**

Source: Australian Government Department of Climate Change, Energy, the Environment and Water.

Annual emissions of greenhouse gases from the Land use, land use change and forestry sector



LULUCF, Land use, land use change and forestry sector; Mt CO_2-e, million tonnes of carbon dioxide equivalent. The six categories comprise the annual land transitions within the LULUCF section. Forest conversions is the sum of forest converted to other land types (mostly grassland).

Source: Adapted from Figure 6.1.3, *National Inventory Report 2021* (DCCEEW 2023).

Forest soil and water

A total of 37.0 million hectares of forest is managed for protection of soil and water values. This is 28% of Australia's forests, most of which is native forest.

- This area includes formal nature conservation reserves, informal reserves in multiple-use public native forests, forests protected by prescription (such as steep slopes, erodible soil types and riparian (streamside) zones where harvesting and road construction are not permitted), and forested catchments managed specifically for drinking water supply.
- There has been a slight increase in the area and proportion of forest managed for protection of soil and water values since the last report in 2018.

Beech-forest tree-roots, Tasmania. Photo: Claire Howell

Area of forest managed primarily for protection of soil and water

	Area of forest managed for protective functions ('000 hectares)									Total forest area ('000 hectares)	Proportion of total forest (%)
Year	ACT	NSW	NT	Qld	SA	Tas.	Vic.	WA	Total		
2021	121	6,114	6,743	8,891	2,688	2,098	4,851	5,510	**37,016**	133,562	28

Combination of data from the comprehensive, adequate and representative (CAR) reserve system and the National Reserve System (NRS).

Source: ABARES *Forests of Australia (2023)*; National Forest Inventory; Collaborative Australian Protected Areas Database 2020, Australian Government Department of Climate Change, Energy, the Environment and Water; state and territory data.

Forest growth stage and old-growth forest

Australia's native forests comprise stands of regeneration, regrowth, mature and senescent growth stages, as well as mixed (uneven) aged forest.

The growth stage of a native forest is one determinant of its biodiversity and ecological values. Native forest growth stage data were collected over the period 1995–2000 as part of the Comprehensive Regional Assessments for the eleven Regional Forest Agreement regions, however, a complete national dataset is not available. The latest published information on forest growth stage is available in *Australia's State of the Forests Report 2018* at Indicator 1.1b and in *State of the forests Tasmania 2022*.

Old-growth forest is not a specific growth stage, but is defined as 'ecologically mature forest where the effects of past disturbances are now negligible'. Old-growth forests typically contain large, old trees and are also characterised by habitat features such as stem and branch hollows, dead standing trees and woody debris on the forest floor. Mapping of old-growth forests occurred as part of the Regional Forest Agreement process and has been updated intermittently. Information current to 2018 identified 4.5 million hectares of old-growth forest occurs in the eleven RFA regions.

Forest fragmentation

Australia's native forests are largely continuous, not fragmented.

Forest fragmentation describes the degree to which forested areas are separated by non-forested areas or adjoin non-forested areas. Fragmentation occurs naturally in native forests with the presence of rock outcrops, wetlands, lakes and non-forest vegetation. However, increasing forest fragmentation of native forest in previously continuous forest is a process that significantly impacts many forest-dwelling species and is an identified threat to forest ecological communities.

Forest fragmentation continues to be primarily caused by clearing of forest associated with land-use change for agriculture, mining and urban development, and also for roads and other utilities.

The most recent national scale reporting on forest fragmentation is available in *Australia's State of the Forests Report 2018*. At the national scale the majority of Australia's native forest are continuous, typically found in areas of higher rainfall and areas that have experienced lower rates of clearing.

For further information on this theme
See Indicators 3.1a–b, Indicator 5.1a and Indicator 4.1a of *Australia's State of the Forests Report*, available at agriculture.gov.au/abares/forestsaustralia/sofr.

Subsequent updates will cover forest growth stage (Indicator 1.1b), forest fragmentation (Indicator 1.1d), management of risks to forest soil and water (Indicators 4.1b–e), and ecosystem services from forests (Indicator 6.1c).

Mangroves near Cairns, north Queensland. Photo: Rohan Jacobsen

Forests managed for wood production

Commercial plantation

Australia has 1.82 million hectares of commercial plantations that are managed for pulplog and sawlog production.

The commercial plantation estate comprises:

- 1.06 million hectares of softwood plantations, most of which is radiata pine (*Pinus radiata*)
- 0.74 million hectares of hardwood plantations, most of which are Tasmanian blue gum (*Eucalyptus globulus*) on the mainland and shining gum (*E. nitens*) in Tasmania
- 0.02 million hectares of unknown or mixed species plantations.

The area of commercial plantation reported here differs from the most recent area published by the National Plantation Inventory which is compiled from non-spatial data sources that cannot be integrated with the national spatial (mapped) total forest area dataset that is required to identify the area of all forests in Australia.

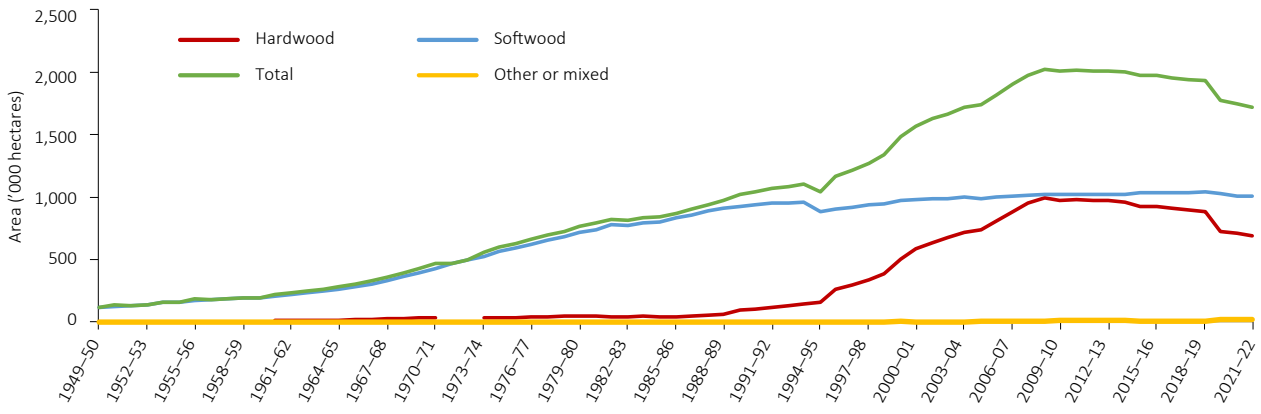
The area of Australia's commercial plantations peaked in 2010–11. Since then, the area of softwood plantations has remained stable, but the area of hardwood plantations has decreased by 30% predominantly due to land use changes to agriculture.

Only small areas of new softwood or hardwood plantations have been established since 2010–11. This low level of new commercial plantation establishment has been predominantly driven by increasing competition for land between commercial plantations and agricultural land uses.

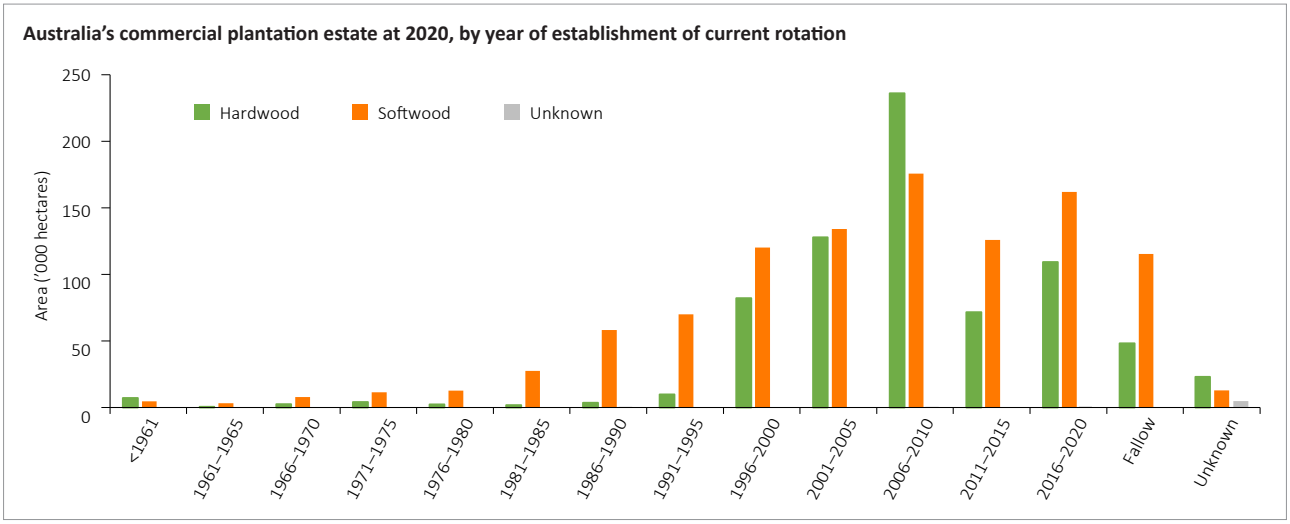
Most (77%) of the current rotation of the existing hardwood plantation estate was planted since 2000, including 236 thousand hectares planted in 2006–10. The majority (also 77%) of the current rotation of Australia's softwood plantation estate was planted since the 1990s, with between 120 thousand and 175 thousand hectares replanted in each five-year period since 1996.

Softwood plantation, Bright, Victoria. Photo: Greg Brave - Shutterstock

Area of commercial plantations, 1949–50 to 2021–22



Source: *Australian plantation statistics 2023 update* (ABARES 2023).

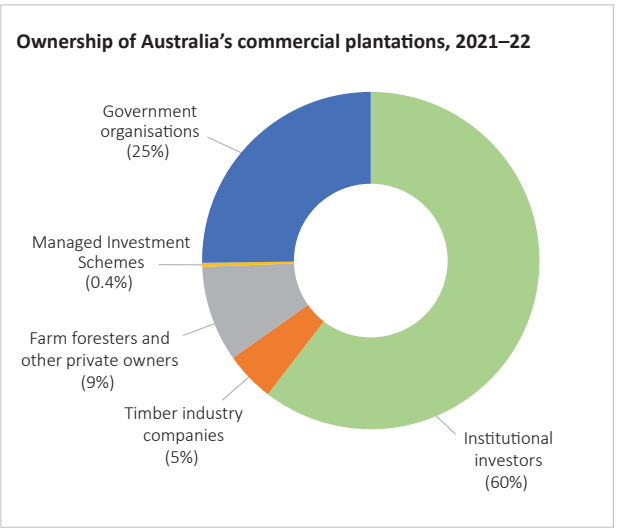


Areas fallow in 2020 are between rotations.
Source: *Australian plantation statistics 2023 update* (ABARES 2023).

Commercial softwood plantations are mainly radiata pine (*Pinus radiata*), with a small proportion of southern pines (hybrids of *P. elliottii* and *P. caribaea*), hoop pine (*Araucaria cunninghamii*) and maritime pine (*P. pinaster*). Radiata pine plantations are grown across south-eastern and south-western Australia where conditions are more favourable, while southern pines are mostly planted in south-east Queensland. Hoop pine is planted in Queensland, and maritime pine is planted in drier parts of Western Australia. The majority of softwood species are managed for sawlog production on a 25–35 year rotation (from year of planting to final harvest), while hoop pines are managed on a longer 45-year rotation.

The commercial hardwood plantation estate is dominated by Tasmanian blue gum (*Eucalyptus globulus*) and shining gum (*E. nitens*), both of which are predominantly managed for pulplog production on a 12–14 year rotation. Tasmanian blue gum plantations are located across southern Australia, while most shining gum plantations are in Tasmania. A small proportion of the hardwood plantation estate is managed for sawlogs on 25–50 year rotations, mainly blackbutt (*E. pilularis*) and flooded gum (*E. grandis*) in northern New South Wales, and Tasmanian blue gum and shining gum in Tasmania.

An increasing proportion of commercial plantation is owned by institutional investors (60%), such as pension funds, with only one quarter of the area publicly owned. The proportion that remains as managed investment schemes is very small.



Ownership data refer to ownership of trees. Joint venture arrangements between government agencies and private owners are included under 'Government organisations' where government is the manager of the plantation resource. Institutional investors include pension funds.
Totals may not tally due to rounding.
Source: *Australian plantation statistics 2023 update* (ABARES 2023).

Softwood plantation, Victoria. Photo: Greg Brave - Shutterstock

Native forest managed for wood production

The total area of Australia's native forest that is legally available and suitable for commercial wood production, and the net harvestable area of multiple-use public native forests, have both decreased since 2015–16 continuing the steady decrease observed since 1995–96.

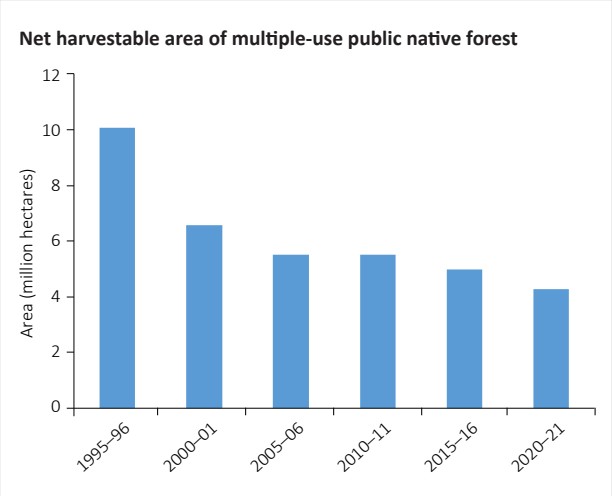
The area of native forest legally available and suitable for commercial wood production on public and private land was calculated as 27.4 million hectares in 2020–21. This is a decrease from 28.1 million hectares in 2015–16.

This area of 27.4 million hectares includes 21.4 million hectares on leasehold and private tenure. Much of this area has low suitability for commercial wood production and is therefore used predominantly for grazing or other purposes.

On multiple-use public native forest there were 4.3 million hectares of 'net harvestable area' after accounting for local harvesting restrictions and exclusions, accessibility constraints and unmerchantable forest stands. This is a decrease from 5.0 million hectares reported in 2015–16.

Since the first national-level reporting in *Australia's State of the Forests Report 1998* there has been a steady decrease in the native forest area available for harvesting. This has been primarily due to the transfer of multiple-use public native forest to nature conservation reserves, and increases in areas where values are protected by management prescriptions (such as riparian exclusion zones, flora and fauna exclusion zones, slope limits and threatened ecological communities).

The ending of commercial wood harvesting in multiple-use public native forests in Victoria and Western Australia from 1 January 2024 will have reduced the native forest area available and suitable for commercial wood production to 25.2 million hectares, and reduced the net harvestable area of multiple-use public native forest to 2.8 million hectares using 2021 data.



Area values do not include harvestable area on leasehold or private lands accessible to public forest agencies for wood harvesting.

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

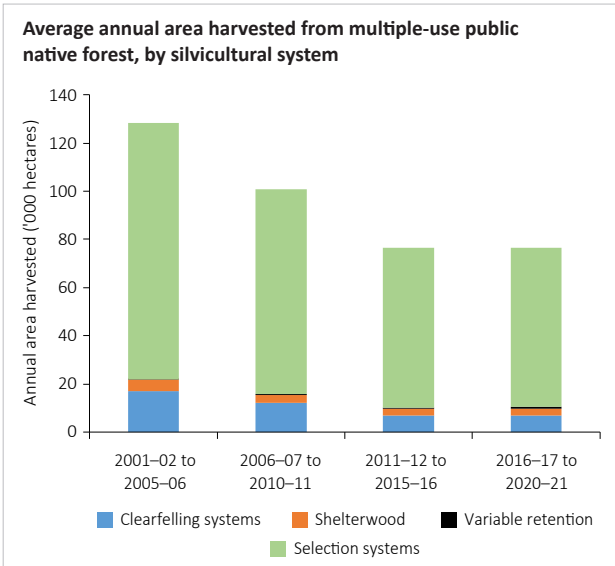
The average annual area of multiple-use public native forests from which wood was harvested remained steady at 77 thousand hectares over the period 2016–17 to 2020–21.

Within this area, most (86%) was harvested using selection silviculture systems. The proportion harvested by clearfelling systems was 9%.

The average annual area of multiple-use public native forests harvested for the reporting period 2016–17 to 2020–21 was 77 thousand hectares, unchanged from the annual average of 77 thousand hectares harvested in the period 2011–12 to 2015–16.

There are a range of forest management (silvicultural) systems used in native forests managed for wood production, depending on the forest ecosystem, species mix and previous forest management practices. Of the area of multiple-use public native forest harvested over the period 2016–17 to 2020–21, 86% was harvested using selection systems (selection, native cypress pine silviculture, and commercial thinning), 9% by clearfelling systems (clearfelling, fire-salvage clearfelling, and intensive silviculture with retention), 3% by shelterwood systems, and 1% by variable retention systems.

Over the period 2016–17 to 2020–21, the average annual proportion of harvested multiple-use public native forest effectively regenerated, as assessed against tree stocking standards, was 81% in New South Wales, 97% in Tasmania, and 100% in Queensland. For Victoria, areas treated for regeneration were formally assessed as meeting regeneration standards. For Western Australia, the level of regeneration was assessed as adequate, with more detailed reporting in the *End-of-term review of performance of the Forest Management Plan 2014–2023*.



The area of forest managed by variable retention system is difficult to distinguish at this scale.

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

Sustainable harvest of publicly managed native forests

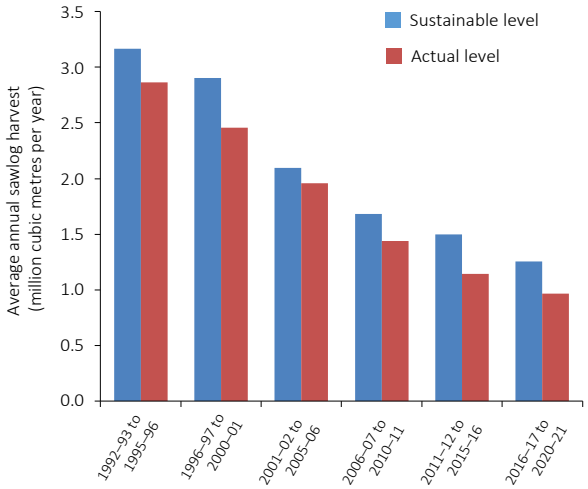
The volume of sawlogs harvested from public native forests has remained within calculated sustainable levels and allowable limits since 1995–96.

The sustainable annual yield of high-quality sawlogs from native forests is the maximum volume of wood that can be harvested each year while ensuring maintenance of the functioning of the native forest ecosystem as a whole and the supply of wood products in perpetuity.

An average annual volume of 0.97 million cubic metres of high-quality sawlogs was harvested from publicly managed native forests nationally during the period 2016–17 to 2020–21. This was 23% below the calculated national sustainable yield of high-quality sawlogs from these forests for the same period.

The average annual sustainable yield of high-quality sawlogs from multiple-use public native forests declined nationally by 16% since the 2011–12 to 2015–16 period, and by 25% since the 2006–07 to 2010–11 period. This was due to a range of factors including the transfer of areas of multiple-use public native forests to nature conservation reserve, increased restrictions on wood harvesting in codes of forest practice and other regulatory instruments, and the impacts of intense broad-scale bushfires.

National average annual sustainable yield and actual harvest of sawlogs from publicly managed native forests



Includes harvest from private and leasehold native forests in Queensland where timber rights are owned by the Crown.

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

For further information on this theme
See Indicators 2.1a–c and 2.1e of *Australia's State of the Forests Report*, available at agriculture.gov.au/abares/forestsaustralia/sofr.

Mountain Ash at Lavers Hill, Victoria. Photo: Steve Read

Wood and non-wood forest products

Wood and non-wood products from Australia's forests make an important contribution to the economy and society. An increasing proportion of Australia's wood for wood products is sourced from commercial plantations.

Volumes and values of wood harvested

The total volume of logs harvested in Australia in 2022–23 (25.0 million cubic metres) fell by 3.9% compared to 2021–22 and fell by 17% compared to 2015–16 (30.1 million cubic metres). Logs harvested include sawlogs, pulplogs and other logs, from softwood plantations, hardwood plantations and native forests.

Despite the decrease in the total volume harvested, the total value of logs harvested in 2022–23 was stable at $2.4 billion (adjusted for inflation) compared to 2021–22 due to significant increases in log prices.

Softwood plantation logs

The largest production category by value are softwood logs from commercial plantations, with a total harvest value of $1.3 billion in 2022–23. By volume:

- 8.0 million cubic metres (57%) were sawlogs, primarily processed domestically to produce sawn wood for housing construction
- 5.6 million cubic metres (40%) were pulplogs, used domestically to produce paper and wood-based panels, or exported overseas as woodchips or logs
- 0.4 million cubic metres (3%) were other softwood logs.

Softwood plantation harvest volumes are primarily driven by the number of new domestic dwelling commencements each year and changes in international trade conditions.

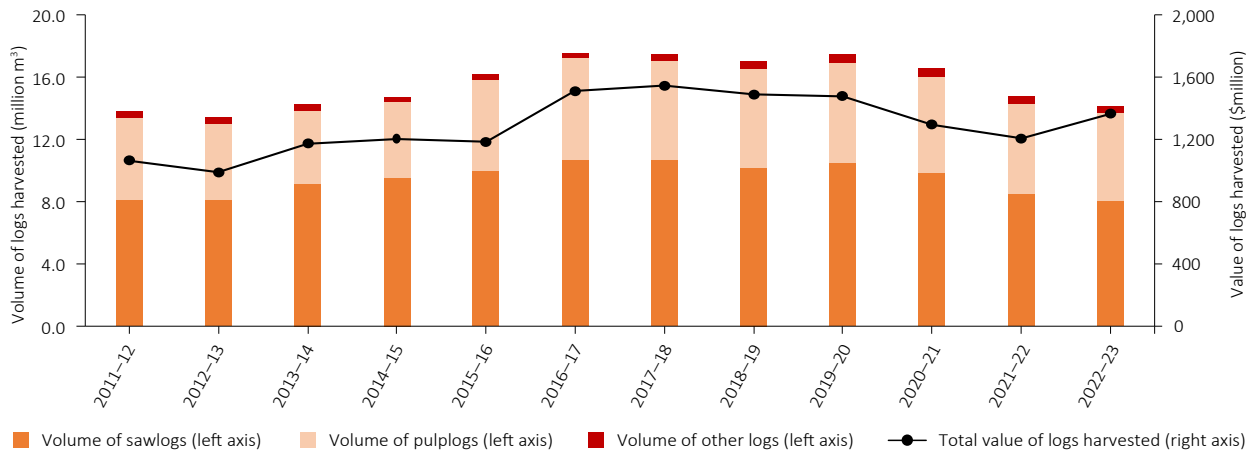
Australia's log harvest by volume and value, 2022–23

	Volume of logs harvested		Value of logs harvested	
Harvested log type	**million m³**	**% change from 2021–22**	**million $**	**% change from 2021–22**
Native forest (incl. native cypress pine)	2.5	-29.2	296	-20.4 (-25.5)
Commercial plantation hardwood	8.5	10.3	800	12.9 (5.6)
Commercial plantation softwood	14.0	-5.4	1,348	11.8 (4.5)
Total	**25.0**	**-3.9**	**2,443**	**6.9 (-0.1)**

Values in brackets are in real terms (2022–23 dollars) to account for inflation. Values for native forest logs include hardwood native forest logs and native cypress pine softwood logs. Fuel logs are not included.

Source: *Australian forest and wood products statistics, Production to 2022–23* (ABARES 2024).

Volume and value of softwood plantation logs harvested, 2011–12 to 2022–23



Adjusted for inflation to 2022–23 dollars. Includes a small component ($17.4 million or 0.12 million cubic metres) of softwood native cypress pine logs harvested from native forests. 'Volume of sawlogs' includes veneer logs and logs for plywood.

Source: *Australian forest and wood products statistics, Production to 2022–23* (ABARES 2024).

Hardwood plantation logs

Hardwood plantation logs are the second largest production category for Australia's commercial forestry sector, with a total harvest value of $0.8 billion in 2022–23. By volume:

- 7.7 million cubic metres (92%) were pulplogs, primarily exported as woodchips to Asia for use in pulp and paper mills
- 0.69 million cubic metres (8%) were sawlogs.

The volume and value of Australia's hardwood plantation log harvest is largely driven by global demand for paper products, mill capacity in Asia, and Australia's trade competitiveness. Sawlog volume and value from hardwood plantations is limited by availability, as most existing hardwood plantations are not able to be managed to produce sawlogs of comparable quality to native forest sawlogs.

Hardwood plantations produced 78% of the volume of all hardwood logs produced in Australia in 2022–23.

Native forest logs

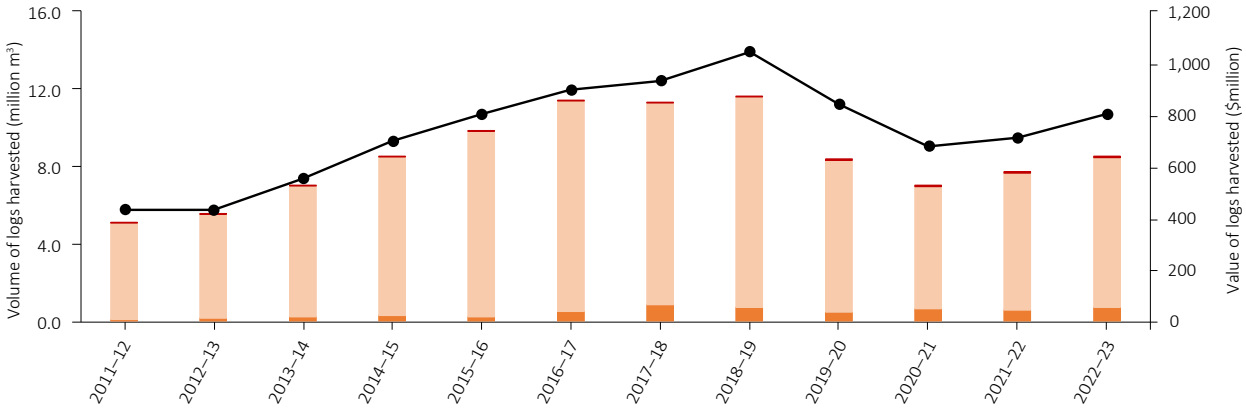
Native forests managed for wood production are managed predominantly for higher value sawlogs for the domestic market, with pulplogs as a by-product. Native forest logs are mostly hardwood eucalypt species, with a small proportion of softwood native cypress pine logs.

Of the logs harvested from native forests in 2022–23:

- the volume was 2.5 million cubic metres, a 29% decrease from 2021–22, with sawlog and pulplog harvests reducing by 24% and 37% respectively
- the total value was $0.3 billion, a 26% decrease from 2021–22.

The fall in the value and volume of production from Australia's native forests over the 12 months to 2022–23 is a continuation of the trend observed over the past two decades.

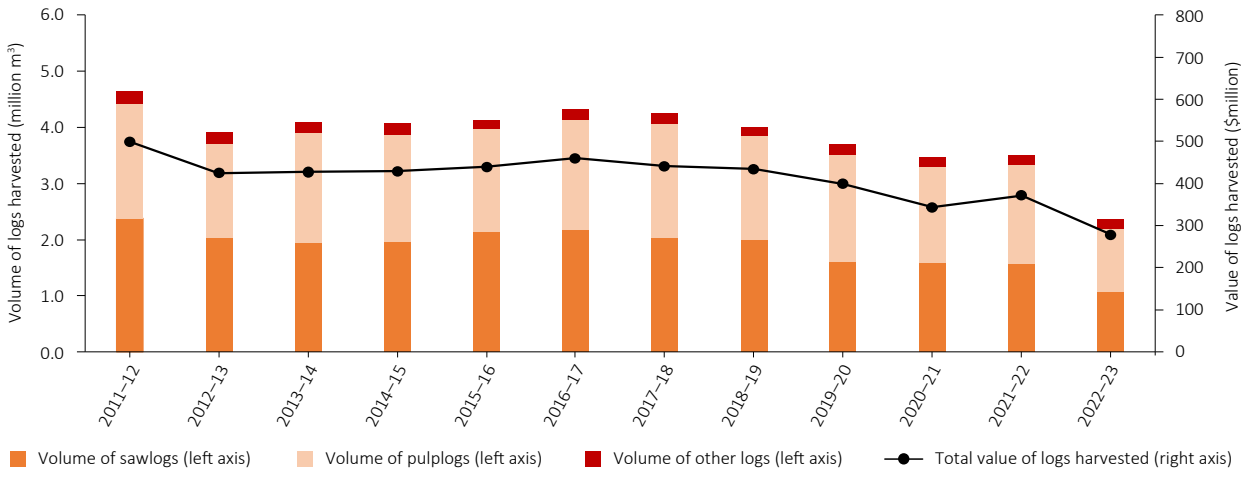
Volume and value of hardwood plantation logs harvested, 2011–12 to 2022–23



Adjusted for inflation to 2022–23 dollars. 'Volume of sawlogs' includes veneer logs and logs for plywood. 'Total volume of logs harvested' includes the category 'other', which comprises other plantation log products.

Source: *Australian forest and wood products statistics, Production to 2022–23* (ABARES 2024).

Volume and value of native forest logs harvested, 2011–12 to 2022–23



Adjusted for inflation to 2022–23 dollars.

Source: *Australian forest and wood products statistics, Production to 2022–23* (ABARES 2024).

Native forest sawlogs (both hardwood and cypress pine) are primarily processed domestically to produce durable and appearance-grade sawnwood products such as floorboards, decking, cladding, and furniture. Hardwood native forest pulplogs are generally processed locally and exported as woodchips to Asia. In those states in which native forest harvesting from public forests is permitted, harvest volumes and associated values are limited by the available sustainable yield of those forests. The availability of the private native forest resource varies significantly between jurisdictions.

The value added by the Australian forestry and forest products industries, referred to as 'industry value added', was $11.3 billion in 2022–23, which is 0.44% of Australia's gross domestic product (GDP).

- The 'Other wood product manufacturing' sub-sector drove most of the value added ($5.0 billion), reflecting the transformation of logs into high-value products such as wooden structural fittings and components, which include roof trusses, doors, wall and window frames, shop fronts and joinery (including kitchen cabinets) for buildings.

Trade, production and consumption

Australia exported $2.8 billion of forest and wood products in 2022–23, with major components being woodchips (46%) and paper and paperboard (30%).

Demand from Asian markets is the main determinant of Australian woodchip exports.

The value of forest and wood product imports into Australia totalled $6.9 billion, primarily paper and paperboard (36%) and miscellaneous forest products (22%, which primarily includes wood for construction uses).

Australian import markets for sawnwood are highly diversified, providing flexibility for the sector.

Australia produced 4.3 million cubic metres of sawnwood in 2022–23, of which 89% was softwood and 11% was hardwood. Almost all of this production was directed to the domestic market. Australia's apparent consumption of sawnwood in 2022–23 totalled 4.8 million cubic metres.

Australia produced 2.9 million tonnes of paper and paperboard in 2022–23, including packaging and industrial paper, printing and writing paper, household and sanitary paper, and newsprint. Australia's apparent consumption of paper and paperboard in 2022–23 totalled 3.1 million tonnes.

An average 5.7 million cubic metres of firewood and fuelwood was consumed annually in the period 2017–22 in Australia. Many small-to-medium businesses in the forestry sector are involved with firewood processing, sales and distribution. In the 10 years to 2021–22, residential firewood use declined by 15%, while industrial fuelwood use increased by 34%.

- In 2021–22, firewood and fuelwood use provided 86.6 petajoules of renewable energy, which was 17% of total renewable energy consumption. Firewood and fuelwood were the third highest renewable energy fuel type consumed, after wind energy and solar photovoltaic energy.

Forecast plantation log availability and native forest log supply

Australia's potential average annual plantation log availability is forecast to increase, while the native forest log supply is forecast to decrease.

Plantation logs

The potential average annual plantation log availability is forecast to increase from 24.9 million cubic metres in the 2020–24 period to 29.0 million cubic metres by the 2055–59 period.

Most of the sawn timber used for housing and general construction in Australia is sourced from plantation softwood sawlogs. The availability of plantation softwood sawlogs is forecast to increase from 10.5 million cubic metres per year in the 2020–24 period to 14.3 million cubic metres per year in the 2050–54 period. The peak is primarily associated with softwood plantations replanted after the 2019–20 bushfire season reaching maturity.

Harvested logs near Oberon, New South Wales. Photo: Alf Manciagli - Shutterstock

Forecast potential average annual plantation log availability, Australia, 2020–24 to 2060–64

	Volume ('000 cubic metres)								
Log type	**2020–24**	**2025–29**	**2030–34**	**2035–39**	**2040–44**	**2045–49**	**2050–54**	**2055–59**	**2060–64**
Hardwood									
Pulplog	8,996	9,877	9,943	9,434	8,591	9,057	8,695	9,292	8,913
Sawlog	663	990	1035	948	948	905	819	814	819
Subtotal	**9,659**	**10,867**	**10,978**	**10,382**	**9,539**	**9,962**	**9,514**	**10,106**	**9,732**
Softwood									
Pulplog	4,733	4,656	4,626	4,765	4,515	4,502	4,878	4,712	4,622
Sawlog	10,531	11,140	11,797	13,777	13,513	13,821	14,330	14,212	13,332
Subtotal	**15,264**	**15,796**	**16,423**	**18,542**	**18,028**	**18,323**	**19,208**	**18,924**	**17,954**
Total	**24,923**	**26,663**	**27,401**	**28,924**	**27,567**	**28,285**	**28,722**	**29,030**	**27,686**

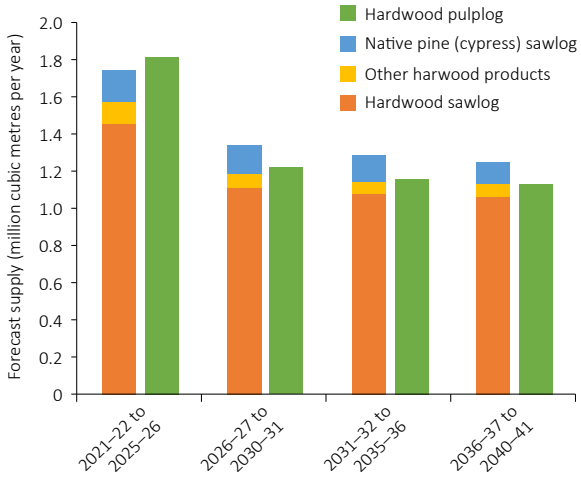
Sawlogs include all quality classes of plantation sawlogs.
Source: ABARES (2021).

Native forest logs

The forecast annual native forest hardwood sawlog supply is 1.5 million cubic metres from 2021–22 to 2025–26 and then dropping to 1.1 million cubic metres from 2026–27. Supply of pulplogs is forecast at 1.8 million cubic metres per year from 2021–22 to 2025–26 and then dropping to 1.2 million cubic metres per year in the following five-year period.

The forecast decrease of supply reflects the ending of commercial wood harvesting in multiple-use public native forests in some states, and the impact of the 2019–20 bushfires on growing stock.

Forecast annual log supply from native forest on public, leasehold and private land, 2021–22 to 2040–41



'Other hardwood products' includes poles, piles, girders and other logs. Firewood and industrial fuelwood are not included in the forecast projections.
'Hardwood sawlog' includes high-quality and low-quality sawlogs and veneer products.
Source: ABARES.

Non-wood forest products

Australia's forests provide for a wide range of high-value non-wood forest products including honey, native bush foods, essential oils and a variety of animal products.

Non-wood forest products are products of biological origin other than wood that are derived from forests. Many Australian non-wood forest products are commercialised and produced for both domestic and export markets.

Data and information on non-wood forest products are limited due to the dispersed and small size of the industries dependent on these products. Information on native and feral animal products (meat, hides), beekeeping products (honey, beeswax), essential oils (eucalyptus, tea-tree and other) and sandalwood products is available in *Australia's State of the Forests Report 2018*.

For further information on this theme
See Indicators 2.1c, 6.1a and 6.1d of *Australia's State of the Forests Report*, available at agriculture.gov.au/abares/forestsaustralia/sofr.

Subsequent updates will cover non-wood forest products (Indicators 2.1d and 6.1b) and recycling of wood products (Indicator 6.1e).

Employment and education

Employment, wages and safety

Total direct employment in the forest sector in 2021 was 51,120 persons, a 1.7% decrease from 2016.

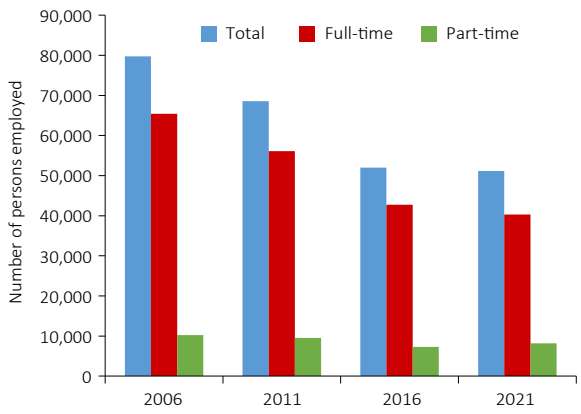
National data on forest sector employment are derived from the Australian Bureau of Statistics (ABS) *Census of Population and Housing 2021*.

- The sector includes four subsectors (Forestry and logging, Forestry support services, Wood product manufacturing, and Pulp, paper and converted paper product manufacturing) but does not capture employment in forest-based tourism, production of non-wood forest products, or management of forested national parks and reserves.

Over the period 2016 to 2021, full-time employment in the forest sector decreased by 6% and part-time employment increased by 12%.

- Total direct employment decreased in the Wood product manufacturing subsector, and in the Pulp, paper and converted paper product manufacturing subsector, but increased in the Forestry and logging subsector and in the Forestry support services subsector.

National employment in the forest sector, by employment status, 2006 to 2021



Total employment is higher than the sum of full-time and part-time employment, because total employment also includes a relatively small number of persons employed but away from work and for whom the number of hours worked is not provided.

Source: *Census of Population and Housing* (ABS 2021).

In 2021, there were 25 Local Government Areas (LGAs) rated as dependent on forest and wood products industries through having 2% or more of their working population employed in the sector and containing more than 20 workers employed in these industries.

- Levels of community adaptive capacity varied considerably across these 25 LGAs. Community adaptive capacity is represented by a combination of economic diversity of industries that provide employment within the community, and the social capital and human capital resources available in the community.
- Three of these LGAs (Oberon and Snowy Valleys in New South Wales, and Mount Gambier in South Australia) had 9% or more of their workforce employed in forest and wood products industries.
- Since 2016, the number of people employed in the forestry sector increased substantially in six regional LGAs in Tasmania, Victoria, the Northern Territory and Western Australia.
- Analysis of the impact on communities of recent policy decisions to end commercial wood harvesting on public land in Victoria and Western Australia from January 2024 is yet to be completed.

A number of state-based studies of forest sector employment have also been undertaken, some of which include estimates of indirect employment.

Between 2016–17 and 2020–21, total annual wages and salaries in the forest sector varied between a minimum of $5.2 billion in 2016–17 and a maximum of $5.5 billion in 2018–19 after adjusting for inflation.

- The average per-person wage for the forestry sector increased slightly over the period 2016–17 to 2020–21 when adjusted for inflation, as part of a steady trend.
- In 2021, the proportion of forest sector worker households with weekly incomes below the median household equivalised income ($959) was slightly higher (28%) than in total workforce households (24%).

Between 2015–16 and 2020–21, the number of serious injury claims in the forest sector:

- increased from 126 to 152 in the Forestry and logging subsector
- increased from 1,252 to 1,406 in the Wood product manufacturing subsector
- decreased from 205 to 181 in the Pulp, paper and converted paper product manufacturing subsector.

The incidence of serious injury claims per 1,000 employees in 2020–21 for the Forestry and logging and the Wood product manufacturing subsectors were higher than the all-industries average, while the incidence rates for the Pulp, paper and converted paper product manufacturing subsector were on par with the all-industries average.

Education

A range of options for training and education are available in Australia across areas relevant to sustainable forest management, including operational competency certificates, coursework certificates and diplomas, and undergraduate, graduate and postgraduate degrees.

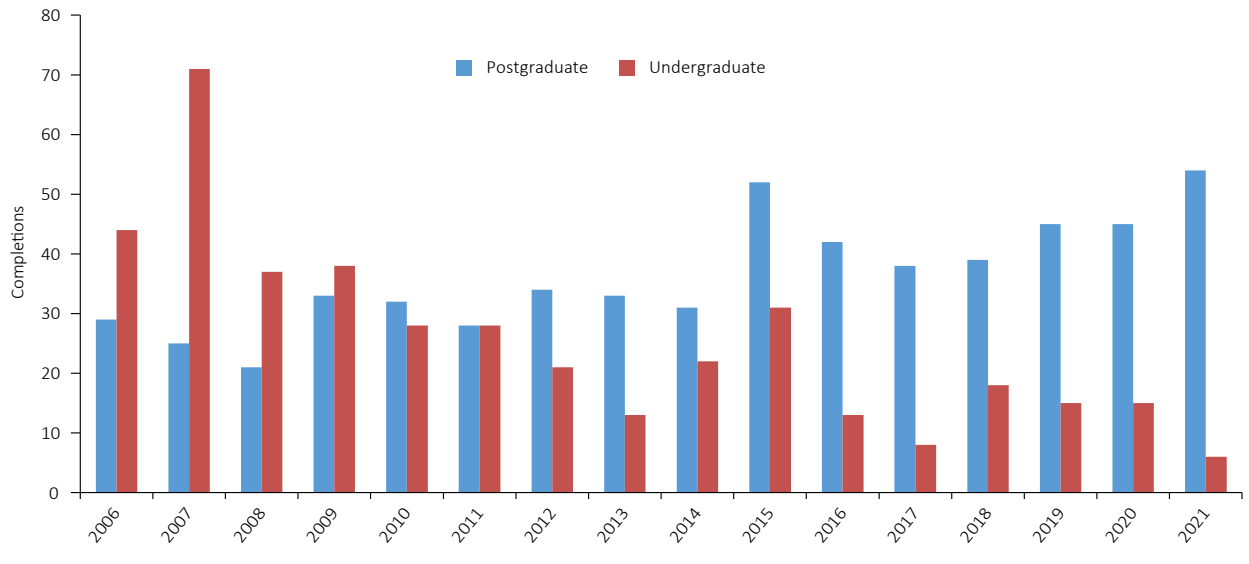
Over the last two decades, there has been a decreasing trend in undergraduate degree completions in forestry and forest-related studies, and an increasing trend in postgraduate degree completions.

- 58% of forestry workers nationally had qualifications in 2021 such as certificates, diplomas or degrees, compared with 69% in the total workforce.
- Vocational education and training in technical qualifications at certificate level and at diploma level remain available to support the forest, wood, and paper products industry sectors.
- Fellowships, grants, and awards are available for professional development opportunities to those working in wood products or forestry industries, including through the Gottstein Memorial Trust Fund.

For further information on this theme
See Indicators 6.5a, 6.5b, 6.5c and 7.1b of *Australia's State of the Forests Report*, available at agriculture.gov.au/abares/forestsaustralia/sofr.

Subsequent updates will cover the broader economic framework for sustainable forest management (Indicator 7.1c).

Australian university degree completions in forest-related studies, 2006–21



Data provided to Department of Education by education providers. Postgraduate degree completions include graduate diplomas.
Source: Australian Government Department of Education and Training, Higher Education Statistics Collection, 2023.

Cultural and social values

Indigenous communities and forests

The cultural use of native forests enables Indigenous peoples to connect or reconnect with Country through activities such as hunting, collecting bush food, use of fire, collecting materials for arts and tool-making, and sharing stories and social ceremonies.

- Cultural burning is an example of a cultural, forest-based practice that forms a core part of Indigenous cultural identity and connection with land and community.

Indigenous participation in forest management occurs through a variety of mechanisms, including direct ownership, management, employment, co-management of reserve areas, consultation about cultural heritage, and programs for engagement of urban Indigenous people with forests.

- Categories on Indigenous ownership and management arrangements describe the degree of management control, decision making and influence that Indigenous people have over forest land. Together, forest on land under all Indigenous ownership, management arrangements or other special rights comprise the Indigenous forest estate. The Indigenous forest estate is discussed further in the Australia's forest area theme.
- A range of forest-based activities provide economic benefits for Indigenous peoples as well as facilitating cultural connections to forested areas.

In 2021, a total of 1,478 Indigenous people (0.6% of the national Indigenous workforce) were directly employed in the forest and wood products industries.

- There were 25 Local Government Areas with more than 2% of their Indigenous workforce employed in the forest and wood products industries.
- Local Government Areas with the highest numbers of Indigenous employees in the forest and wood products industries include Snowy Valleys in New South Wales, Roper Gulf, West Arnhem and East Arnhem in the Northern Territory, and East Pilbara in Western Australia.

Heritage

Heritage represents the tangible and intangible connection Australians have with the past, through landscapes, landmarks, historic structures, significant places and events, and customs and ceremonies.

All Australian governments manage heritage registers of natural, historic and Indigenous places that are recognised for their outstanding significance, historical relevance or social value. Indigenous and non-Indigenous heritage values are protected by various levels of state, territory and Commonwealth legislation, and heritage management plans are developed by many government departments and private organisations that manage forest estates.

Information on forests on Indigenous and non-Indigenous heritage-listed sites is available in *Australia's State of the Forests Report 2018*.

Visitation

Most areas in nature conservation reserves and multiple-use public forests are available to the public for recreational and tourism purposes.

Recreational opportunities in nature conservation reserves are often more restricted but typically include bushwalking, picnicking and camping in designated areas. Multiple-use public forests, including native state forests and publicly owned plantations, generally provide for the broadest range of recreational activities which may include trail bike, mountain bike and horse riding, dog walking, and hunting in certain circumstances.

Information on forest visitation, including the area of forests available for recreation/tourism and the range of recreation/tourism, is available in *Australia's State of the Forests Report 2018*.

For further information on this theme
See Indicator 6.5d of *Australia's State of the Forests Report*, available at agriculture.gov.au/abares/forestsaustralia/sofr.

Subsequent updates will cover forest recreation and tourism (Indicators 6.3a–b), Indigenous and non-Indigenous values and heritage (Indicators 6.4a–b), Indigenous participation in forest management (Indicator 6.4c), and the importance of forests to people (Indicator 6.4d).

Cradle Mountain–Lake St Clair National Park, Tasmania. Photo: Claire Howell

Investment, research and development

Investment in research and development activities (R&D) typically leads to improvement in forest management practices, and to new technologies for commercial adoption.

Total R&D business expenditure in the forest and wood products sector decreased from $164 million in 2005–06 to $102 million in 2017–18.

- Business R&D expenditure in the Forestry and logging subsector decreased by 57% between 2005–06 and 2019–20 when adjusted for inflation to 2019–20 values.
- Business R&D expenditure in the Wood product manufacturing subsector decreased by 47% from 2005–06 to 2019–20 when adjusted for inflation to 2019–20 values.
- Business R&D expenditure decreased by 47% in the Pulp, paper and converted paper product manufacturing subsector from 2005–06 to 2017–18 when adjusted for inflation to 2019–20 values.
- Data relating to expenditure on forest and forest products R&D by state and territory government agencies are not available for the reporting period.

The total number of forest-related researchers employed by state and territory agencies was reported as 118.9 full-time-equivalent (FTE) staff for 2020–21, an increase from the 87.5 FTE staff reported for 2015–16, but less than half of the 245.5 FTE staff reported for 2011–12.

- The increases in staff numbers since 2015–16 occurred in the Australian Capital Territory, New South Wales and Queensland, but research staff numbers declined in Tasmania over this period.
- The long-term reduction in forest R&D capacity over the last decade resulted from changes in funding and delivery models for state and territory forest management agencies.
- An increased proportion of the research personnel employed in 2020–21 were engaged in research not necessarily specific to forests.

Investment in and adoption of new technologies have taken place across a broad range of areas of activity during the period 2016 to 2024. This included:

- more extensive use of ground-based and airborne LiDAR (and other remote sensing technologies) to monitor forest structure, condition and health as well as fire severity and impact
- measurement of wood properties in standing trees
- artificial intelligence in fire detection and fauna surveys
- increased application of genomic technologies in tree breeding.

Business R&D expenditure in the forest and wood products sector

	Business R&D expenditure ($ million)									
Subsector	**2005–06**	**2006–07**	**2007–08**	**2008–09**	**2009–10**	**2011–12**	**2013–14**	**2015–16**	**2017–18**	**2019–20**
Forestry and logging	16	20	22	26	38	26	22	13	10	9
Wood product manufacturing	76	55	51	57	57	38	21	n.a.	41	55
Pulp, paper and converted paper product manufacturing	72	71	71	54	n.a.	48	43	70	51	n.a.
Total research expenditure in forest and wood products	**164**	**146**	**144**	**137**	**n.a.**	**112**	**86**	**n.a.**	**102**	**n.a.**
Total business R&D expenditure in Australia	10,434	12,639	15,047	17,291	16,760	18,323	18,849	16,659	17,437	18,171
Proportion of total business R&D expenditure that is forest and wood products expenditure	**1.57%**	**1.16%**	**0.96%**	**0.79%**	**n.a.**	**0.61%**	**0.46%**	**n.a.**	**0.58%**	**n.a.**

n.a., not available. Totals are not shown where data are incomplete. Subsector values reported by ABS have a relative standard error of 25–50% and should be used with caution. 2017–18 is the last year for which complete data are available.

Source: *Research and Experimental Development, Businesses, Australia, 2021–22* (ABS 2023).

Over the period 2016 to 2024, Australia's capacity to conduct and apply forest R&D at the national level has been coordinated and delivered through a number of national organisations, in addition to individual universities and state and territory agencies. These national organisations include:

- the Australian Bureau of Agricultural and Resource Economics and Sciences
- the Commonwealth Scientific and Industrial Research Organisation
- Forest and Wood Products Australia
- Australian Forest and Wood Innovations (previously the National Institute for Forest Products Innovation)
- the Terrestrial Ecosystem Research Network.

Australia also supported international forest research through the Australian Centre for International Agricultural Research over the period 2017 to 2024.

For further information on this theme
See Indicator 6.2b and Indicator 7.1e of *Australia's State of the Forests Report*, available at agriculture.gov.au/abares/forestsaustralia/sofr.

Subsequent updates will cover investment and expenditure in forest management (Indicator 6.2a).

Obi Obi Valley from Mapleton Falls National Park lookout, Queensland. Photo: Tony Hunn

Frameworks for supporting conservation and sustainable management of Australia's forests

Australia's forest policy and management is underpinned by legal, institutional and economic frameworks at the national and the state and territory levels. These frameworks provide for reporting to the community on the state of Australia's forests.

Legal and policy frameworks

In Australia, state and territory governments have primary responsibility for land and forest management.

- All states and territories have legislation and dependent regulations designed to ensure the conservation and sustainable management of forests in their jurisdictions.
- Some of this legislation is administered jointly by, and requires coordination between, state or territory and local governments, statutory authorities and/or regional management authorities.
- In addition, the Australian Government has certain national-level powers and responsibilities, particularly through the *Environment Protection and Biodiversity Conservation Act 1999* and Regional Forest Agreements.

A well-established policy framework, guided by a National Forest Policy Statement, also supports the conservation and sustainable management of Australia's forests, both nationally and in all states and territories.

- This includes Australia's approach to a National Reserve System based on principles of comprehensiveness, adequacy and representativeness (the CAR reserve system).
- This policy framework includes the long-term state or territory policies, strategies and charters under which state and territory government organisations and agencies responsible for forest management operate.

Management plans

A forest area with a management plan is an area for which there is a long-term, documented and periodically reviewed management plan containing defined management goals.

A total of 37.7 million hectares (28% of Australia's forests) were covered by management plans relating to their conservation and sustainable management, as at 2021.

- Management plans are in place for 25.9 million hectares of forest in the National Reserve System, and 10.8 million hectares of multiple-use public forest and forest in the Defence estate.
- In addition, management plans are in place for the area of private forests certified under either the Responsible Wood certification scheme or the Forest Stewardship Council scheme.

Forests with a management plan, 2021

	Area with management plan ('000 hectares)								
Category	**ACT**	**NSW**	**NT**	**Qld**	**SA**	**Tas.**	**Vic.**	**WA**	**Australia**
Primarily conservation	109	5,435	6,094	2,861	1,683	1,537	3,797	4,419	**25,935**
Multiple values including wood production	17	1,768	903	3,558	52	656	2,515	1,295	**10,766**
Private forest with certification	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	**960**
Total forests with a management plan	**n.a.**	**n.a.**	**n.a.**	**n.a.**	**n.a.**	**n.a.**	**n.a.**	**n.a.**	**37,660**

n.a., not available at the time of publication.

'Primarily conservation': forest areas in the National Reserve System with an existing, identified management plan, World Heritage area, Ramsar Wetlands, and Informal reserves on multiple-use public native forest.

'Multiple values including wood production': multiple-use public forests covered by management plans, and the forest under Australian Government Department of Defence estate environment management plans.

'Private forest with certification': privately owned or managed production forests covered by a forest certification scheme.

Sources: CAPAD 2020, Australian Government Department of Climate Change, Energy, the Environment and Water; Australian Government Department of Defence; Responsible Wood; Forest Stewardship Council.

Forest management codes of practice provide specific guidance for sustainable forest management practices in public and private plantations and native forests managed for wood production in each state and territory, as well as in nature conservation reserves in Tasmania. In forests managed for wood production, the codes cover a range of topics, such as forest planning; forest access and roads; forest harvesting; the conservation of non-wood values; pest, weed and fire management; and the harvesting of non-wood forest products.

Certification

Forest management certification is the voluntary, independent assessment of forest management activities and operations in a particular area of forest against a credible standard that has criteria, requirements and indicators encompassing environmental, economic, social and cultural values.

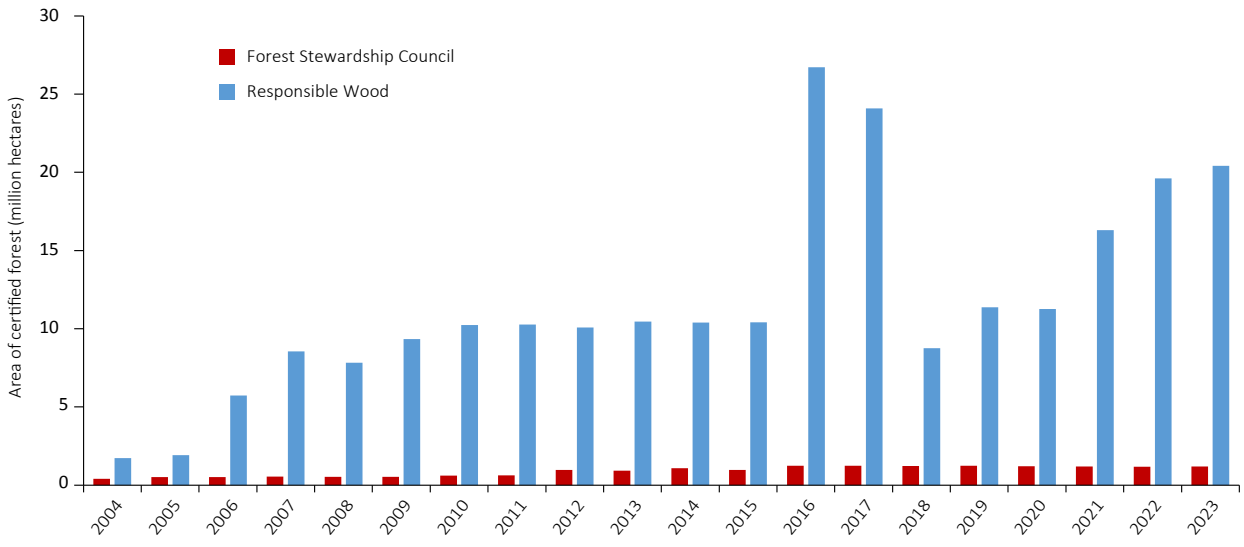
- Two forest certification schemes operate in Australia: an international scheme operated by the Forest Stewardship Council, and the Responsible Wood certification scheme which is endorsed by the international Programme for the Endorsement of Forest Certification (PEFC).
- Both schemes have forest management standards and chain-of-custody standards.

A total of 20.4 million hectares of forest were certified for forest management under the Responsible Wood scheme, and 1.2 million hectares were certified for forest management under the Forest Stewardship Council scheme, as at June 2023. The area estimated to be certified under both schemes at that time was 1.06 million hectares.

Chain-of-custody standards have criteria and requirements for assessing and tracking wood and forest products originating in certified forests through all phases of ownership, transportation and manufacturing, from a defined forest area to the final product delivered to the consumer.

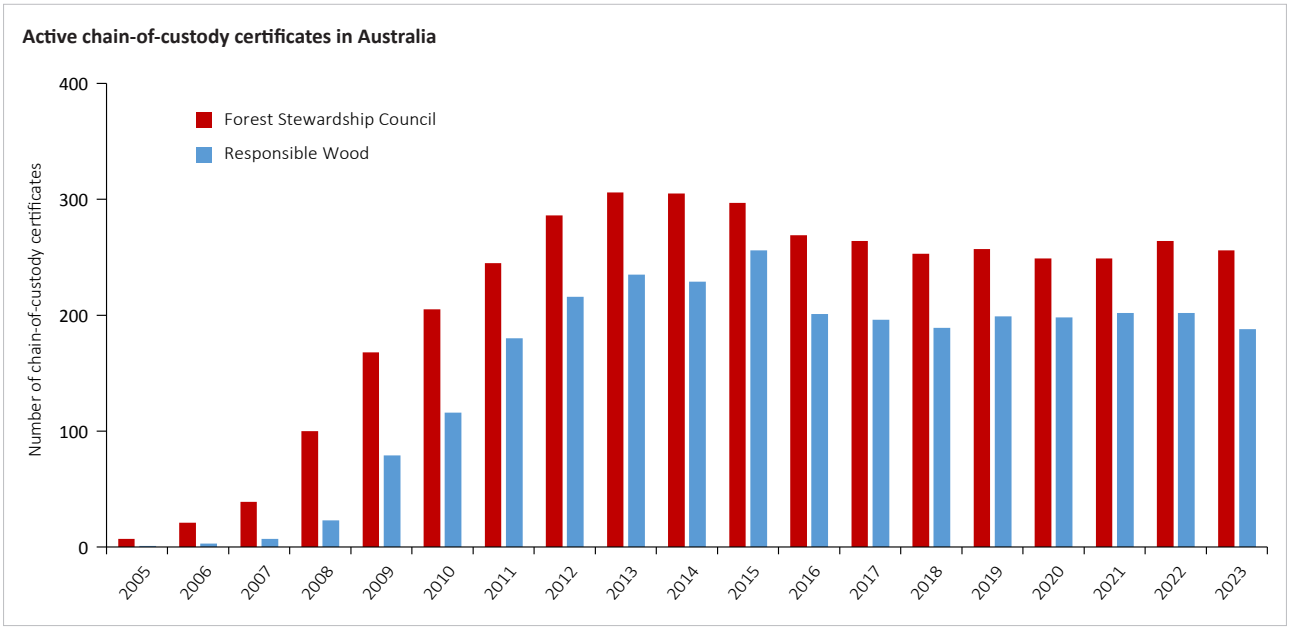
There were 256 chain-of-custody certificates active under the Forest Stewardship Council scheme, and 188 chain-of-custody certificates active under the Responsible Wood scheme, at June 2023.

Area of certified forest management in Australia, 2004–23



Data are for end of June each year. Responsible Wood areas for 2016 and 2017 are considered anomalous, resulting from certification and then removal of largely non-forested areas.

Sources: Australian Forestry Standard Limited, Responsible Wood, Programme for the Endorsement of Forest Certification, Forest Stewardship Council (FSC) (International). Some areas of forest have both Responsible Wood and FSC certification.



Data are for end of June each year.
Sources: Australian Forestry Standard Limited, Responsible Wood, Programme for the Endorsement of Forest Certification, Forest Stewardship Council (International).

Monitoring and reporting

Australia's National Forest Policy Statement commits the Australian Government and state and territory governments to report on the state of the forests every five years. In addition, the Commonwealth *Regional Forest Agreements Act 2002* states that 'the Minister must cause to be established a comprehensive and publicly available source of information for national and regional monitoring and reporting in relation to all of Australia's forests'.

The *Australia's State of the Forests Report* (SOFR) series has implemented these commitments since 1998, and is the mechanism by which the state of Australia's forests, and changes over time in a range of social, economic and environmental forest related criteria and indicators (see page 39), are reported to government and industry stakeholders and the broader community. The update of indicators across 2023 and 2024 and subsequent updates will be delivered online as individual indicator updates, accompanied by a five-yearly SOFR Synthesis. This publication is the first *SOFR Synthesis*.

- Data in the SOFR series cover all of Australia's forests, both public and private, and forests managed for conservation and for wood production objectives.
- Trends over time are reported when the data are of sufficient quality, and drivers of change are identified if these are clear.
- The SOFR series does not present detailed interpretation in regard to the policy or management implications of the data. Such analyses are to be found in other publications by Commonwealth, state and territory government agencies, including ABARES, and by independent researchers.
- Some states also publish five-yearly 'state of the forests' reports or similar reports, based on a framework of criteria and indicators similar to the national SOFR series.

The information in the SOFR series is presented systematically against sustainable forest management criteria and indicators that are based on the framework of the international Montreal Process Working Group for the sustainable management of temperate and boreal forests. This framework provides a common basis to describe, monitor, assess and report on forests, and to assess performance against the principles of sustainable forest management.

- A recent Montreal Process Synthesis Report presents a compilation of long-term trends in 11 key indicators across forests in the 12 Montreal Process member countries, including Australia.

For further information on this theme
See Indicators 7.1a–b and 7.1d of *Australia's State of the Forests Report*, available at agriculture.gov.au/abares/forestsaustralia/sofr.

Subsequent updates will cover the capacity to monitor change (Indicator 7.1d).

Australia's framework of criteria and indicators of sustainable forest management

Criterion 1: Conservation of Biological Diversity	
1.1a	Area of forest by forest type and tenure
1.1b	Area of forest by growth stage
1.1c	Area of forest in protected area categories
1.1d	Fragmentation of forest cover
1.2a	Forest dwelling species for which ecological information is available
1.2b	The status of forest dwelling species at risk of not maintaining viable breeding populations, as determined by legislation or scientific assessment
1.2c	Representative species from a range of habitats monitored at scales relevant to regional forest management
1.3a	Forest associated species at risk from isolation and the loss of genetic variation, and conservation efforts for those species
1.3b	Native forest and plantations of indigenous timber species which have genetic resource conservation mechanisms in place
Criterion 2: Maintenance of Productive Capacity of Forest Ecosystems	
2.1a	Native forest available for wood production, area harvested, and growing stock of merchantable and non-merchantable tree species
2.1b	Age class and growing stock of plantations
2.1c	Annual removal of wood products compared to the volume determined to be sustainable for native forests and future yields for plantations
2.1d	Annual removal of non-wood forest products compared to the level determined to be sustainable
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
Criterion 3: Maintenance of Ecosystem Health and Vitality	
3.1a	Scale and impact of agents and processes affecting forest health and vitality
3.1b	Area of forest burnt by planned and unplanned fire
Criterion 4: Conservation and Maintenance of Soil and Water Resources	
4.1a	Area of forest land managed primarily for protective functions
4.1b	Management of the risk of soil erosion in forests
4.1c	Management of the risks to soil physical properties in forests
4.1d	Management of the risks to water quantity from forests
4.1e	Management of the risks to water quality in forests
Criterion 5: Maintenance of Forest Contribution to Global Carbon Cycles	
5.1a	Contribution of forest ecosystems and forest industries to the global greenhouse gas balance
Criterion 6: Maintenance and Enhancement of Long Term Multiple Socio-Economic Benefits to Meet the Needs of Societies	
6.1a	Value and volume of wood and wood products
6.1b	Values, quantities and use of non-wood forest products
6.1c	Value of forest based services
6.1d	Production and consumption and import/export of wood, wood products and non-wood products
6.1e	Degree of recycling of forest products
6.2a	Investment and expenditure in forest management
6.2b	Investment in research, development, extension and use of new and improved technologies
6.3a	Area of forest available for public recreation/ tourism
6.3b	Range and use of recreation/tourism activities available
6.4a	Area of forest to which Indigenous people have use and rights that protect their special values and are recognised through formal and informal management regimes
6.4b	Registered places of non-Indigenous cultural value in forests that are formally managed to protect those values
6.4c	The extent to which Indigenous values are protected, maintained and enhanced through Indigenous participation in forest management
6.4d	The importance of forests to people
6.5a	Direct and indirect employment in the forest sector
6.5b	Wage rates and injury rates within the forest sector
6.5c	Resilience of forest dependent communities to changing social and economic conditions
6.5d	Resilience of forest dependent Indigenous communities to changing social and economic conditions
Criterion 7: Legal, Institutional and Economic Framework for Forest Conservation and Sustainable Management	
7.1a	Extent to which the legal framework supports the conservation and sustainable management of forests
7.1b	Extent to which the institutional framework supports the conservation and sustainable management of forests
7.1c	Extent to which the economic framework supports the conservation and sustainable management of forests
7.1d	Capacity to measure and monitor changes in the conservation and sustainable management of forests
7.1e	Capacity to conduct and apply research and development aimed at improving forest management and delivery of forest goods and services

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