



Australian Government

Department of Agriculture
and Water Resources

ABARES

Australia's State of the Forests Report 2018



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

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The Australian Government Department of Agriculture and Water Resources acknowledges the traditional custodians of country throughout Australia and their continuing connections to land, sea and community. We pay our respect to their cultures and elders past, present and future.



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Foreword

Australia's forests are diverse, extensive, and highly regarded for their ecological, economic and social values. They provide a range of benefits including wood and non-wood forest products and ecosystem services. The range of services covers water protection and supply, soil protection, carbon storage and sequestration, habitat for flora and fauna species, tourism and recreation, and cultural values for both non-Indigenous and Aboriginal and Torres Strait Islander peoples.

Australia's State of the Forests Report 2018 presents a comprehensive national synthesis of information describing Australia's forests. The information is presented systematically against sustainable forest management criteria and indicators that are based on the framework of the international Montreal Process Working Group. 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.

The fifth report in the series, *Australia's State of the Forests Report 2018* enables an efficient connection between state, national and international reporting processes. The report is driven through national processes such as reporting requirements for regional forest agreements and Australia's national forest policy. In turn, it provides data directly to international processes including the Global Forest Resources Assessment led by the Food and Agriculture Organization of the United Nations, the United Nations Sustainable Development Goals, and the Global Forest Goals of the United Nations Forum on Forests.

The completion of this report represents a substantial effort from two national committees comprising representatives from state and territory forest management and policy agencies, and Commonwealth government agencies. Essential input has also come from academia, research organisations and industry bodies. Production of the report was undertaken by the Australian Bureau of Agricultural and Resource Economics and Sciences in the Australian Government Department of Agriculture and Water Resources.

Australia's State of the Forests Report 2018 is an essential resource for all who work in, manage or value Australia's forests. The report provides data, information and sufficient narrative context to let the reader explore the implications for sustainable forest management of changes in the social, environmental and economic aspects of Australia's forests.

Steve Hatfield-Dodds
Executive Director
ABARES

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¹ Until January 2013, Forests NSW.

² Until July 2017, Forestry Tasmania.

³ Until January 2015, the Department of Environment and Primary Industries.

⁴ Until July 2017, the Department of Parks and Wildlife.

⁵ Until February 2015, the Department of Agriculture, Fisheries and Forestry.

⁶ Until January 2018, the Department of Environment and Heritage Protection.

⁷ Until March 2018, the Department of Environment, Water and Natural Resources.

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⁸ Until July 2016, the Department of the Environment.

Acronyms and abbreviations⁹

ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences (Australian Government)	DEPI	Department of Environment and Primary Industries (Victorian Government)
ABS	Australian Bureau of Statistics (Australian Government)	DENR	Department of Environment and Natural Resources (Northern Territory Government)
ACIAR	Australian Centre for International Agriculture Research (Australian Government)	DERM	Department of Environment and Resource Management (Queensland Government)
ACT	Australian Capital Territory	DEW	Department for Environment and Water (South Australian Government)
AFAC	Australasian Fire and Emergency Service Authorities Council	DEWNR	Department of Environment, Water and Natural Resources (South Australian Government)
AFSC	Australian Forest Certification Scheme	DFA	Defined Forest Area
ANU	Australian National University	DIA	Department of Indigenous Affairs (Australian Government)
ANZECC	Australian and New Zealand Environment and Conservation Council	DIIS	Department of Industry, Innovation and Science (Australian Government)
ANZIC	Australia and New Zealand Industry Classification	DLCM	Dynamic Land Cover Mapping
ARC	Australian Research Council	DLRM	Department of Land Resource Management (Northern Territory Government)
ATSC	Australian Tree Seed Centre	DNRE	Department of Natural Resources and Environment (Victorian Government)
AVHRR	Advanced Very High Resolution Radiometer	DoEE	Department of the Environment and Energy (Australian Government)
BRS	Bureau of Rural Sciences (Australian Government)	DPaW	Department of Parks and Wildlife (Western Australian Government)
BMAD	Bell-Miner-Associated Dieback	DPI (NSW)	Department of Primary Industries (New South Wales Government)
CAPAD	Collaborative Australian Protected Areas Database	DPI (Victoria)	Department of Primary Industries (Victorian Government)
CAR	Comprehensive, Adequate and Representative	DPIPWE	Department of Primary Industries, Parks, Water and Environment (Tasmanian Government)
CCWA	Conservation Commission of Western Australia	DPIR	Department of Primary Industry and Resources (Northern Territory Government)
CFI	Carbon Farming Initiative	DSE	Department of Sustainability and Environment (Victorian Government)
C&I	criteria and indicators	DSG	Department of State Growth (Tasmanian Government)
COAG	Council of Australian Governments	DSEWPac	Department of Sustainability, Environment, Water, Population and Communities (Australian Government)
CO₂	carbon dioxide	EMS	Environmental Management System
CO₂-e	carbon dioxide-equivalent	EPA	Environment Protection Authority (New South Wales Government)
CPCWA	Conservation and Parks Commission, Western Australia	EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
CPH	Census of Population and Housing	EPL	Environment Protection Licence
CPI	Consumer Price Index	EPSDD	Environment, Planning and Sustainable Development Directorate (Australian Capital Territory Government)
CRA	Comprehensive Regional Assessment	ERF	Emissions Reduction Fund
CRC	Cooperative Research Centre	ERIN	Environmental Resources Information Network
CSIRO	Commonwealth Scientific and Industrial Research Organisation (Australian Government)	ESDD	Environment and Sustainable Development Directorate (Australian Capital Territory Government)
DBCA	Department of Biodiversity, Conservation and Attractions (Western Australian Government)	FAO	Food and Agriculture Organization of the United Nations
DCCEE	Department of Climate Change and Energy Efficiency (Australian Government)	FCNSW	Forestry Corporation of New South Wales
DEC	Department of Environment and Conservation (Western Australian Government)		
DEDJTR	Department of Economic Development, Jobs, Transport and Resources (Victorian Government)		
DEHP	Department of Environment and Heritage Protection (Queensland Government)		
DELWP	Department of Environment, Land, Water and Planning (Victorian Government)		

⁹ A subsequent table relates agency names that applied during the SOFR 2018 reporting period, to agency names in use at 31 July 2018.

FFMG	Forest Fire Management Group
FFPC	Forestry and Forest Products Committee
FMP	Forest Management Plan
FPA	Forest Practices Authority, Tasmania
FPC	Forest Products Commission of Western Australia
FPC	Foliage Projective Cover
FPPF	Future Potential Production Forest
FSC	Forest Stewardship Council
FT	Forestry Tasmania (Tasmanian Government Business Enterprise)
FTAs	free trade agreements
FTE	full-time-equivalent
FullCAM	Full Carbon Accounting Model
FWPA	Forest and Wood Products Australia
GA	Geoscience Australia (Australian Government)
GDP	gross domestic product
GFCF	gross fixed capital formation
GFRA	Global Forest Resources Assessment (FAO)
GIS	geographic information system
GVP	gross value of production
HCV	high conservation value
HWP	harvested wood products
IFOA	Integrated Forestry Operations Approval
ILC	Indigenous Land Corporation
ILUA	Indigenous Land Use Agreement
IPA	Indigenous Protected Area
IUCN	International Union for Conservation of Nature
LGA	Local Government Area
LTER	Long-Term Ecological Research
LTERN	Long-Term Ecological Research Network
LULUCF	Land Use, Land-Use Change and Forestry
MCFFA	Ministerial Council on Forestry, Fisheries and Aquaculture
MIG	Montreal Process Implementation Group for Australia
MIS	managed investment scheme
MLE	Multiple Lines of Evidence
MODIS	Moderate-resolution Imaging Spectroradiometer
Mt C	million tonnes of carbon
NCAS	National Carbon Accounting System
NAFI	North Australia and Rangelands Fire Information
NCLD	National Conservation Lands Database
NCP	National Competition Policy
NFI	National Forest Inventory
NFISC	National Forest Inventory Steering Committee
NGGI	National Greenhouse Gas Inventory
NHL	National Heritage List
NIHSA	Non-Indigenous Heritage Sites of Australia
NIR	National Inventory Report
NNTT	National Native Title Tribunal
NPI	National Plantation Inventory

NPWS	National Parks and Wildlife Service (New South Wales Government)
NRM	Natural Resource Management
NRMMC	Natural Resource Management Ministerial Council
NRS	National Reserve System
NSW	New South Wales
NT	Northern Territory
NVIS	National Vegetation Information System
NWFP	non-wood forest product
NWI	National Water Initiative
OEH	Office of Environment and Heritage (New South Wales Government)
PBCRC	Plant Biosecurity Cooperative Research Centre
PFT	Private Forests Tasmania
PIRSA	Department of Primary Industries and Regions SA (South Australian Government)
PJ	Petajoule (10 ¹⁵ joules)
Qld	Queensland
R&D	research and development
RD&E	research, development and extension
RFA	Regional Forest Agreement
RIRDC	Rural Industries Research and Development Corporation (Australian Government)
RNE	Register of the National Estate
SA	South Australia
SAC	Self-Assessable Vegetation Clearing Code (Queensland)
SCoPI	Standing Council on Primary Industries
s.l.	sensu lato (“in the broad sense”)
SLA	Statistical Local Area
SLATS	State-wide Landcover and Trees Study
SEEA	System of Integrated Environmental and Economic Accounts
SNC	Spring Needle Cast
SoE	State of the Environment
SOFR	State of the Forests Report
SPOT5	Satellite Pour l’Observation de la Terre 5
SPRAT	Species Profile and Threats Database
s.s.	sensu stricto (“in the narrow sense”)
STBA	Southern Tree Breeding Association
STT	Sustainable Timber Tasmania (Tasmanian Government Business Enterprise)
TAFE	Technical and Further Education
Tas.	Tasmania
TERN	Terrestrial Ecosystem Research Network
UNESCO	United Nations Educational, Scientific and Cultural Organization
VET	Vocational Education and Training
VFMP	Victorian Forest Monitoring Program
Vic.	Victoria
WA	Western Australia
WHA	World Heritage Area



Eucalyptus saligna, Willowdale Arboretum. Mark Parsons

Agency name changes

Agency names used in this report are the names correct during the SOFR 2018 reporting period (01 July 2011 to 30 June 2016). This table shows the agency name as at 31 July 2018 for those agencies for which different agency names were used during the reporting period.

Jurisdiction	Agency name and acronym during part or all of SOFR 2018 reporting period (01 July 2011 to 30 June 2016)		Agency name and acronym as at 31 July 2018	
Commonwealth	Department of Agriculture, Fisheries and Forestry	DAFF	Department of Agriculture and Water Resources	DAWR
	Department of Agriculture	DA	Department of Agriculture and Water Resources	DAWR
	Department of Sustainability, Environment, Water, Population and Communities	DSEWPaC	Department of the Environment and Energy	DoEE
	Department of the Environment	DoE	Department of the Environment and Energy	DoEE
Australian Capital Territory	Environment and Sustainable Development Directorate	ESDD	Environment, Planning and Sustainable Development Directorate	EPSDD
New South Wales	Department of Environment and Heritage Protection	DEHP	Department of Environment and Science	DES
	Forests NSW	FNSW	Forestry Corporation of NSW	FCNSW
Northern Territory	Department of Natural Resources, Environment, the Arts and Sport	DNREAS	Department of Environment and Natural Resources	DENR
	Department of Land Resource Management	DLRM	Department of Environment and Natural Resources	DENR
Queensland	Department of Agriculture, Fisheries and Forestry	DAFF	Department of Agriculture and Fisheries	DAF
	Department of Environment and Heritage Protection	DEHP	Department of Environment and Science	DES
South Australia	Department of Environment, Water and Natural Resources	DEWNR	Department for Environment and Water	DEW
Tasmania	Forestry Tasmania	FT	Sustainable Timber Tasmania	STT
Victoria	Department of Sustainability and Environment	DSE	Department of Environment and Primary Industries	DEPI
	Department of Environment and Primary Industries	DEPI	Department of Environment, Land, Water and Planning	DELWP
Western Australia	Department of Parks and Wildlife	DPaW	Department of Biodiversity, Conservation and Attractions	DBCA
	Conservation Commission of Western Australia	CCWA	Conservation and Parks Commission, Western Australia	CPCWA
Non-government	Australian Forestry Standard Limited	AFS Ltd	Responsible Wood	RW



Eucalypt forest, Cowaramup, Western Australia. iStockphoto/metriognome

Executive summary

Australia's State of the Forests Report 2018 (SOFR 2018) is the fifth in a series of national five-yearly reports on Australia's forests, and covers a range of social, economic and environmental values. Previous national SOFR reports were published in 1998, 2003, 2008 and 2013.

As far as possible, SOFR 2018 presents data for the five-year period between July 2011 and June 2016. However, the varied nature of available data means that not all reported figures cover this range. SOFR 2018 also reports trends over longer periods of time where this is possible.

Australia's forests are recognised and valued for their diverse ecosystems and unique biodiversity; for their cultural heritage; for their 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. At the same time, Australia's forests are subject to a range of pressures, including extreme weather events, drought and climate change; invasive weeds, pests and diseases; changed fire regimes; clearing for urban development, mining, infrastructure or agriculture; and the legacy of previous land-management practices.

The sustainable management and conservation of Australia's forests, whether on public or on private land, requires a sound understanding of their extent, type, use and management. SOFR 2018 provides comprehensive information from a wide range of sources that can contribute to a better understanding of the broad range of values relating to Australia's forests and their current management.

The information presented in SOFR 2018 covers primarily the five-year period from 2011 to 2016, or otherwise using the best available data. The report is organised under a framework of seven criteria for sustainable forest management developed by the international-level Montreal Process Working Group on Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests, and then under 44 separate indicators. This Executive Summary draws together data from the material presented under these 44 indicators into a number of key themes.

 This icon indicates data, maps or graphics from *Australia's State of the Forests Report 2018* that are available for electronic download. Data used in figures and tables in the Executive Summary, together with higher resolution versions of maps, are available via www.doi.org/10.25814/5be12aa83aa34 and www.doi.org/10.25814/5be3bc4321162.

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 2016

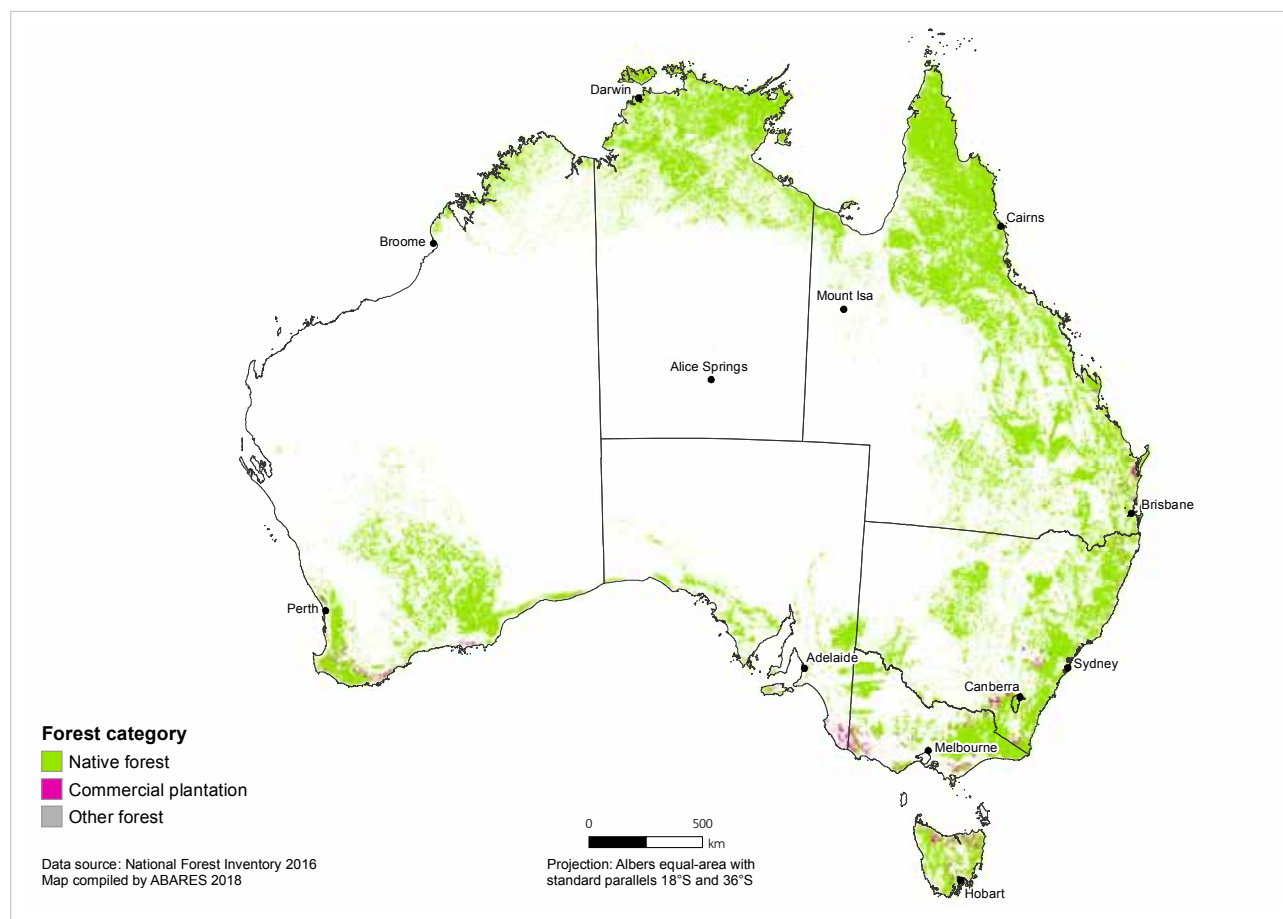
Australia has 134 million hectares of forest, covering 17% of Australia's land area. Australia has approximately 3% of the world's forests, and globally is the country with the seventh largest forest area.

Queensland has the largest area of forest (39% of Australia's forest), with the Northern Territory (18%), Western Australia (16%), and New South Wales (15%), making up much of the balance.

Australia's forests can be divided into three categories:

- 'Native forest' – 132 million hectares, 98% of Australia's forest area
- 'Commercial plantations' – 1.95 million hectares, 1.5% of Australia's forest area
- 'Other forest' – 0.47 million hectares, 0.4% of Australia's forest area, and comprising mostly non-commercial plantations, and planted forests of various types.

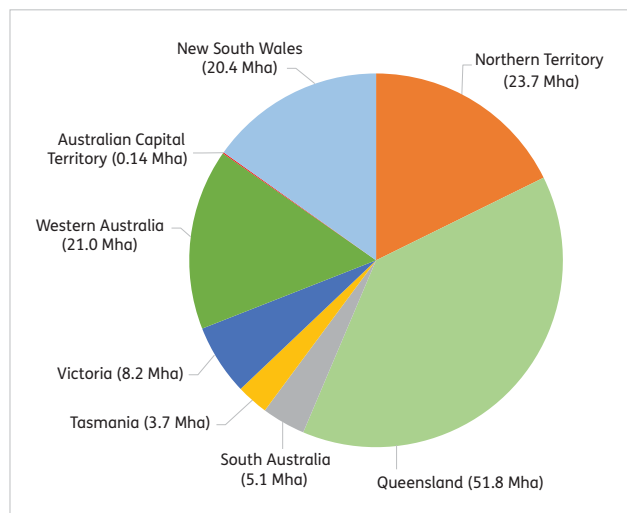
Australia's forests, by forest category



'Other forest' is not visible at this scale.

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

Australia's forest area, by jurisdiction



Mha, forest area in million hectares

The data used to create this figure are available in Microsoft Excel via www.doi.org/10.25814/5be12aa83aa34

Native forest

Native forest is the most extensive category of Australia's forests, covering 132 million hectares.

Native forests are dominated by eucalypt forests (101 million hectares) and acacia forests (11 million hectares).

The majority of native forests (91 million hectares) are woodland forests, which have a canopy cover between 20% and 50%.

By ownership, most of Australia's native forests (88 million hectares) are in private and leasehold tenures. The area of native forest in formal nature conservation reserves is 22 million hectares, and the area of multiple-use public native forests is 10 million hectares.

The Indigenous forest estate

The area of forest over which Indigenous peoples and communities have ownership, management or special rights of access or use is known as the Indigenous forest estate. This is a total of 70 million hectares of forest (52% of Australia's forests), almost all of which is native forest.

The term 'Indigenous' is used throughout the SOFR series to encompass all Aboriginal and Torres Strait Islander peoples.

The Indigenous forest estate is classified into four broad ownership and management categories:

Indigenous owned and managed	Indigenous co-managed
Indigenous managed	Forest subject to 'Other special rights'

The geographic distribution of these areas is presented later in this Executive Summary.

The area reported in SOFR 2018 for the Indigenous forest estate represents an increase of 28 million hectares over that previously reported.

- The increase has been driven primarily by an increase in the area of land over which Indigenous people have 'Other special rights', including through native title determinations and Indigenous Land Use Agreements.



Eucalyptus mannifera, Cuumbeun Nature Reserve, New South Wales.

Forest area change

Australia's forest area has increased progressively since 2008. The net increase in forest area over the period 2011 to 2016 was 3.9 million hectares.

This increase in forest area is due to the net effect of forest clearing or reclearing for agricultural use; regrowth of forest on areas previously cleared for agricultural use; expansion of forest onto areas not recently containing forest; establishment of environmental plantings; and changes in the commercial plantation estate.

- In each year of the period 2011–2016, the area of forest cleared or recleared was less than the area of forest regrowing from previous clearing.
- In the year 2015–16, first-time clearing was recorded for 60 thousand hectares of forest, 564 thousand hectares of forest regrew on land cleared after 1972, and reclearing of 395 thousand hectares of regrowth forest was recorded. The total area of forest recorded as cleared was 455 thousand hectares.

The change in forest area is determined from annual Landsat satellite data interpreted for Australia's National Greenhouse Gas Inventory.

- Temporary changes in forest area or canopy cover that result from a range of short-term factors, such as wildfire, wood harvesting, and regrowth or regeneration from these events, are not included in these area change figures.

Forest area data

The forest area dataset prepared for SOFR 2018 combines data from a wide range of different datasets, assembled using a Multiple Lines of Evidence methodology.

Data on Australia's forest area are assembled in the National Forest Inventory from a wide range of spatial datasets provided by states and territories, and from remotely sensed data sourced from various agencies. When these datasets disagree on whether an area is or is not forest, ABARES uses a formal process to determine the final allocation.

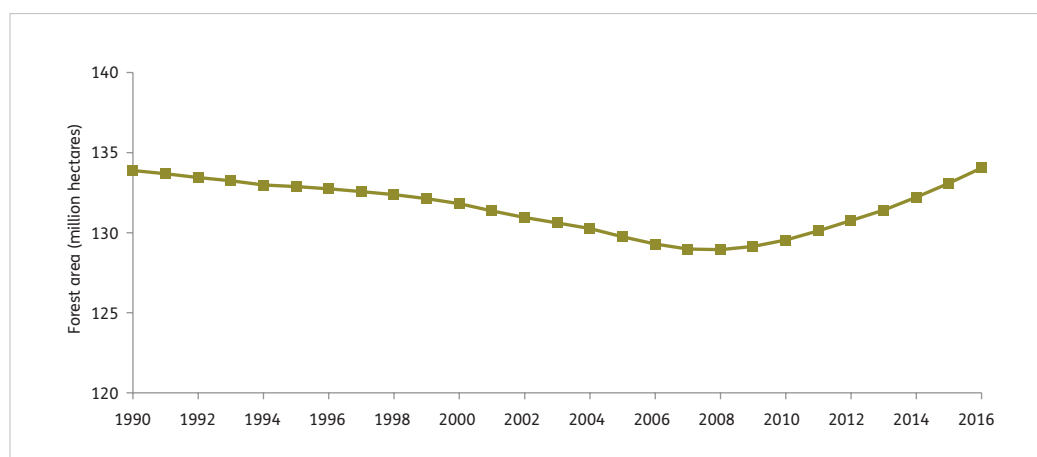
- The forest cover area statements in SOFR 2018 may therefore not align exactly with figures in individual datasets published in other Commonwealth reports or by individual states or territories.
- Spatial data for Commercial plantations are incorporated from the National Plantation Inventory.

SOFR 2013 reported a total forest area of 125 million hectares as at 2011, compared to the 134 million hectares of forest reported in SOFR 2018 as at 2016.

- Most of this difference in the understanding of Australia's forest extent derives from use of more accurate state, territory and national datasets and recent high-resolution imagery, not from actual on-ground changes in forest area.
- The change in reported forest area was greatest in the Northern Territory, where areas of woodland forest not reported as forest in SOFR 2013 have been identified, mapped, and reported as forest in SOFR 2018.

For further information on this theme, see Indicator 1.1a, Indicator 6.4a and Indicator 7.1d of *Australia's State of the Forests Report 2018*.

Australia's forest area since 1990



Calculated by ABARES from data in the National Inventory Report 2016, Australian Government Department of the Environment and Energy.

The data used to create this figure are available in Microsoft Excel via www.doi.org/10.25814/5be12aa83aa34

Forest biodiversity

In Australia, substantial emphasis is placed on the management of forest ecosystems for the conservation of biodiversity, including through the creation of reserves, development of management prescriptions, and identification and listing of threatened species.

Forest managed for protection of biodiversity

A total of 46 million hectares (35%) of Australia's native forest is on land protected for biodiversity conservation, or where biodiversity conservation is a specified management intent.

This area is the result of a range of formal and informal processes on both public and private land that are used to protect areas of forest for the conservation of biodiversity. Many areas of forest are protected by, and reported under, more than one process.

- Part of this area is contributed by Australia's National Reserve System, which includes 34 million hectares of forest (26% of Australia's native forests) that have a primary management intent of nature conservation.

Aichi Biodiversity Targets are articulated in the United Nations Strategic Plan for Biodiversity 2011–2020 under the international Convention on Biological Diversity, and include the target that at least 17% of terrestrial areas are protected. With 35% of Australia's native forest area managed for the protection of biodiversity, Australia has therefore met this Aichi Biodiversity Target with respect to native forests.

Forest biodiversity and threatened species

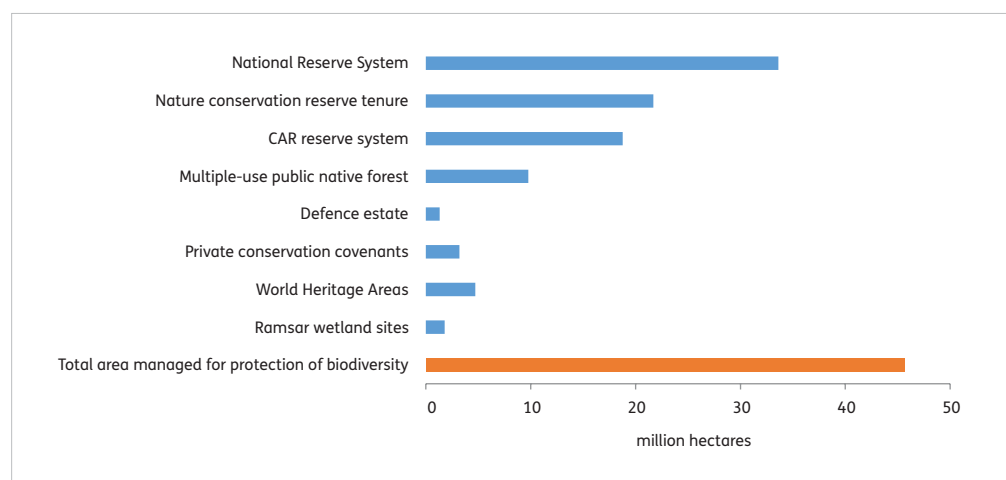
Australia's national lists of forest-dwelling species (species that use forests for part of their lifecycle) include 2,486 forest-dwelling native vertebrate fauna species (animals), and 16,836 forest-dwelling native vascular flora species (plants).

Of the forest-dwelling native vertebrate fauna species, 1,119 have been identified as forest-dependent species (species that require forest habitat for part of their lifecycle and could not survive or reproduce without it).

A total of 1,420 forest-dwelling fauna and flora species are listed as threatened species under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

Of the listed threatened forest-dwelling fauna and flora species, 842 species are forest-dependent.

Area of native forest managed for protection of biodiversity, 2016, by protection process



Many areas of forest are protected under more than one process.

The data used to create this figure are available in Microsoft Excel via www.doi.org/10.25814/5be12aa83aa34

The most common threats to nationally listed forest-dwelling fauna and flora include forest loss from clearing for agriculture and urban and industrial development; impacts of predators; small population sizes; and unsuitable fire regimes.

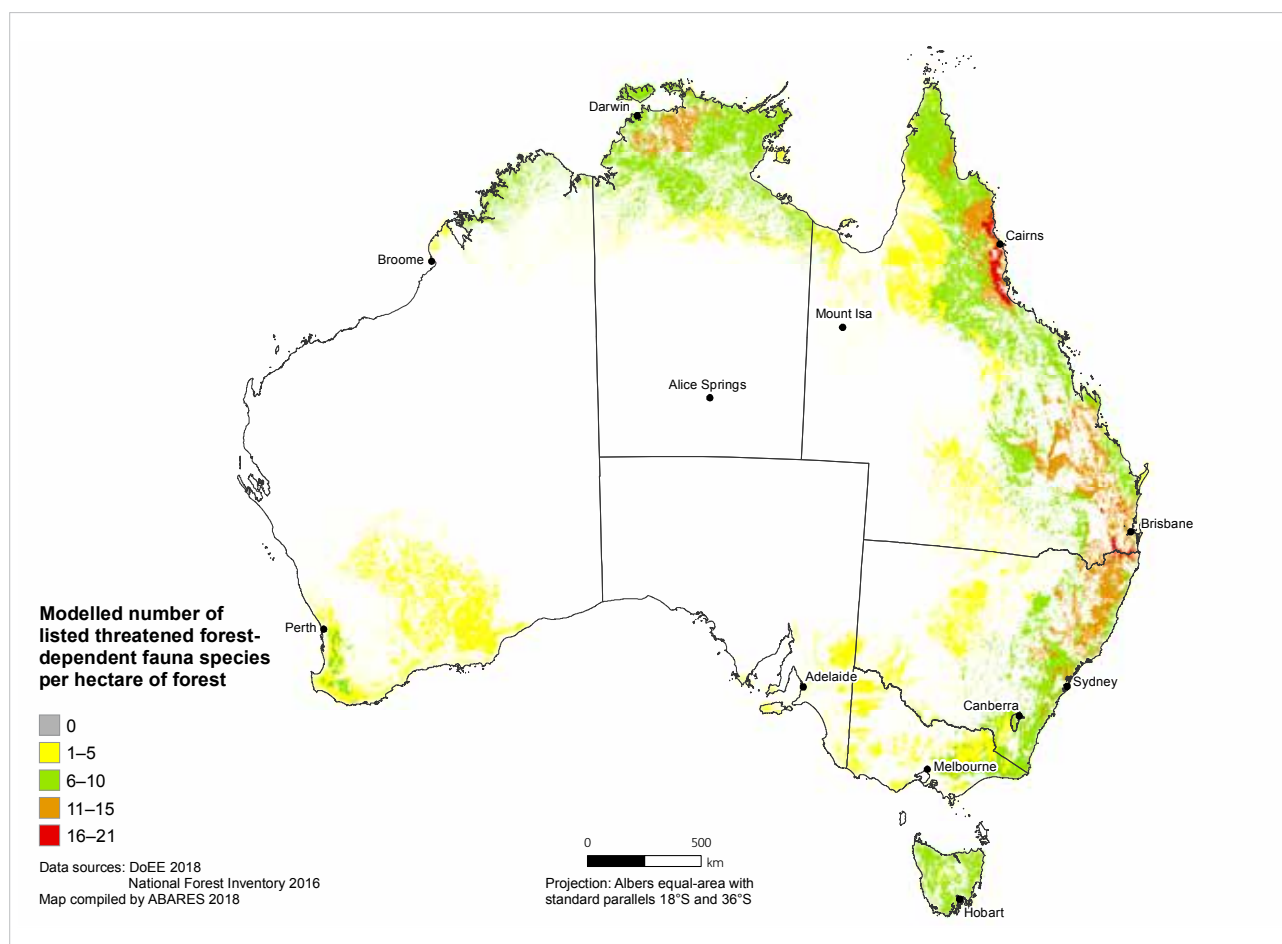
- For listed forest-dwelling fauna species, the most common threat categories are forest loss from clearing for agriculture and urban and industrial development, as well as predation by introduced predators.
- For listed forest-dwelling flora species, the most common threat categories are small population sizes, as well as mortality agents and unsuitable fire regimes.
- A total of 57% of Australia's listed threatened forest-dwelling fauna and flora species have genetic-related reasons contributing to their listing. This includes species with populations that are low in numbers or fragmented, or that have low genetic variability.
- Based on the emphasis given in listing advice documents in regard to their impacts, forestry operations pose a less significant threat to nationally listed forest-dwelling fauna and flora species compared with other threat categories.

The number of listed threatened forest-dwelling and forest-dependent flora and fauna species per hectare of forest have been separately modelled and mapped across Australia. As an example, the regions with the highest density of listed threatened forest-dependent fauna species are the coastal ranges between Townsville and Cooktown in north Queensland, and the border ranges between Queensland and New South Wales.

During the period 2011–16, a total of 68 forest-dwelling species were added to the national list of threatened species, and 77 forest-dwelling species were removed.

- Most additions were based on inherently small population sizes and/or ongoing impacts on habitat extent and quality, including impacts of introduced species and unsuitable fire regimes.
- Most removals of listed species were a result of improved information that indicated that species were no longer considered valid species or were not threatened.

Distribution of listed threatened forest-dependent fauna species



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



Rainbow Pitta (*Pitta iris*), a forest-dwelling bird, in Kakadu National Park, Northern Territory.

Australia's forest genetic resources are conserved by a variety of means, including in situ in Australia's native forest and in restoration plantings, as well as in commercial and environmental plantations, seed orchards, arboreta and seed banks.

- There are also tree-breeding and genetic improvement programs for at least 48 native wood-producing and oil-producing species and varieties
- Some Australian native forest species also form a dominant part of the hardwood plantation industry overseas.

For further information on this theme, see Indicator 1.1c, Indicators 1.2a–c and Indicators 1.3a–b of *Australia's State of the Forests Report 2018*.

Forest condition and function

Australia's forests provide a range of ecosystem services in regards to biodiversity, carbon, soil and water. The extent to which these ecosystem services are delivered varies with forest growth stage, with the degree of fragmentation of the forest area, and as a result of the impacts of fire, climatic conditions, and pests and diseases.

Forest growth stage and old-growth forest

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

Data collected over the period 1995–2000 as part of Comprehensive Regional Assessments for Regional Forest Agreements showed that all forest growth stages were present on all tenures, although in different proportions.

- Considering the long time-spans over which forest development occurs, the distribution of growth stages across tenures is unlikely to have changed since data on growth stage were collected.

Old-growth forest is not a specific growth stage, but is defined in relation to stand structure, as 'ecologically mature forest where the effects of disturbance are now negligible'.

- The area of old-growth forest in Regional Forest Agreement regions is calculated to have decreased by 0.5 million hectares between the signing of Regional Forest Agreements and 2016.
- The majority of this decrease occurred in Victoria, almost entirely due to bushfires in the decade to 2009.

Forest fragmentation

The majority of Australia's native forest is continuous, not fragmented.

Forest fragmentation describes the extent to which forest areas are separated by or adjoin non forest areas. It can be assessed as the proportion of forest that is completely bounded by other forest, or alternatively as forest patch size.

- At the 1-hectare scale, 72% of Australia's native forest area is comprised of areas that are completely bounded by forest.
- A total of 68% of Australia's native forest is in patches of over 100 thousand hectares.

Native forest that is not fragmented is found in forested areas of higher rainfall, as well as in regions that have experienced the least clearing for agricultural land use, and in nature conservation reserves.

The most fragmented forests occur in drier regions where woodland forest naturally borders areas of vegetation with lower tree canopy cover, as well as in areas with higher impacts from historical land clearing for agriculture and from urban development.

Forest fire

The total area of forest in Australia burnt one or more times during the period 2011–12 to 2015–16 was 55 million hectares (41% of Australia's total forest area). Areas that burnt more than once during this period were more likely to be in northern Australia.

Of the cumulative area of fire in forests over this period, 69% was unplanned fire.

The annual area of fire in Australia's forests in the period 2011–12 to 2015–16 varied from a high value of 27.4 million hectares in 2012–13, to a low value of 14.9 million hectares in 2015–16.

- The cumulative area of fire in forest across this period (the sum of the forest fire areas for each of the five years) was 106 million hectares.
- The largest cumulative areas of fire in forests were in northern Queensland and the Northern Territory.
- However, this figure includes large areas of forest, especially in northern Australia, that were burnt in more than one of the five years comprising this period.

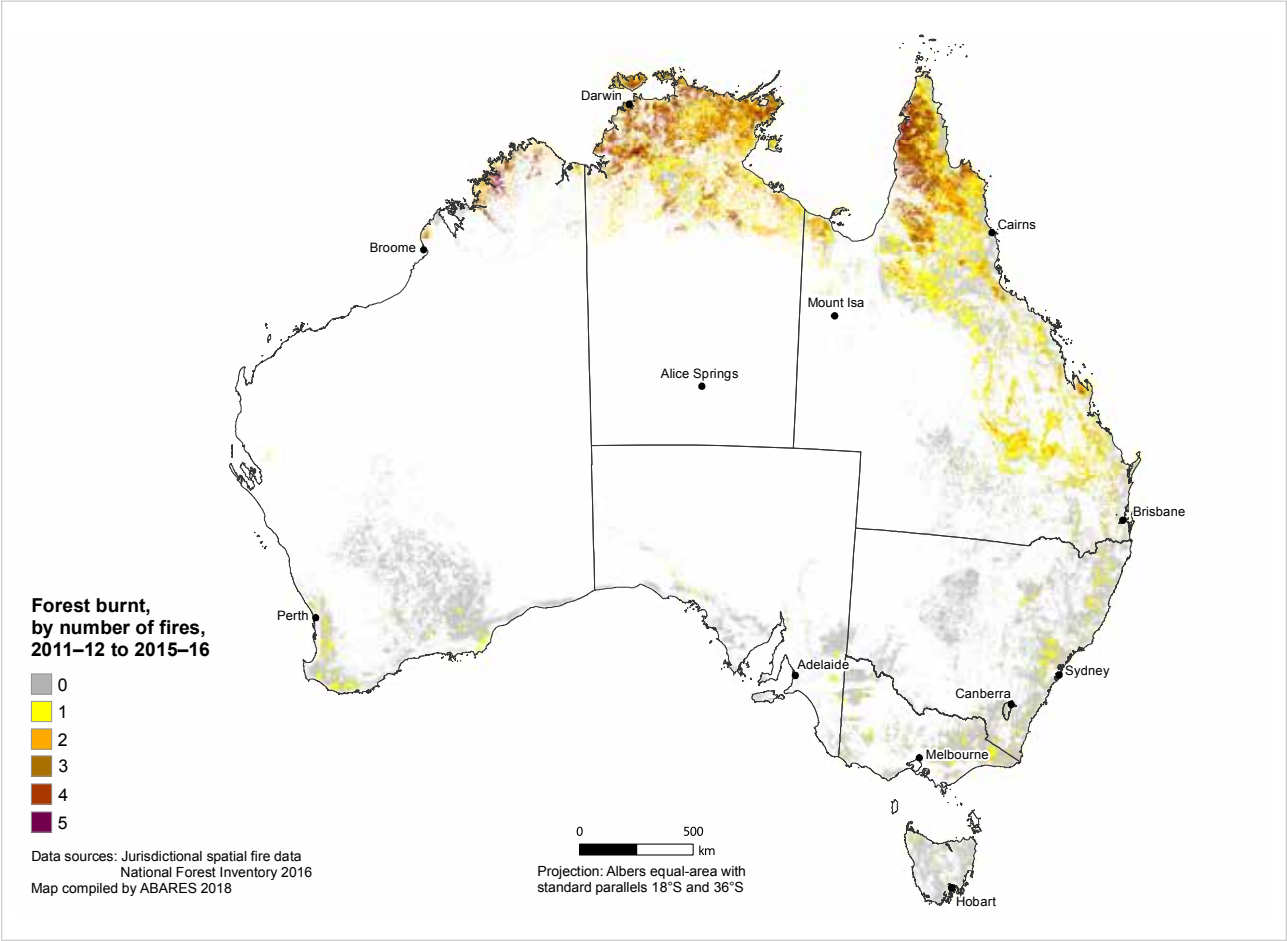
When areas of forest burnt in multiple years are allowed for, the total area of forest burnt one or more times during the period 2011–12 to 2015–16 was 55 million hectares (41% of Australia's total forest area). The balance (59% of Australia's forest area) did not experience fire in this period.

- Tasmania (6% of its forest area) and South Australia (6%) had the lowest proportions of forest area burnt one or more times during this period.
- The Northern Territory (84%) had the highest proportion of forest area burnt one or more times during this period.

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

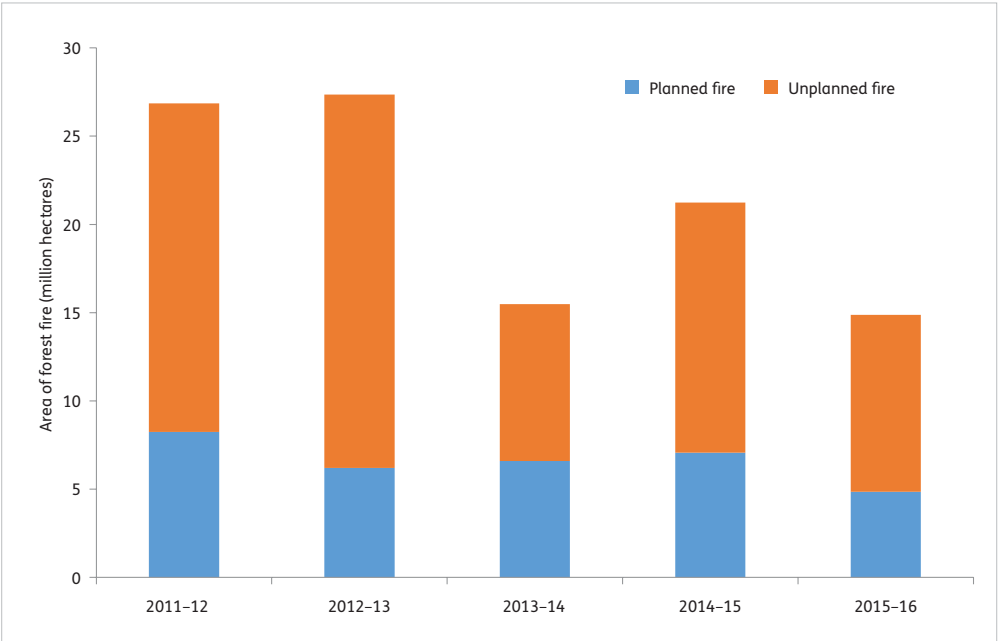
- Of the cumulative area of fire in Australia's forests in the period 2011–12 to 2015–16, 69% was unplanned fire and 31% was planned fire, as identified by state and territory fire management agencies.

Distribution of forest burnt by fire in the period 2011–12 to 2015–16, by fire frequency



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

Area of planned and unplanned forest fire



The data used to create this figure are available in Microsoft Excel via www.doi.org/10.25814/5be12aa83aa34

Forest carbon

Carbon stocks in Australia's forests increased by 0.6%, to 21,949 million tonnes, during the period 2011–16.

In addition, 94 million tonnes of carbon was present in wood and wood products in use in 2016, and 50 million tonnes of carbon in wood and wood products in landfill.

Forests contributed to the net sequestration by the land sector of an amount of carbon dioxide that offset 3.5% of total human-induced greenhouse gas emissions in Australia over this period.

A total stock of 21,949 Mt C (million tonnes of carbon) was stored in Australia's forests at the end of June 2016. Of this forest carbon store:

- 85% was stored in non-production native forests, 14% in production native forests and 1.2% in plantations¹⁰.
- 36% was in above-ground biomass and 64% was in below-ground biomass.

Over the period 2001–16, carbon stocks in forests have varied by no more than 0.7% of the total stock. Over the most recent five years (2011–16), forest carbon stocks increased by 129 Mt, due to a combination of recovery from past clearing, additional growth of plantations, reduced clearing of native forest, expansion of the area of native forests, and continued recovery from bushfire and drought.

In addition to carbon in forests, 94 Mt C was present in wood and wood products in use, and 50 Mt C in wood and wood products in landfill.

- Carbon stocks in both these pools increased steadily over the period 2001–16.
- Carbon stock in wood and wood products in use and in landfill increased by 25 Mt over the period 2001–16, which was greater than the 12 Mt decrease in carbon stocks in forests over this period.
- In total, 22,093 Mt C was held in Australia's forests plus harvested wood products at the end of June 2016.

These forest and wood products carbon stock figures are derived from the carbon stock data that are used to calculate emissions from the land-use, land-use change and forestry sector for Australia's National Greenhouse Gas Inventory. Those emissions values are determined according to the accounting rules specified under the United Nations Framework Convention on Climate Change or the Kyoto Protocol, and cannot simply be related to differences in forest carbon stocks over time.

During the period 2011–16, the land-use, land-use change and forestry sector contributed net sequestration of an amount of carbon dioxide that offset 3.5% of total human-induced greenhouse gas emissions for this period in Australia. This was primarily due to sequestration through forest growth and forest management practices exceeding emissions from activities such as land clearing.

Forest soil and water

A total of 27% of Australia's forests are managed primarily for protective functions, including protection of soil and water values.

The area of Australia's public forest managed primarily for protective functions, including protection of soil and water values, is 36.6 million hectares (27% of Australia's total forest area).

- This area includes formal nature conservation reserves, informal reserves in multiple-use public 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 water supply.

The forest practices systems in Australia's states and territories contain regulations and guidelines designed to prevent or mitigate soil erosion, protect soil physical properties, manage activities that could affect water yields, and manage risks to water quality. Processes are also in place to monitor and ensure compliance with measures that protect forest soil and water resources.

Carbon stored in forests and harvested wood products, 2001 to 2016

Forest category	Carbon (million tonnes)			
	2001	2006	2011	2016
Native forests	21,765	21,583	21,557	21,676
Plantations	190	222	252	258
Other forests	6	8	11	15
Total forest	21,961	21,813	21,820	21,949
Wood products in use	77	83	89	94
Wood products in landfill	42	46	49	50
Total wood products	119	129	138	144
Total forests and wood products	22,080	21,943	21,958	22,093

Source of data: Australian Government Department of the Environment and Energy.

The data used to create this table are available in Microsoft Excel via www.doi.org/10.25814/5be12aa83aa34.

¹⁰ Land uses as defined for the National Greenhouse Gas Inventory

Forest health

The range of native and established introduced pathogens and insect pests active during the period 2011–16 is comparable with previous reporting periods.

Myrtle rust is present in all states and territories except the Australian Capital Territory, South Australia and Western Australia. Forests continue to be impacted by climatic conditions.

A total of 25 introduced vertebrate pest species, and 110 weed species, were reported as having an adverse effect on forests in one or more jurisdictions.

- Introduced vertebrate pests with widespread adverse impacts on forests in one or more jurisdictions were deer, cats, rabbits, pigs, foxes and cane toads.
- Weed species with widespread adverse impacts on forests in one or more jurisdictions were Gamba grass, bridal creeper, Mission grass, lantana, St Johns wort, prickly pear, and blackberry.
- In most jurisdictions, a greater number of vertebrate and weed species were reported as damaging to native forest in conservation reserves and in multiple-use public forests, than to plantations.

The range of native and established introduced pathogens and insect pests active during the period 2011–16 is comparable with previous reporting periods.

- However, for several of the insect pests of plantations previously reported to be most damaging, there were sharp declines over this period in the number of populations that required management.

Myrtle rust is present in all eastern states of Australia and in the Northern Territory.

- Subtropical wet sclerophyll forest or rainforest communities that have mid-storey and understorey layers rich in species of the Myrtaceae family are being severely altered by myrtle rust, with populations of two widespread species, *Rhodamnia rubescens* and *Rhodomyrtus psidioides*, in rapid local decline.

Forests affected by extended drought in southern Australia commenced recovery in the period 2011–16, and the activity of secondary pests and pathogens that attacked drought-stressed trees declined. However, the trend of increasing mean annual temperatures for Australia continued during the period 2011–16, with each year between 2013 and 2016 setting a new record for annual average temperature.



Historic water wheel, Lowden Forest Park, New South Wales.

Most of the forests that suffered extensive damage from tropical cyclone Yasi in 2011 are also recovering. In February 2015, tropical cyclone Marcia caused significant damage to pine plantations in the Byfield area, Queensland, and 600 thousand cubic metres of logs were salvaged from damaged plantations.

Extensive areas of mangrove along the southern coast of the Gulf of Carpentaria suffered rapid dieback and mortality in late 2015.

- The event coincided with unusually low sea-levels and several climate anomalies, which in combination are thought to have produced hypersaline conditions that were beyond levels tolerated by the mangrove species.

Australia has developed a Plantation Forest Biosecurity Plan and a National Forest Biosecurity Surveillance Strategy Implementation Plan to strengthen surveillance systems and minimise the threats from forest pests and pathogens.

For further information on this theme, see Indicator 1.1b, Indicator 1.1d, Indicators 3.1a–b, Indicators 4.1a–e, Indicator 5.1a and Indicator 6.1c of *Australia's State of the Forests Report 2018*.

Production forests

Australia's plantations and native forests provide for commercial production of wood products, under a range of silvicultural systems. Following harvest, areas are regenerated or replanted.

Commercial plantations

The area of commercial plantation was 1.95 million hectares in 2014–15. This area increased from 1990 to 2010, but reduced by 44 thousand hectares (2%) between 2010–11 and 2014–15.

The area proportion of commercial plantations where the trees are privately owned increased to 79% in 2014–15.

As determined from the National Forest Inventory spatial dataset, the area of commercial plantations in 2014–15 was 1.95 million hectares, comprising 1.0 million hectares of softwood species (mostly pines), 0.9 million hectares of hardwood species (mostly eucalypts), and 0.01 million hectares of unknown or mixed species plantations.

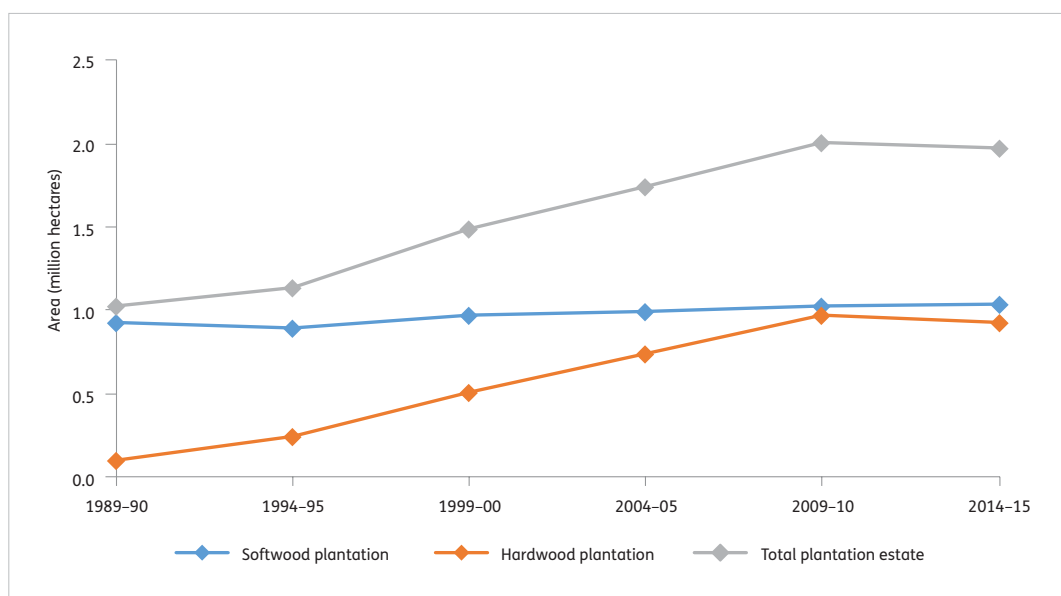
The area of commercial plantations reduced by 44 thousand hectares (2%) between 2010–11 and 2014–15.

- This change reflects a combination of plantation land that was not commercially productive being converted to agricultural or other land uses, and revisions of area figures on land use by plantation managers.
- The area of commercial softwood plantations increased by 1% between 2010–11 and 2014–15, while the area of commercial hardwood plantations decreased by 5%.

The area proportion of Australia's commercial plantation estate where the trees are owned by government organisations decreased from 24% to 21% between 2010–11 and 2014–15, while the proportion where the trees are privately owned increased from 76% to 79%.

The average rate of re-establishment of commercial plantations after harvest between 2011–12 and 2015–16 was 38,500 hectares per year. Across different jurisdictions over this period, the average area proportion of re-established commercial plantation that met stocking standards varied between 93% and 99%.

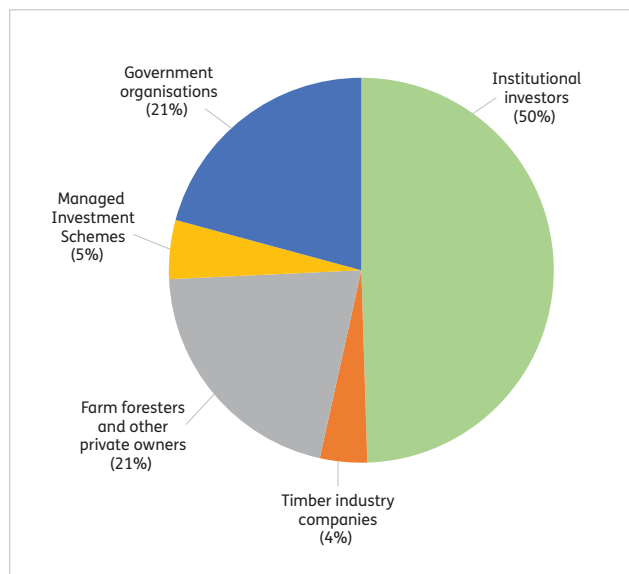
Australia's commercial plantation area, 1989–90 to 2014–15



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

The data used to create this figure are available in Microsoft Excel via www.doi.org/10.25814/5be12aa83aa34

Ownership of Australia's commercial plantations, 2014–15



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.

Note: totals may not tally due to rounding.

The data used to create this figure are available in Microsoft Excel via www.doi.org/10.25814/5be12aa83aa34

Production native forest

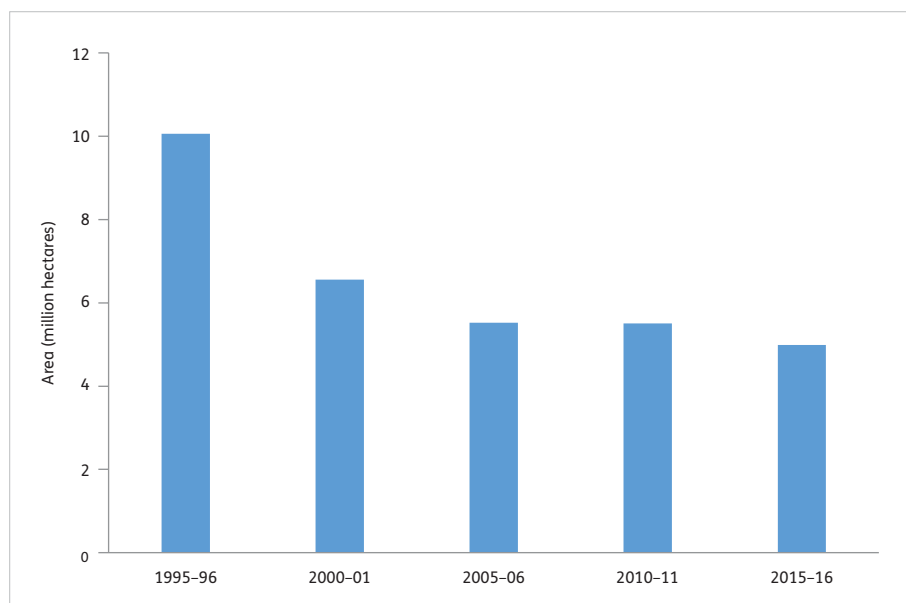
The extent of native forest that is available and suitable for commercial wood production on private and public land was 28.1 million hectares in 2015–16. This area decreased from 2011–12 to 2015–16.

The net harvestable area of multiple-use public native forests was 5.0 million hectares in 2015–16. This area also decreased from 2010–11 to 2015–16.

The extent of native forest that is available and suitable for commercial wood production was 28.1 million hectares in 2015–16. This is a decrease from 29.3 million hectares in 2010–11.

- This area of 28.1 million hectares includes 21.8 million hectares on leasehold and private tenure. However, much of this area is rated as low commerciality (on the basis of its suitability for commercial wood production), is isolated from markets, and harvesting is not financially viable, and is therefore used predominantly for grazing or for other purposes.
- This area of 28.1 million hectares also includes 6.3 million hectares of multiple-use public native forests, much of which is located in the higher rainfall areas of south-west, south-east and eastern Australia.
- When additional exclusions and restrictions to manage non-wood values are taken into account, this available and suitable area of multiple-use public native forests is further reduced to a 'net harvestable area' of 5.0 million hectares. This is a decrease from 5.5 million hectares in 2010–11.
- The decreases in these area measures from 2011–12 to 2015–16 mostly resulted from transfer of areas of multiple-use public native forest to nature conservation reserves, as well as increases in areas to which harvesting restrictions apply.

Net harvestable area of multiple-use public native forest



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

The data used to create this figure are available in Microsoft Excel via www.doi.org/10.25814/5be12aa83aa34

The average annual area of multiple-use public native forest from which wood was harvested decreased to 78 thousand hectares over the period 2011–12 to 2015–16.

Within this area, the proportion harvested by clearfelling systems decreased to 9%.

The average annual area of multiple-use public native forests harvested in Australia in the period 2011–12 to 2015–16 was 78 thousand hectares.

- This is a 24% decrease from the annual average of 102 thousand hectares for the period 2006–07 to 2010–11, which in turn was a 21% decrease from the annual average of 129 thousand hectares for the period 2001–02 to 2005–06.
- The total area harvested on multiple-use public native forests in 2015–16, 73 thousand hectares, is 1.5% of the net harvestable area of public native forest, and 0.75% of the total area of multiple-use public native forest.

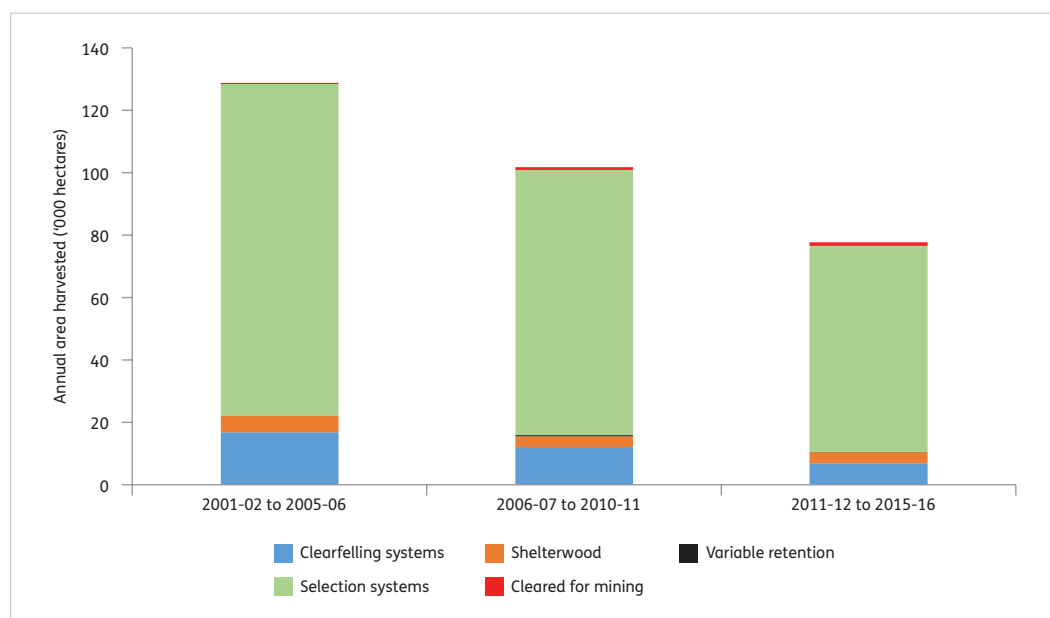
A range of silvicultural systems are used for forest harvesting.

- Of the area of multiple-use public native forest harvested over the period 2011–12 to 2015–16, 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), 5% by shelterwood systems, and 0.2% by variable retention systems.
- The annual average area harvested by clearfelling systems decreased from 17 thousand hectares in 2001–02 to 2005–06, to 12 thousand hectares in 2006–07 to 2011–12, to 7 thousand hectares in 2011–12 to 2015–16.

Across the period 2011–12 to 2015–16, the annual average proportion of harvested multiple-use public native forest that was effectively regenerated, as assessed against stocking standards, was 79% in New South Wales, 100% for Queensland, 95% for Tasmania and 92% for Victoria. For Western Australia, the level of regeneration was assessed as adequate, with more detailed reporting to be provided in the mid-term performance review of the *Forest Management Plan 2014–2023*.

For further information on this theme, see Introduction, Indicator 1.1a and Indicators 2.1a–c of *Australia's State of the Forests Report 2018*.

Average annual area harvested from multiple-use public native forest, by silvicultural system



The area of variable retention harvesting is not visible at this scale. Jarrah forests in Western Australia that are harvested as part of clearing for bauxite mining are shown as 'cleared for mining'. The three time-periods refer to the reporting periods for SOFR 2008, SOFR 2013 and SOFR 2018 respectively.

The data used to create this figure are available in Microsoft Excel via www.doi.org/10.25814/5be12aa83aa34

Harvested wood and non-wood products

Wood and non-wood products from Australia's forests make a substantial contribution to the economy and to society more generally. An increasing proportion of Australia's wood is produced in plantations.

Wood volumes harvested

Australia's log harvest in 2015–16 was 30.1 million cubic metres, a 13% increase from 2010–11.

The volume of logs harvested from commercial plantations increased over this period, and 86% of the total log harvest was derived from commercial plantations in 2015–16.

A progressive reduction in total native forest harvest volumes has occurred in all jurisdictions since the period 2001–06. The national harvest of sawlogs from private native forests has also declined progressively since that period.

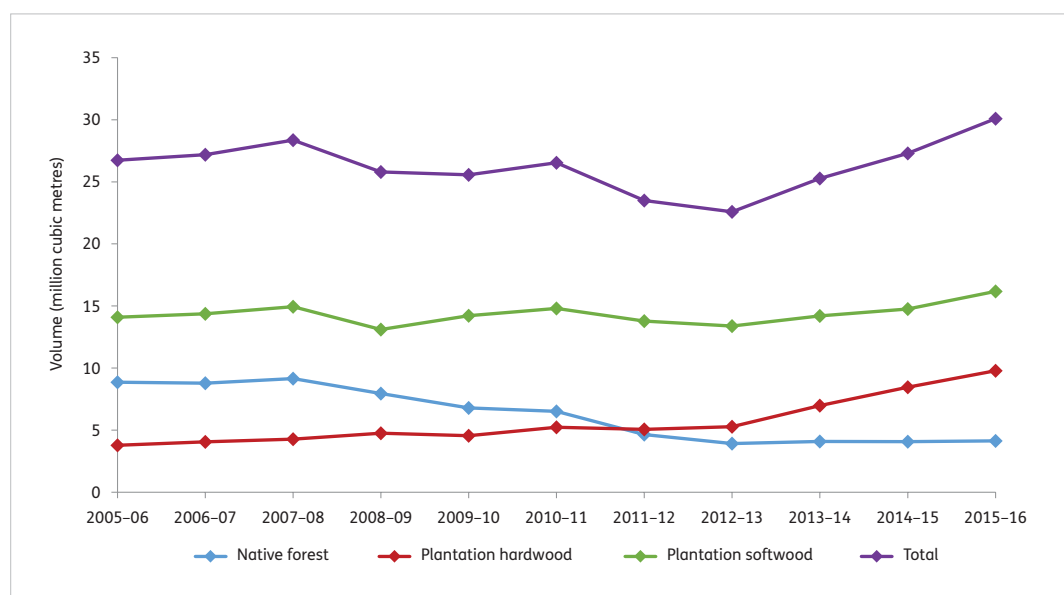
The total volume of Australia's log harvest in 2015–16 was 30.1 million cubic metres, a 13% increase from 26.5 million cubic metres in 2010–11.

Over the period 2010–11 to 2015–16, the volume of logs harvested from commercial hardwood and softwood plantations increased by 30%, from 20.0 million cubic metres to 26.0 million cubic metres.

- The volume of logs harvested in 2015–16 comprised 9.8 million cubic metres of plantation hardwood logs and 16.2 million cubic metres of plantation softwood logs.
- Over the period 2000–01 to 2015–16, the annual plantation hardwood pulplog harvest increased from 0.9 million cubic metres to 9.6 million cubic metres.
- Approximately 60% by volume of the total plantation log harvest in the period 2011–16 was sawlogs, and 39% by volume was pulplogs. However, of the total plantation hardwood log harvest in this period, only 2% by volume was sawlogs and 98% by volume was pulplogs.
- In 2015–16, 86% of the volume of logs harvested in Australia was from commercial plantations.

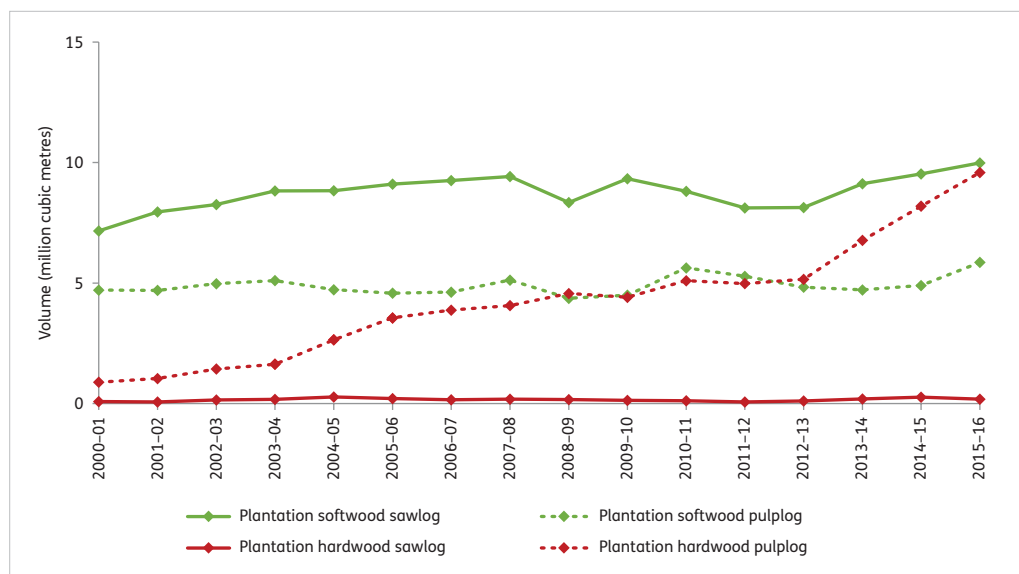
The availability of sawlogs and pulplogs for harvest from softwood plantations is expected to remain relatively constant over the period from 2015–19 to 2055–59. During the same period, the total availability of sawlog for harvest from hardwood plantations is expected to increase, while the total availability of pulplog for harvest from hardwood plantations is expected to decrease.

Volume of logs harvested from native forests and commercial plantations



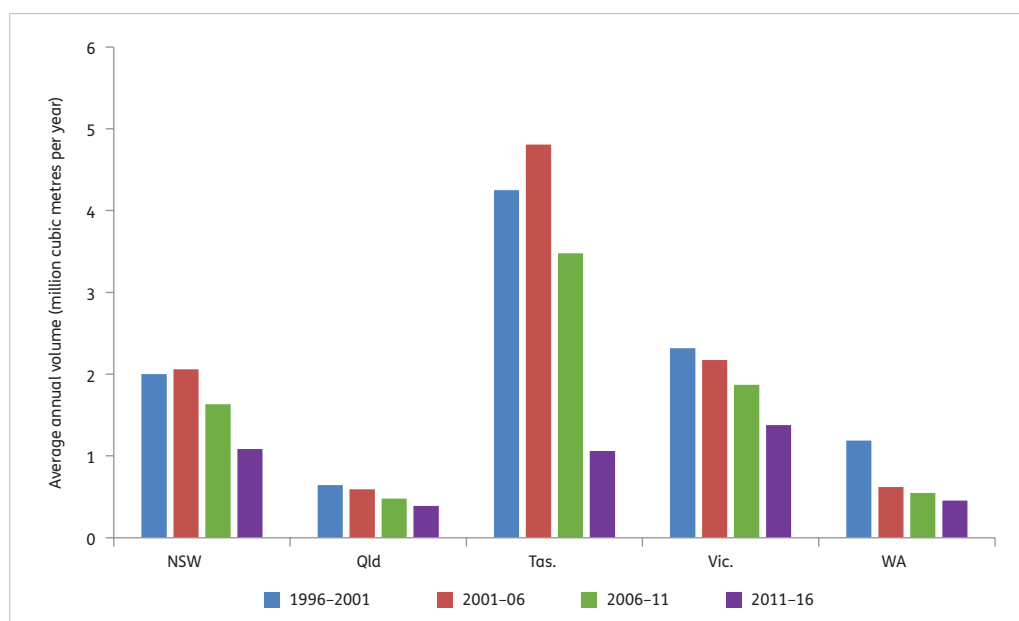
The data used to create this figure are available in Microsoft Excel via www.doi.org/10.25814/5be12aa83aa34

Volume of hardwood and softwood sawlogs and pulplogs harvested from plantations



The data used to create this figure are available in Microsoft Excel via www.doi.org/10.25814/5be12aa83aa34

Volume of logs harvested from native forests across Australia



No harvesting of public native forest occurs in Australian Capital Territory, the Northern Territory or South Australia.

The data used to create this figure are available in Microsoft Excel via www.doi.org/10.25814/5be12aa83aa34

Over the period 2010–11 to 2015–16, the volume of logs harvested from native forests declined by 37%, from 6.5 million cubic metres to 4.1 million cubic metres. A progressive reduction in native forest harvest volumes has occurred over the last 20 years in all jurisdictions in which there is harvesting of native forest, due to reduction in areas available for wood production, and changes in national and international markets.

The national harvest of sawlogs from private native forests has declined progressively since the period 2001–06. The reasons for this decline differ between states, and are not always clear.

Native forests remain the main source of hardwood sawlogs, because most hardwood plantations cannot be managed to produce sawlogs of comparable quality, although there

is on-going research on this topic. Native forest sawlogs are primarily used to make feature-grade sawn timber products.

Production from plantations and native forests can also be analysed as sawnwood, wood-based panels, and paper and paperboard. Over the period 2010–11 to 2015–16:

- The total volume of sawnwood production increased by 12%, from 4.6 to 5.1 million cubic metres.
- The total volume of wood-based panel production decreased by 2%, from 1.73 million cubic metres to 1.70 million cubic metres.
- The total weight of paper and paperboard production increased by 2%, from 3.16 million tonnes to 3.22 million tonnes.

In 2015–16, the value of logs harvested from native forests and commercial plantations was \$2.3 billion.

In 2015–16, the value of production of wood products industries was \$23.7 billion.

In 2015–16, the value added by the forest and wood products industries was \$8.6 billion, representing a contribution to Australia’s gross domestic product of 0.52%.

The value of logs harvested from native forests and commercial plantations (calculated at the mill door) increased by 22% over the period 2010–11 to 2015–16, from \$1.9 billion to \$2.3 billion.

- The value of logs harvested from native forests decreased from \$0.50 billion to \$0.39 billion over this period.
- The value of logs harvested from commercial plantations increased from \$1.36 billion to \$1.88 billion over this period.

The value of production (total industry turnover, or sales and service income) of the wood products industries decreased by 2% over the period 2010–11 to 2015–16, from \$24.0 billion to \$23.7 billion.

- The value of sawnwood production decreased by 7%, from \$3.8 billion in 2010–11 to \$3.5 billion in 2014–15.
- The value of wood-based panel production decreased by 3%, from \$1.62 billion in 2010–11 to \$1.57 billion in 2015–16.
- The value of paper and paperboard production decreased by 4%, from \$10.9 billion in 2010–11 to \$10.5 billion in 2015–16.

The value added by the forest and wood products industries was \$8.6 billion in 2015–16, representing a contribution to Australia’s gross domestic product of 0.52%. In 2010–11 the value added was \$8.3 billion, a contribution of 0.59%.

Sustainable harvest of native forests

The volume of sawlogs harvested from public native forests in the period 2011–12 to 2015–16 was within sustainable yield levels in New South Wales, Tasmania, Victoria and Western Australia, and was within the allowable cut in Queensland.

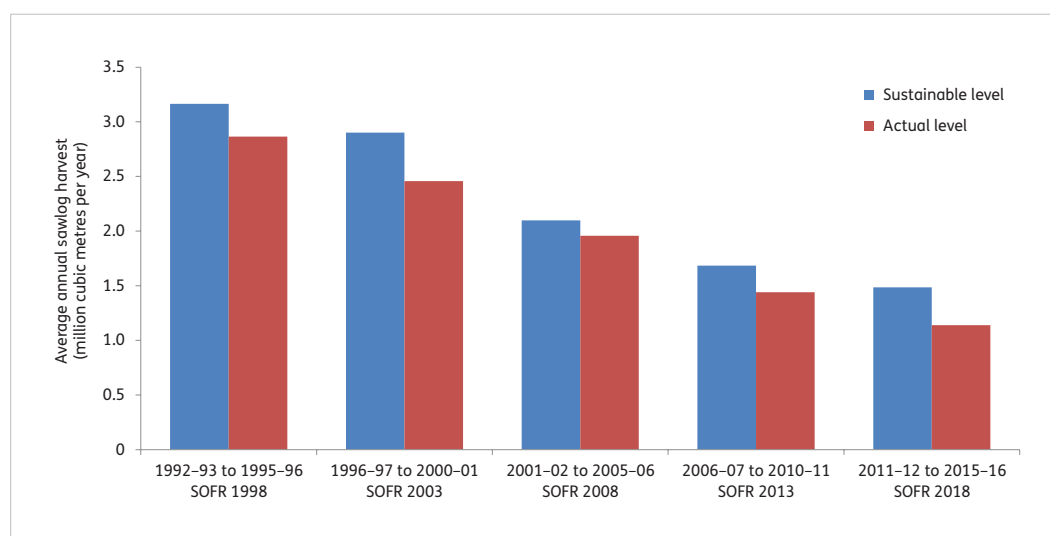
An average annual volume of 1.14 million cubic metres of high-quality sawlog was harvested from multiple-use public native forests (including other native forests where timber is owned by the Crown) nationally in the period 2011–12 to 2015–16.

- This is a 21% decrease from the annual average volume of 1.44 million cubic metres in the period 2006–07 to 2010–11, which in turn was a 26% decrease from the annual average of 1.96 million cubic metres for the period 2001–02 to 2005–06.

The sustainable annual yield of high-quality sawlogs from multiple-use public native forests is the yield that can be removed each year while ensuring maintenance of the functioning of the native forest system as a whole and the supply of wood products in perpetuity. This sustainable yield has declined by 53% from 1992–93 to 2015–16.

- Reasons for the decline in sustainable yield from multiple-use public native forests include the transfer of multiple-use public native forests into nature conservation reserves, increased restrictions on harvesting, revised estimates of growth and yield, and (especially in Victoria) impacts of occasional, intense broad-scale bushfires.

National average annual harvest and sustainable yield of sawlog from multiple-use public native forests



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

The data used to create this figure are available in Microsoft Excel via www.doi.org/10.25814/5be12aa83aa34

However, the volume of sawlogs harvested from public native forests in each of the five reporting periods from 1992–93 to 2015–16 remained within sustainable yield levels in New South Wales, Tasmania, Victoria and Western Australia or within allowable tolerances, and was within the allowable cut in Queensland. No harvesting of public native forest occurs in the Australian Capital Territory, the Northern Territory, or South Australia.

Nationally, the sustainable yield of high-quality sawlogs from publicly managed native forests is forecast to continue to decline until the period 2030–34. After that time, it is forecast to increase slightly, given no further reductions in net harvestable area, and successful management of risk from wildfire, disease and climate change.

Non-wood forest products

Australia produces a wide range of non-wood forest products derived from forest fauna, flora and fungi, and many non-wood forest products supply commercial domestic and export markets. High-value non-wood forest products include wildflowers, seed, honey, and aromatic products derived from tea-tree and sandalwood.

Data on annual removals are limited for many non-wood forest products, but are available for some of the more commercially significant non-wood forest products such as tree ferns in Tasmania, eastern grey kangaroo and wallaroo in Queensland, Bennett's wallaby and brushtail possum in Tasmania, and honey nationally. Information on the production, consumption and trade of non-wood forest products is also often difficult to obtain because of the generally small size of industries based on these products and their dispersed nature.

Beekeeping is one of the largest non-wood forest product industries. Over the period 2011–16:

- an annual average of 20.8 thousand tonnes of honey was produced, much of which was derived from forested lands
- the annual volume of honey production declined by 17%
- the gross annual value of honey production increased by 39%, to \$110 million.



Banksia inflorescence, Queensland.

Consumption, trade and recycling of wood products

Australia's trade in wood products experienced strong growth over the past decade, with the sum of imports and exports (total merchandise trade) exceeding \$8 billion for the first time in 2015–16.

Australia continues to be a net importer of wood and wood products.

The patterns of annual consumption of forest products in Australia changed over the period 2010–11 to 2015–16.

- Annual consumption of sawnwood increased by 12%, to 5.6 million cubic metres.
- Annual consumption of wood-based panels increased by 5%, to 2.1 million cubic metres.
- Annual consumption of paper and paperboard fell by 8%, to 3.7 million cubic metres.

Australia's trade in wood products experienced strong growth over the past decade, with the sum of imports and exports (total merchandise trade) exceeding \$8 billion for the first time in 2015–16.

- Between 2010–11 and 2015–16, the total annual value of wood product imports increased from \$4.4 billion to \$5.5 billion, driven mainly by higher imports of miscellaneous forest products and wood-based panels.
- The total value of annual wood product exports increased from \$2.5 billion to \$3.1 billion over this period, primarily due to higher exports of roundwood, woodchips, and paper and paperboard.
- Australia continues to be a net importer of wood and wood products.

Residential use of firewood declined by 12% between 2006–11 and 2011–16, whereas industrial use of fuelwood increased by 19%.

- In the period 2011–16, industrial fuelwood was used to generate an annual average of 40 petajoules of energy.

In 2015–16, 1.7 million tonnes of recycled paper were used for domestic paper and paperboard production in Australia, contributing 53% of paper and paperboard produced.

- A total of 1.4 million tonnes of recycled paper were also exported in 2015–16.
- Altogether, in 2014–15 Australia recycled 60% of the 5.3 million tonnes of paper and cardboard waste generated.

For further information on this theme, see Indicators 2.1c–e, Indicators 6.1a–b and Indicators 6.1d–e of *Australia's State of the Forests Report 2018*.

Employment and education

The forest sector is a significant employer in rural and regional Australia. Educated workers are integral to the development of the forest and wood products industries, and economic diversity, community wellbeing and capital resources contribute to resilient communities.

Employment, wages and safety

Total national direct employment in the forest sector was 51,983 persons in 2016, a 24% decrease from 2011.

A total of 30 Local Government Areas are 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.

Total national direct employment in the forest sector was estimated at 51,983 persons in 2016, down by 24% from 68,596 persons in 2011. Forest sector employment decreased in all jurisdictions except the Northern Territory during this period.

- Between 2011 and 2016, national direct employment decreased in the wood product manufacturing subsector and the pulp, paper and converted paper product manufacturing subsector, but increased in the smaller forestry and logging and forestry support services subsectors.
- The key drivers for the reduction in total employment in the forest sector were consolidation of processing into larger facilities with higher labour efficiencies, and restructuring of the sector.
- The forestry and wood products sector also creates employment indirectly, in activities that support or depend on this sector.

In 2016, there were 30 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.

- Five of these LGAs had 8% or more of their workforce employed in the forest and wood products industries.
- Employment in forest and wood products industries declined in 21 of these 30 LGAs over the period 2011–16. With the exception of LGAs in Victoria, these declines were greater than the declines observed in total employment within each LGA.
- Large proportional increases in forest and wood products industries employment were in LGAs in south-west Victoria and northern Tasmania.

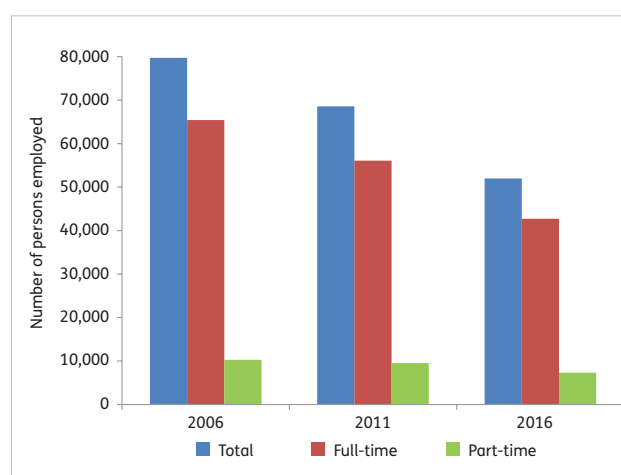
Total annual wages and salaries in the forest sector were between \$4.0 and \$4.3 billion over the period 2010–11 to 2015–16. In 2015–16:

- the average annual wage in the forestry and logging subsector was \$41,538
- the average annual wage in the wood product manufacturing subsector was \$53,233
- the average annual wage in the pulp, paper and converted paper product subsector was \$94,125.

Nationally, 28% of forest sector workers households had weekly incomes below \$800. This is slightly lower than the proportion for total workforce households.

- The proportion of households with weekly incomes below \$800 fell by more in the forest sector over the five years to 2016, than in the broader workforce.

Total national employment in the forest sector



Total employment is slightly 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.

The data used to create this figure are available in Microsoft Excel via www.doi.org/10.25814/5be12aa83aa34

Between 2010–11 and 2014–15, the number of serious injury claims rose by 5% in the forestry and logging subsector (from 137 to 144), and fell by 25% in the wood and paper product manufacturing subsector (from 1,826 to 1,371).

- The incidence of serious injury claims per thousand employees in each sector varied similarly.

Education and community resilience

Levels of community adaptive capacity varied considerably across the 30 Local Government Areas rated as dependent on forest and wood products industries.

Nationally, 54% of forestry workers had non-school qualifications in 2016, compared with 65% in the total workforce.

Community adaptive capacity can be represented as a combination of economic diversity, community wellbeing, and capital resources. Higher levels of adaptive capacity in communities can indicate greater resilience to industry change.

- Levels of community adaptive capacity varied considerably across the 30 Local Government Areas rated as dependent on forest and wood products industries.

In 2016, the median age of forest and wood products workers was from 40 to 50 years in 22 of the 30 LGAs dependent on forest and wood products industries.

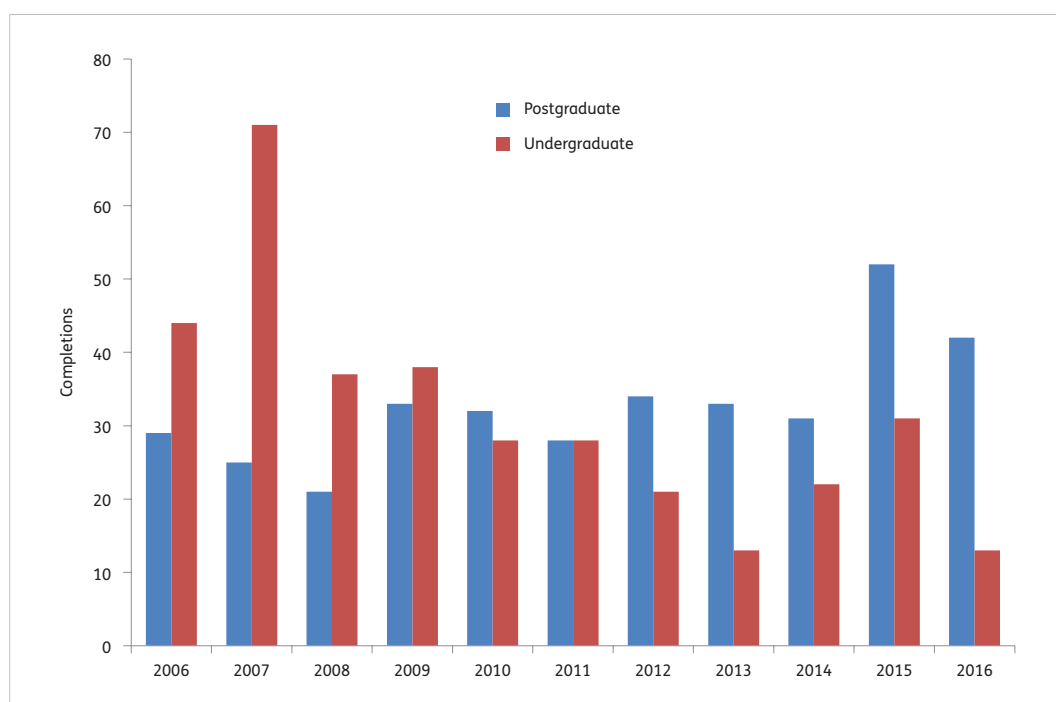
- There was a small increase in the median age of forest and wood products workers nationally between 2011 and 2016.
- In eight LGAs dependent on forest and wood products industries, four of which were in Tasmania, the median age of workers in this sector was lower in 2016 than in 2011.

Nationally, 54% of forestry workers had non-school qualifications in 2016 (such as certificates, diplomas or degrees), compared with 65% in the total workforce.

- In 25 of the 30 LGAs dependent on forest and wood products industries, the proportion of forestry workers with qualifications increased between 2011 and 2016.
- A range of training and education qualification options continues to be available in Australia across all areas relevant to sustainable forest management, from operational competency certificates, to coursework certificates and diplomas, and graduate and postgraduate degrees.
- Over time, there has been a decreasing trend in undergraduate degree completions, and an increasing trend in postgraduate degree completions.

For further information on this theme, see Indicators 6.5a–c and Indicators 7.1b–c of *Australia's State of the Forests Report 2018*.

Australian university degree completions in forest-related studies



Postgraduate degree completions include graduate diplomas.

The data used to create this figure are available in Microsoft Excel via www.doi.org/10.25814/5be12aa83aa34

Social and community

Australia's forests provide multiple social values to the community. They provide opportunities for tourism and recreation, and include many sites that provide evidence of the interactions between people and forest landscapes.

Heritage

In 2016, 11.0 million hectares of forest was on non-Indigenous heritage-listed sites. In addition, in 2016 there were an estimated 126 thousand registered Indigenous heritage sites within forest.

Heritage represents the tangible and intangible connections that people have with the past, through landscapes, landmarks, places, historic buildings, objects, significant events, customs and ceremonies. Heritage sites are widespread across Australia's forests.

In 2016, 11.0 million hectares of forest was on non-Indigenous heritage-listed sites across all jurisdictions.

- This is an increase of 3.7 million hectares since 2011, mainly due to the registration of new heritage places.

In addition, in 2016 there were an estimated 126 thousand registered Indigenous heritage sites within forest.

- Excluding the Australian Capital Territory and Victoria, for which spatial data were not available, there were 1.8 million hectares of forest in registered Indigenous heritage sites in 2016.

Visitation

Most forests in nature conservation reserves and multiple-use public native forests in Australia are available to the general public for recreation or tourism purposes. An annual average of 4.2 million visitors visited major forested tourism regions for bushwalking in the period 2011–12 to 2015–16.

The total areas of native forest in nature conservation reserves and multiple-use public native forests tenures are 21.7 million hectares and 9.8 million hectares, respectively. These are the tenures generally available to the general public for recreation or tourism.

- Some land in other tenure categories may be similarly available.
- Kakadu National Park in the Northern Territory is an example of reserved forest on private land tenure that is available for recreation and tourism.

Tourism Australia data indicate that an annual average of 4.2 million visitors visited major forested tourism regions for bushwalking in the period 2011–12 to 2015–16, with 10% of these visitors identifying as international visitors.

- Data are also available at the state and territory level on the number of sites and facilities for a diverse range of recreational activities in both nature conservation reserves and state forests (multiple-use public forests), and the number of visitors.
- For example, Forestry Corporation of New South Wales estimated that there were 28 million recreational visitors to New South Wales state forests during 2015–16. Forestry Corporation of New South Wales manage and maintain more than 150 designated visitor sites.

Indigenous participation and employment

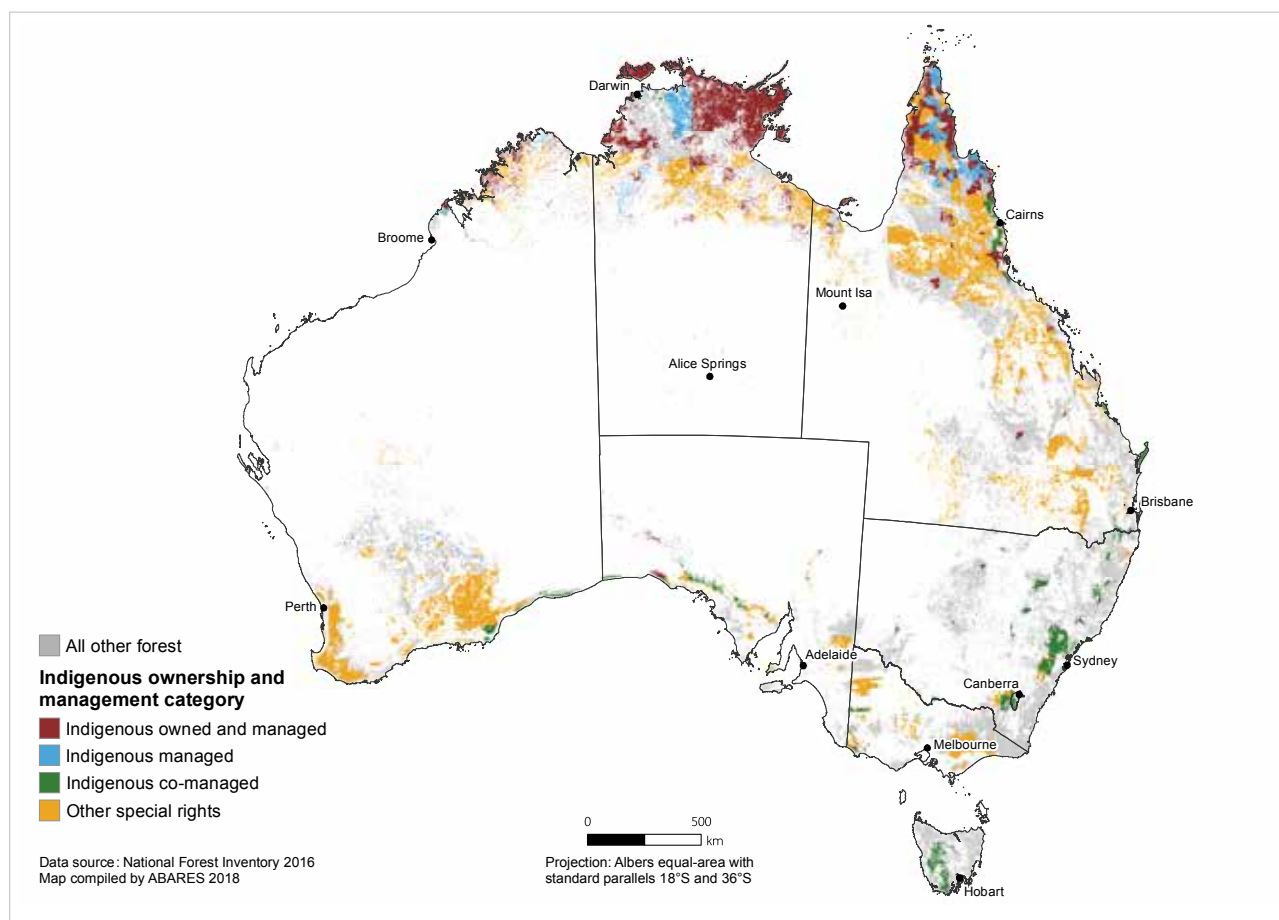
Four Indigenous ownership and management categories describe the degree of management control and influence that Indigenous people have over forest land.

In 2016, the forest and wood products industries directly employed 1,099 Indigenous people, while an estimated 337 Indigenous people were employed in conservation or park operation roles in areas with forested conservation reserves.

Access to native forests, and involvement in native forest management, enables Indigenous people to maintain or re-connect with cultural values, which in turn strengthens personal and community resilience.

- The degree of management control and influence that Indigenous people have over forest relates to the Indigenous ownership and management category into which the forest is classified: Indigenous owned and managed, Indigenous managed, Indigenous co managed, or covered by Other special rights. Together, land in these four categories comprises the Indigenous forest estate.
- This Indigenous forest estate covers a total of 70 million hectares of forest (52% of Australia's forests).
- The largest areas of forest in the Indigenous estate occur within Indigenous Land Use Agreement areas, and areas for which there has been a native title determination.
- Other large areas of forest occur within the Northern Territory Aboriginal Land Trusts, Queensland Aboriginal and Torres Strait Islander land trusts, Indigenous Protected Areas, and owned and leased-back conservation reserves.

Distribution of the Indigenous forest estate by land ownership and management categories



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

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.

- There are ongoing efforts to include Indigenous cultural, contemporary and aspirational values in forest management
- Over time, there has been increased Indigenous participation in the development and implementation of management plans for forest reserves, conservation reserves and regional conservation areas across Australia.

An estimated 337 Indigenous people were employed in conservation or park operation roles in areas with forested conservation reserves in 2016. Forest-related employment that draws on traditional activities and knowledge delivers both cultural and economic benefits.

Participation of Indigenous workers in the commercial forest and wood products industries can also support livelihoods through income, skills development, and a connection with forests through services and advice. In 2016, the forest and wood products industries directly employed 1,099 Indigenous people nationally.

- In seven Indigenous Locations across Australia, more than 10% of the Indigenous workforce was employed in the forest and wood products industries.

Public perceptions of forest management

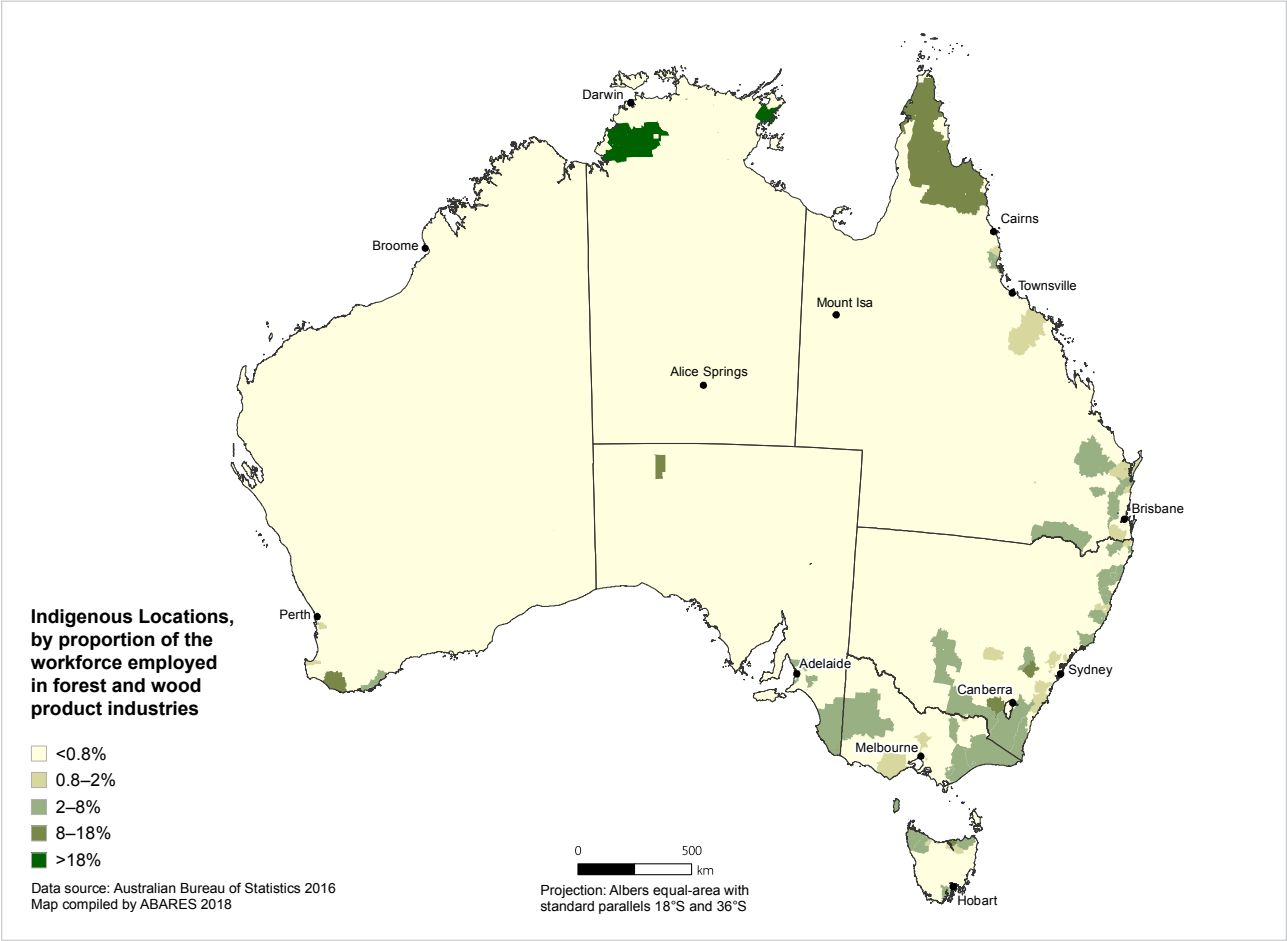
There is a range of public perceptions of forest management and of the acceptability of plantations.

Surveys conducted between 2008 and 2017 on behalf of Forest and Wood Products Australia indicate the attitudes of Australians to a range of forest-related issues. Averaged across these surveys:

- just under half of the respondents agreed that Australia's native forests are being managed sustainably
- a majority of respondents considered that wood is more environmentally friendly than alternative materials, and a large majority of respondents preferred the use of Australian trees rather than overseas trees to make wood products
- a majority of respondents also believed that harvesting trees is acceptable so long as the trees are replaced.

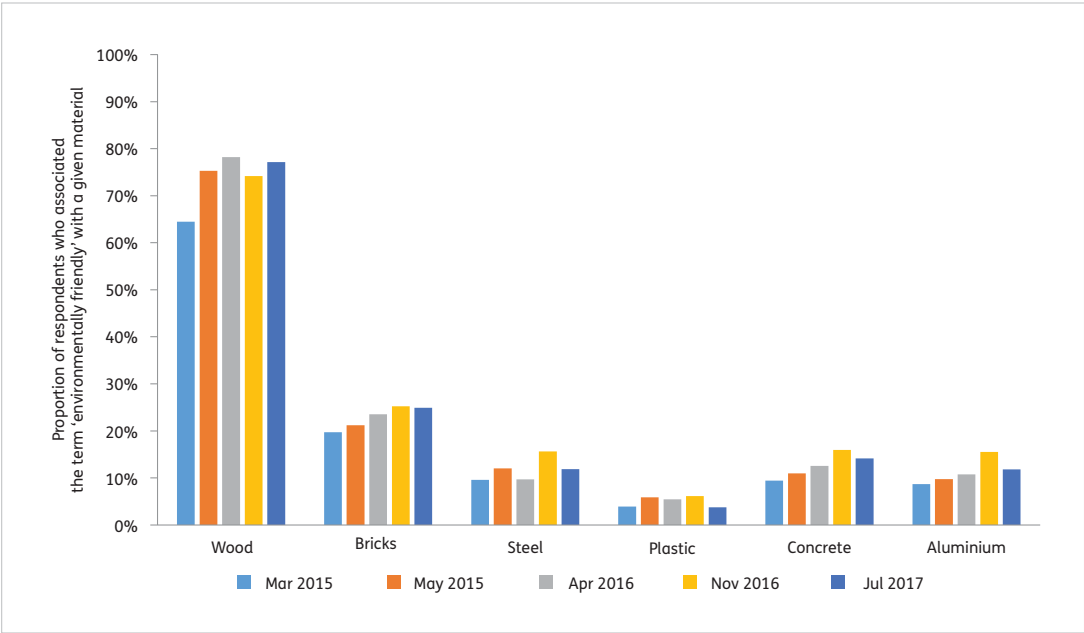
For further information on this theme, see Indicators 6.3a–b, Indicators 6.4a–d and Indicator 6.5d of Australia's *State of the Forests Report 2018*.

Indigenous Locations, by proportion of the Indigenous workforce employed in forest and wood products industries, 2016



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

Perceptions of whether materials are ‘environmentally friendly’



Average proportion of respondents who associated the term ‘environmentally friendly’ with a given material. Source: Forest and Wood Products Australia.

The data used to create this figure are available in Microsoft Excel via www.doi.org/10.25814/5be12aa83aa34

Investment, research and development

Investment in establishing and managing native forests and plantations is key to maintaining forest values and services. Research and development underpin improved management practices and new commercial technologies and facilities.

Investment

Between 2010–11 and 2014–15, funding for new commercial plantations was increasingly sourced from institutional investors. Capital investment in timber industry processing facilities was estimated at \$938 million for the period 2012 to 2017.

Investment in the establishment of new commercial plantations, as well as re-establishment of harvested commercial plantations, is important for future wood availability.

- The annual rate of establishment of new commercial plantations in Australia declined from 4,200 hectares in 2011–12, to 900 hectares in 2014–15, then increased to 1,600 hectares in 2015–16.
- During the period 2011–12 to 2014–15, new plantings comprised mostly hardwood plantations in Victoria, Queensland and the Northern Territory.
- During the period 2014–15 to 2015–16, new plantings comprised solely softwood plantations in New South Wales and Western Australia.

Between 2010–11 and 2014–15, funding for new commercial plantations was increasingly sourced from institutional investors. Institutions have also been involved in purchases of established commercial plantations.

- In 2014–15, institutional investors owned 50% of Australia's commercial plantations, compared to 31% in 2010–11.
- During the same period, farm foresters and other private owners increased their area share of total commercial plantation area from 8% to 21%.
- This shift reflects the increasing contribution of private investment capital to the growth and development of the sector.

Further structural adjustment and consolidation of the sawmill industry also occurred over this period. The domestic softwood sawmill industry is becoming significantly more capital-intensive, and larger in scale.

Capital investment in timber industry processing facilities was estimated at \$938 million for the period 2012 to 2017.

- The majority of these new investments targeted increased productivity, higher recovery and improved grade yield in the sawmilling sectors, and increased productivity and development of new products in the panel and plywood sectors.



Mangroves near Coffs Harbour, New South Wales.

Research and development

Two different surveys show that expenditure on research and development in forestry and forest products has declined over time, as has associated capacity. The number of people involved in research and development in forestry and forest products has also continue to decline.

Investment in research and development activities can lead to improvement in forest management practices, and to new technologies for commercial adoption. However, expenditure on research and development in forestry and forest products and associated capacity has declined.

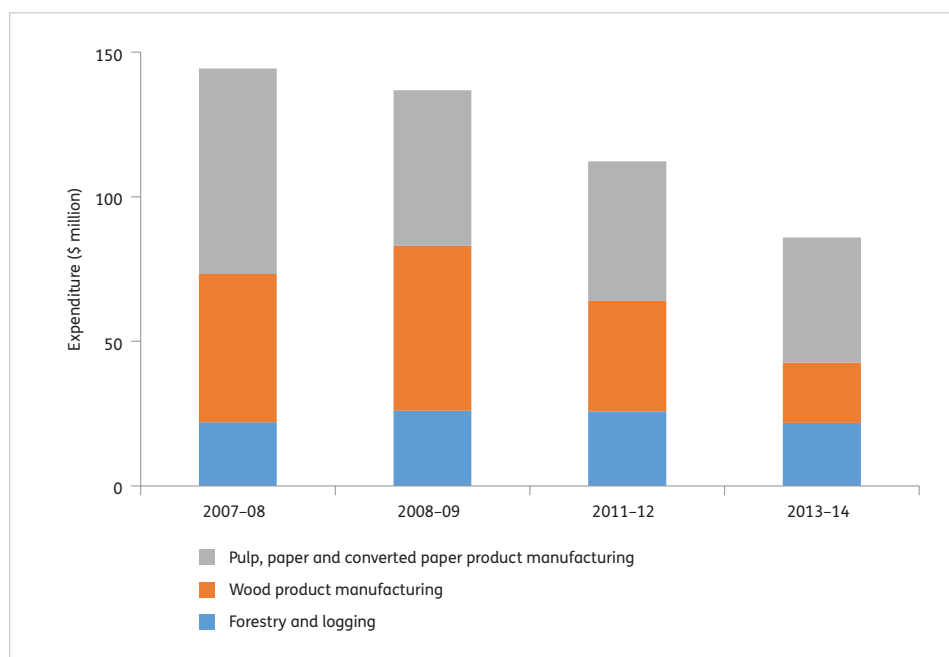
- Australian Bureau of Statistics data show that, from 2007–08 to 2013–14, total expenditure on research and development reported by businesses in the forest and wood products sector declined from \$144 million to \$86 million, although only partial data are available for some years.
- A separate series of surveys of the forest and forest products sector, using a different definition of the sector, reported that research and development expenditure on forestry and forest products decreased from \$88 million in 2007–08, to \$48 million in 2012–13.
- Ongoing changes in funding and delivery models reduced forest research and development capacity across a number of national organisations, but a number of new, university-based forestry and/or forest products research centres were also established during the period 2011–2016.

In parallel, the estimated number of researchers and technicians involved in research and development in forestry and forest products declined from 733 in 2008, to 455 in 2011, and to 276 in 2013.

- The decline has occurred across the public and private sectors, including government agencies and universities.
- The total number of forestry and forest products researchers employed by state and territory agencies was reported as 89.5 full-time-equivalent staff in 2015–16, approximately half the 171.8 full-time-equivalent reported for 2011–12.

For further information on this theme, see Indicators 6.2a–b, Indicator 7.1c and Indicator 7.1e of Australia's *State of the Forests Report 2018*.

Business research and development expenditure in the forest and wood products sector



Source of data: Australian Bureau of Statistics

The data used to create this figure are available in Microsoft Excel via www.doi.org/10.25814/5be12aa83aa34

Frameworks for forest policy, management, monitoring and reporting

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.

Australia has a well-established framework for forest management, guided by a National Forest Policy Statement, and including policy and legislative instruments, and codes of forest practice.

Two schemes certify forest management and provide chain-of-custody certificates for tracking wood products. At June 2018, approximately 8.9 million hectares of native forests and plantations were certified for forest management under either scheme.

Reporting to the community on Australia's forests occurs at the state level, nationally and internationally.

Legal and policy frameworks

All states and territories and the Australian Government have legislation that supports the conservation and sustainable management of Australia's forests.

- Australia's public native forests, including those held in nature conservation reserves and those available for wood production, are governed and managed under state or territory regulatory frameworks and management plans.
- Management of forests on private land is also regulated under various Acts of Parliament.

As at 2016, 43 million hectares (32% of Australia's forests) were covered by management plans relating to their conservation and sustainable management. Management plans are in place for 19 million hectares of forest in the National Reserve System (57% of the area of forest in the National Reserve System).

The effectiveness of government policies in promoting conservation and sustainable management of production forests and conservation reserves was assessed as effective or very effective by the Australia State of the Environment 2016 report.

Certification

At June 2018, approximately 8.9 million hectares of native forests and plantations were certified for forest management under either the Responsible Wood Certification Scheme or the Forest Stewardship Council scheme. Some forests and plantations were certified under both schemes.

In addition, at that date, a total of 189 chain-of-custody certificates for tracking wood from the forest to the final product were issued under the Responsible Wood Certification Scheme, and 258 chain-of-custody certificates were issued under the Forest Stewardship Council scheme.

Monitoring and reporting

Australia's *National Forest Policy Statement* (Commonwealth of Australia 1992) 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 implements these commitments, 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 indicators, are reported to government and industry stakeholders and the broader community.

Some states also publish five-yearly 'state of the forests' reports, based on a framework of criteria and indicators similar to the national SOFR series.

Australia also uses the data compiled for the SOFR series to report internationally on the state of its forests through:

- the Global Forest Resources Assessment and the State of the World's Forest Genetic Resources processes undertaken by the Food and Agriculture Organization of the United Nations
- the United Nations Sustainable Development Goals
- the Global Forest Goals of the United Nations Forum on Forests.



Eucalyptus delegatensis in the Australian Capital Territory.

The availability, coverage and currency of the data available for the national SOFR series vary considerably between indicators and also between reports in this series, but has improved overall for SOFR 2018 compared to SOFR 2013.

- The data available for SOFR 2018 were assessed as comprehensive in each of coverage, currency and frequency for 23 of the 44 national reporting indicators, and as comprehensive in two of these three aspects for a further 11 indicators.
- The most comprehensive information is available for multiple-use public forests, with less information on nature conservation reserves, and significant gaps in data collection and monitoring for leasehold and private forests and for other Crown land.
- A number of new and improved social, economic and environmental datasets compiled for the National Forest Inventory have been analysed and presented in SOFR 2018.
- There are also a number of topics for which data are missing or incomplete.

The national SOFR series presents data on all of Australia's forests, both public and private forests, and both forests managed for conservation and forests managed for production. Trends over time are reported when the data are of sufficient quality, and drivers of change are identified if these are clear.

However, SOFR 2018 does not present detailed analyses or interpretation in regard to the meaning or 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.

Overall, *Australia's State of the Forests Report 2018* addresses its purpose of being a 'comprehensive national report', and provides the reader with information to assess progress towards sustainable forest management in Australia.

For further information on this theme, see Introduction and Indicators 7.1a–d of *Australia's State of the Forests Report 2018*.



Introduction

The forests of Australia are diverse and highly valued, and are among the country's most important natural resources.

Australia's native forests occur in a broad range of geographic landscapes and climatic environments, and contain many endemic species that occur naturally only in Australia or in a particular region within Australia, combining to form unique and complex ecosystems.

Australia's forests are recognised for their wide range of environmental, social and economic values. They support a variety of biodiversity, including many species found nowhere else. They provide ecosystem services such as clean water and soil protection, and opportunities for recreation, tourism, and scientific and educational pursuits, and have important cultural, heritage and aesthetic values. They also provide wood and non-wood products that are used by Australians in their everyday lives.

In 1992, the Australian Government and state and territory governments agreed a *National Forest Policy Statement* (Commonwealth of Australia 1992), which set out a vision for Australia's forests and associated goals, objectives and policies (Box I.i). The *National Forest Policy Statement* commits 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* series implements these commitments. *Australia's State of the Forests Report 2018* (referred to as SOFR 2018) is the fifth report in this series, following those published in 1998, 2003, 2008 and 2013¹¹.

The SOFR series 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 indicators, are reported to government and industry stakeholders and the broader community. The SOFR series meets Australia's formal national reporting requirements for forest information, and the data assembled for SOFR are also used to meet Australia's international forest-related reporting requirements.

¹¹ The *Australia's State of the Forests Report* series can be accessed at www.agriculture.gov.au/abares/forestsaustralia/sofr

What is a forest in Australia?

The definition of forest used in this report is the same as that used in Australia's National Forest Inventory, and in all previous SOFRs:

An area, incorporating all living and non-living components, that is dominated by trees having usually a single stem and a mature or potentially mature stand height exceeding 2 metres and with existing or potential crown cover of overstorey strata about equal to or greater than 20 per cent. This 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.

Under this definition, large expanses of tropical Australia where trees are spread out in the landscape are forest, as are many of Australia's multi-stemmed eucalypt mallee associations. What many people would typically regard as forests – stands of tall, closely spaced trees – comprise a relatively small part of the country's total forest estate.

Much of Australia's open and woodland forests are available for grazing. However, areas identified by the Australian Collaborative Land Use and Management Program¹² as urban and industrial land, land under horticultural land use (such as orchards), and land under intensive agricultural uses, are not included as forest.



Forest near Bellingen, New South Wales.

Australia's forests

Forests extend across the continent's northern tropical regions, and down the east coast through sub-tropical regions to temperate cool-season wet and cold wet zones in the south-east; they are also found in Mediterranean climate zones in the south-east and south-west (see Figure I.i). In some regions, forests extend from these wetter, coastal and sub-coastal areas into central, drier parts of the continent (Figure I.ii). Through these regions, forests grow on soils that vary from ancient, fragile and infertile soils, to more recently formed, fertile soils of alluvial and volcanic origin.

Australia's forests are assigned to three broad categories in Australia's National Forest Inventory, with each category divided into various forest types (see Indicator 1.1a):

- 'Native forests', which are divided into eight national native forest types named after their key genus or structural form: Acacia, Callitris, Casuarina, Eucalypt, Mangrove, Melaleuca, Rainforest, and Other native forest. Across the wide range of rainfall and soil conditions that support forest, more than 80% of Australia's native forests are dominated by eucalypts and acacias.
- 'Commercial plantations', which are plantations grown on a commercial scale for wood production. 'Commercial plantations' were previously known as 'Industrial plantations'. The definition of plantations used in this report is that used in all previous SOFRs and for the National Plantation Inventory:
Intensively managed stands of trees of either native or exotic species, created by the regular placement of seedlings or seeds.
- 'Other forest', which includes non-commercial plantations and planted forest of various types.

Native forests

Australia's native forests are classified into structural classes based on combinations of crown cover, stand height and form, to provide a better understanding of their characteristics.

In terms of crown cover:

- 'Closed forest' is forest where the tree canopies cover more than 80% of the land area.
- 'Open forest' is forest where the tree canopies cover between 50% and 80% of the land area.
- 'Woodland forest' is forest where the tree canopies cover between 20% and 50% of the land area.
- Land with trees where the tree canopies cover less than 20% of the land area is not classified in Australia as forest, but is categorised as various forms of non-forest vegetation.

¹² data.gov.au/dataset/catchment-scale-land-use-of-australia-update-2017

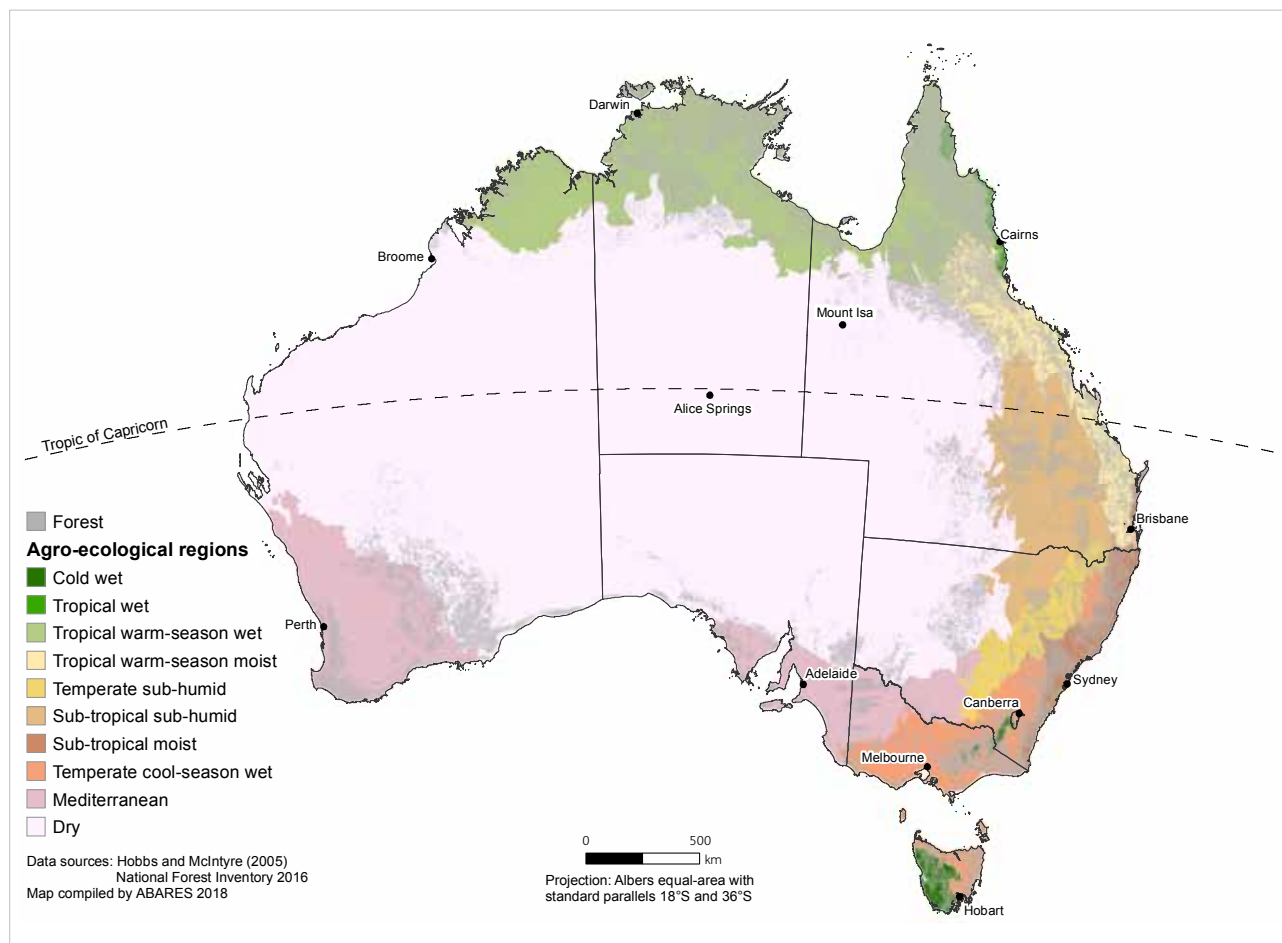
Box I.i: National goals set out in Australia's *National Forest Policy Statement*¹³

The Commonwealth, state and territory governments agree that, to achieve their vision for the forest estate and to ensure that the community obtains a balanced return from all forest uses, eleven broad national goals must be pursued. These goals should be pursued within a regionally based planning framework that integrates environmental and commercial objectives so that, as far as possible, provision is made for all forest values. The eleven broad national goals are as follows:

- **Conservation.** The goals are to maintain an extensive and permanent native forest estate in Australia and to manage that estate in an ecologically sustainable manner so as to conserve the full suite of values that forests can provide for current and future generations. These values include biological diversity, and heritage, Aboriginal and other cultural values.
- **Wood production and industry development.** The goal is for Australia to develop internationally competitive and ecologically sustainable wood production and wood products industries. Efficient industries based on maximising value-adding opportunities and efficient use of wood resources will provide the basis for expansion in wood products manufacturing, which in turn will provide national and regional economic benefits.
- **Integrated and coordinated decision making and management.** The goals are to reduce fragmentation and duplication in the land use decision-making process between the States and the Commonwealth and to improve interaction between forest management agencies in order to achieve agreed and durable land use decisions.
- **Private native forests.** The goal is to ensure that private native forests are maintained and managed in an ecologically sustainable manner, as part of the permanent native forest estate, as a resource in their own right, and to complement the commercial and nature conservation values of public native forests.
- **Plantations.** One goal is to expand Australia's commercial plantations of softwoods and hardwoods so as to provide an additional, economically viable, reliable and high-quality wood resource for industry. Other goals are to increase plantings to rehabilitate cleared agricultural land, to improve water quality, and to meet other environmental, economic or aesthetic objectives.
- **Water supply and catchment management.** The goals are to ensure the availability of reliable, high-quality water supplies from forested land and to protect catchment values.
- **Tourism and other economic and social opportunities.** The goal is to manage Australia's forests in an ecologically sustainable manner for a range of uses, including tourism, recreation and production of non-wood products.
- **Employment, workforce education and training.** The goal is to expand employment opportunities and the skills base of people working in forest management and forest-based industries.
- **Public awareness, education and involvement.** The goals are to foster community understanding of and support for ecologically sustainable forest management in Australia and to provide opportunities for effective public participation in decision making.
- **Research and development.** The goals are to increase Australia's national forest research and development effort and to ensure that it is well coordinated, efficiently undertaken and effectively applied. This research will expand and integrate knowledge about the many aspects of native forests, plantations, forest management, conservation, and forest product development.
- **International responsibilities.** The goals are to promote nature conservation and sustainable use of forests outside Australia and to ensure that Australia fulfils its obligations under relevant international agreements.

¹³ Commonwealth of Australia (1992)

Figure I.i: Agro-ecological regions of Australia



Note: Grey shading under coloured agro-ecological regions shows SOFR 2018 forest coverage.

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

In terms of stand height:

- ‘Tall forest’ is forest with a stand height greater than 30 metres.
- ‘Medium forest’ is forest with a stand height between 10 and 30 metres.
- ‘Low forest’ is forest with a stand height greater than 2 metres and up to 10 metres.

In terms of tree form:

- ‘Eucalypt mallee’ forests contain multi-stemmed trees.

Australia’s definition of forest uses the phrases ‘mature or potentially mature’ with regard to stand height, and ‘existing or potential’ with regard to crown cover. Use of these phrases allows forest areas that have temporarily lost some or all of their trees (for example, as a result of bushfires, cyclones or wood harvesting) to be identified as part of the forest estate.

The majority of Australia’s native forest area is dominated by evergreen, broadleaf, hardwood tree species. For national reporting, the NFI classifies Australia’s native forests into eight broad forest types defined by dominant species and structure. These eight types are described below¹⁴.

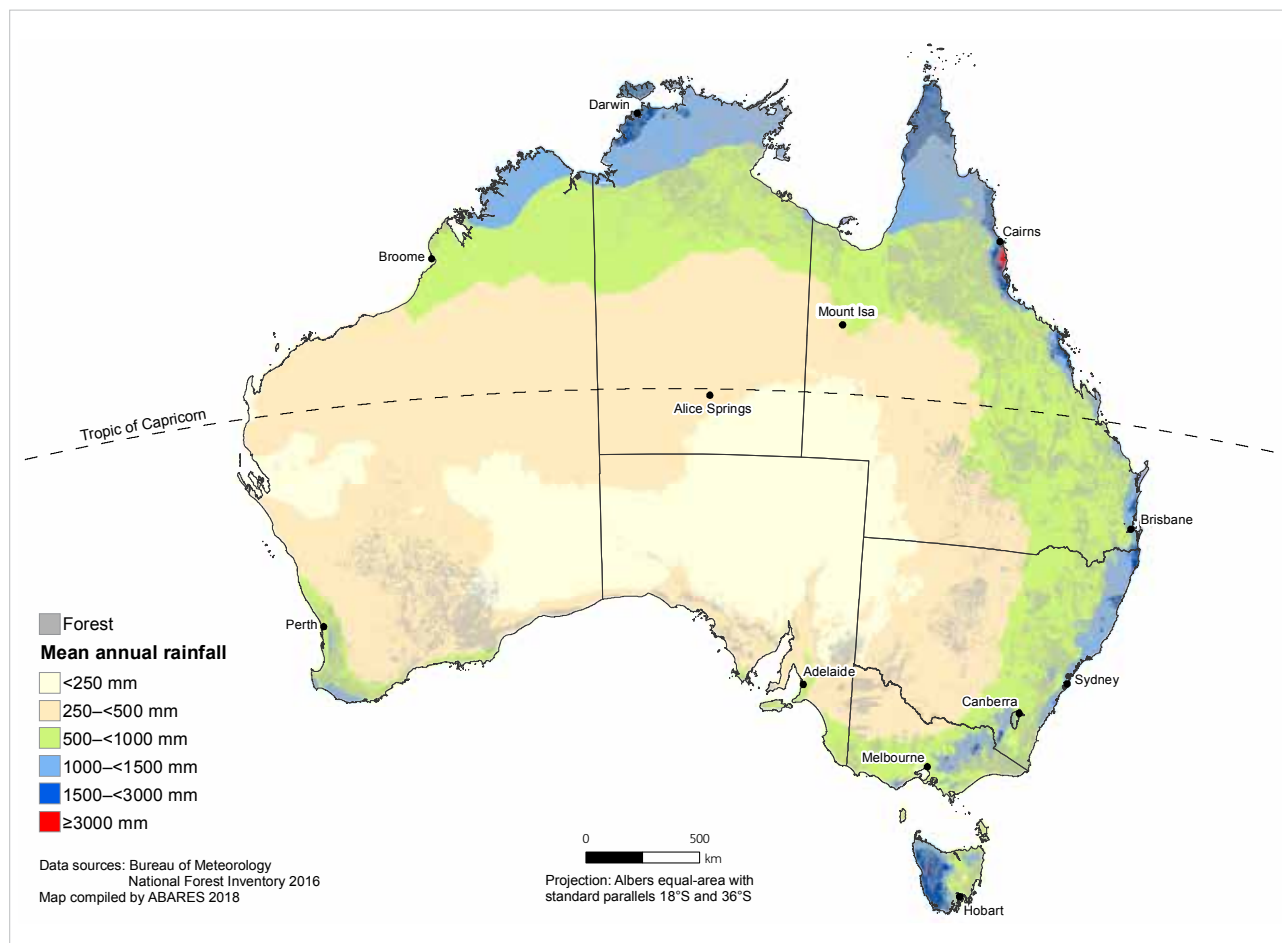
Acacia

Australia has almost 1000 species of *Acacia*, making it the nation’s largest genus of flowering plants. *Acacia* species are remarkably varied in appearance, habit and location, from spreading shrubs to trees that are more than 30 metres tall.

Acacia forests are Australia’s second most extensive forest type. They occur in all Australian states and the Northern Territory, with the largest areas in Queensland and Western Australia. *Acacia* forests are predominantly woodland forests in regions where the average annual rainfall is less than 750 millimetres. Mulga (*Acacia aneura* and related species) is widespread in many parts of the arid and semi-arid zones of Australia. Brigalow (*A. harpophylla*) is widespread in Queensland and northern New South Wales, forming dense forests on flat or undulating country with clay soils. *Acacia* forests are also present in wetter areas: in Tasmania, for example, blackwood (*A. melanoxylon*) dominates stands of swamp forest on poorly drained sites.

¹⁴ The names of the national native forest types have capitalised initial letters (e.g. *Acacia* forest). The related common names do not have capitalised initial letters (e.g. *acacias*) unless they commence a sentence. The related formal genus names are italicised and have capitalised initial letters (e.g. *Acacia*).

Figure I.ii: Mean annual rainfall across Australia



Note: Grey shading under coloured rainfall zones shows SOFR 2018 forest coverage.

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

Callitris

The genus *Callitris* comprises 15 species, of which 13 occur in Australia. *Callitris* trees are commonly called cypress pines because they are related to, and resemble, Northern Hemisphere cypresses; they are not true pines.

Callitris forests typically occur in small patches in drier inland regions, but occasionally cover wide areas. Pure stands of *Callitris* are generally restricted to undulating or flat land with sandy soils, or to upland rocky areas that are protected from fire. More commonly, *Callitris* trees are present in *Acacia*, *Casuarina* and *Eucalypt* forest types that have a shrubby, grassy or herbaceous understorey. White cypress pine (*Callitris glaucophylla*) is a species widely distributed across inland Australia that is used for timber production.

Casuarina

The family Casuarinaceae occurs naturally in Australia, south-east Asia and the Pacific region. The forest type *Casuarina* includes forests dominated by species of either *Casuarina* (6 species in Australia) or *Allocasuarina* (59 species in Australia). Commonly called sheoaks because of the similarity of their timber to that of European oaks, casuarinas are a distinctive part of many Australian coastal and riverine landscapes.

Most casuarina forests are low in height; the tallest casuarina forests grow along rivers, where trees can grow to more than 20 metres. Common inland species include belah (*Casuarina cristata*), desert oak (*Allocasuarina decaisneana*) and river sheoak (*C. cunninghamiana*).

Eucalypt

Eucalypts are iconic Australian forest trees. Eucalypt forests are by far the continent's most common forest type, covering about three-quarters of Australia's native forest estate and occurring in all but the continent's driest regions (Figure I.iii).

The term 'eucalypt' encompasses approximately 800 species in the three genera *Eucalyptus*, *Corymbia* and *Angophora*, with almost all of these species native to Australia. For national reporting, the Eucalypt forest type is divided into 11 forest subtypes based on the form of dominant individuals (multi-stemmed mallee or single-stemmed tree), height of mature trees (low, medium or tall) and crown cover (closed, open or woodland).



Closed forest: an aerial view of rainforest showing typical closed canopy. Barron River, Queensland.



Open forest, Wombeyan Karst Conservation Reserve, New South Wales.



Woodland forest, Undara Volcanic National Park, Queensland.



Non-forest carrying other woody vegetation, Northern Territory.

Eucalypt species have oil-rich foliage that burns readily, and they display a range of strategies to survive and recover from fire. The majority of eucalypt species are evergreen, retaining their leaves year-round.

River red gum (*Eucalyptus camaldulensis*) is the most widely distributed eucalypt, and is found in all Australian mainland states. The forests of south-eastern Australia contain a wide range of dominant eucalypt species, including major commercial timber species such as mountain ash (*E. regnans*), messmate stringybark (*E. obliqua*), alpine ash (*E. delegatensis*), silvertop ash (*E. sieberi*), blackbutt (*E. pilularis*) and spotted gum (*Corymbia maculata*). Some individual trees exceed 90 metres in height. Eucalypt forests in south-western Australia are dominated by jarrah (*E. marginata*) and karri (*E. diversicolor*). Typical eucalypts of northern Australia include Darwin woollybutt (*E. miniata*) and Darwin stringybark (*E. tetradonta*). Many species of mallee eucalypts are found across the inland regions of southern Australia (Figure I.iv).

Mangrove

Although comprising less than 1% of Australia's forest cover, mangrove forests are an important and widespread ecosystem. They are found in the intertidal zones of tropical, subtropical and protected temperate coastal rivers, estuaries and bays, where they grow in fine sediments deposited by rivers and tides. Mangrove trees have a characteristic growth form, including aerial structural roots and exposed breathing roots, to help them cope with regular tidal inundation and a lack of oxygen in the soil.

Avicennia marina, known as white mangrove or grey mangrove, is a widely distributed species of mangrove.

Melaleuca

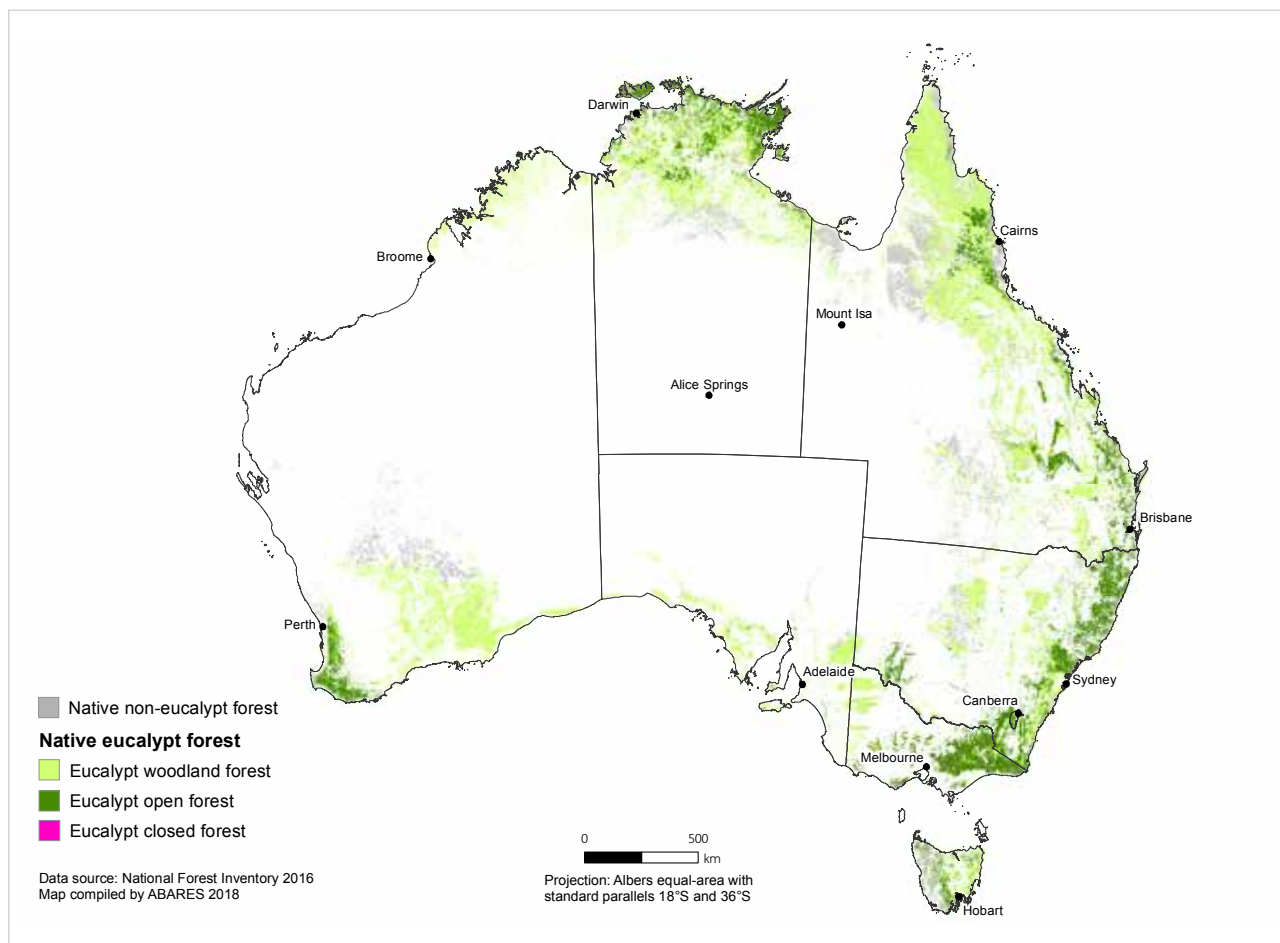
The genus *Melaleuca* contains more than 200 species, most of which are endemic to Australia. Only a few species develop the required community structure and height for stands to be classified as forests; these taller species are known as tea-trees or paperbarks. Common species include broad-leaved paperbark (*Melaleuca viridiflora*) and weeping paperbark (*M. leucadendra*).

Melaleuca forests occur mainly as tracts of low woodland forest across estuarine plains and seasonal swamps in the coastal and near-coastal areas of monsoonal northern Australia, as well as narrow strips beside streams. Most of Australia's Melaleuca forest is in Queensland, particularly Cape York Peninsula, and the northern part of the Northern Territory. Melaleuca forest also occurs on poorly drained sites on the east coast of mainland Australia and in north-western Tasmania.

Rainforest

Australia's rainforests are characterised by high rainfall, lush growth and closed canopies; they rarely support fire, and generally contain no eucalypts or only occasional individual eucalypts as emergent trees above the rainforest canopy. Tree species of the rainforest canopy are shade-tolerant when

Figure I.iii: Distribution of native eucalypt forest, by crown cover class



Note: Grey and coloured shading shows the forest coverage presented in Indicator 1.1a of SOFR 2018.

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

young, able to establish in the understorey of mature forest, and grow into large trees when events such as tree falls, lightning strikes or wind damage (including from cyclones) create gaps in the canopy.

There are many types of rainforest in Australia, varying with rainfall and latitude. Tropical and subtropical rainforests are found in northern and eastern Australia in wet coastal areas. Temperate rainforests occur in eastern and south-eastern Australia: warm temperate rainforests grow in New South Wales and Victoria, while cool temperate rainforests grow in Victoria and Tasmania, with outliers at high altitude in New South Wales and Queensland. Dry rainforests occur in pockets protected from frequent fire in sub-coastal and inland areas of northern and eastern Australia. Monsoon rainforests occur in northern Australia in seasonally dry coastal and sub-coastal regions.

Other native forest

The 'Other native forest' type includes a range of minor native forest types each named after its dominant genus, including *Agonis*, *Atalaya*, *Banksia*, *Hakea*, *Grevillea*, *Heterodendron*, *Leptospermum*, *Lophostemon* and *Syncarpia*, as well as native forests where the type is unknown.

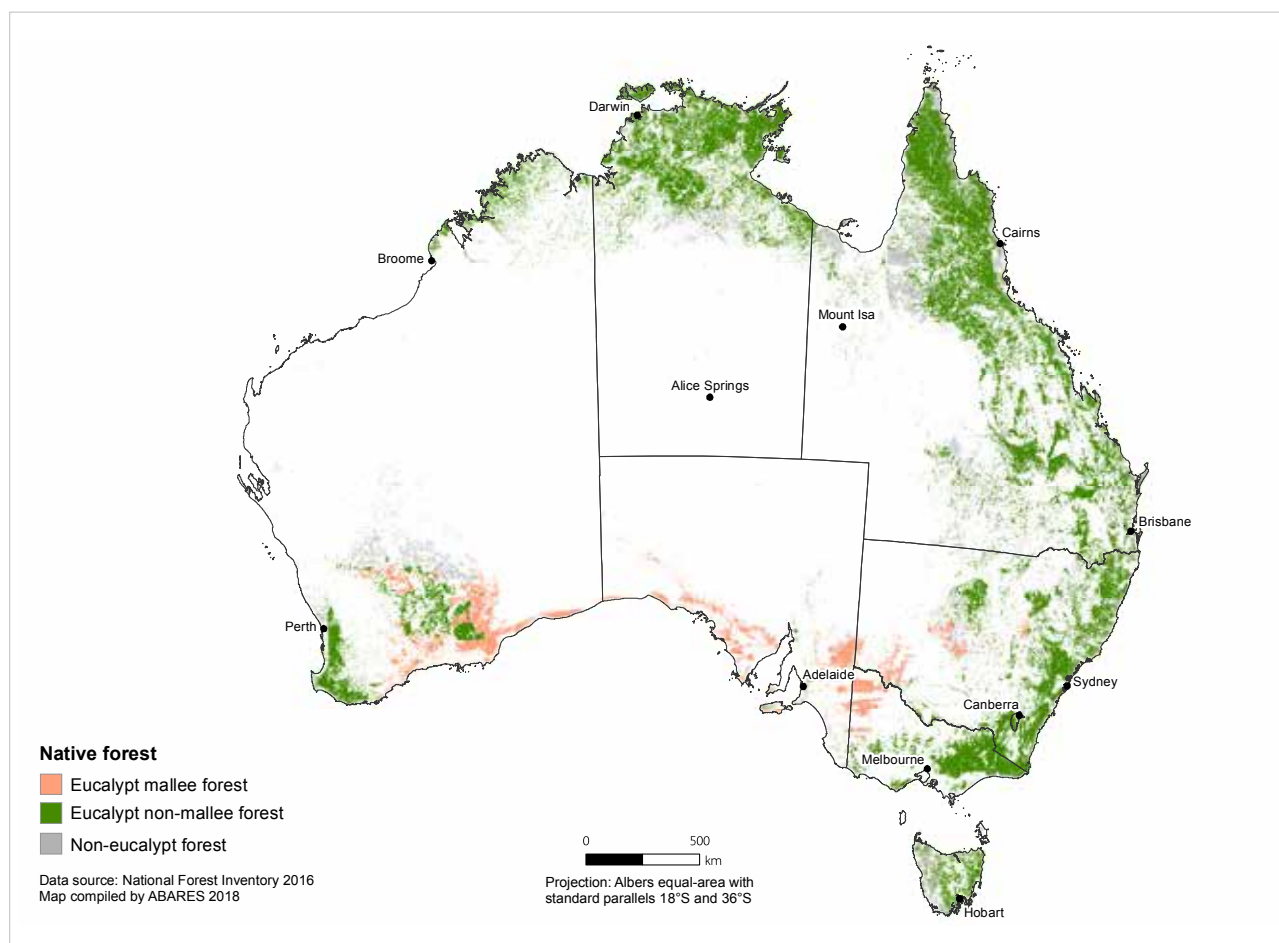
Commercial plantations

Australia's commercial plantations comprise both softwood species (predominantly radiata pine, *Pinus radiata*) and hardwood species (with the most common species being Tasmanian blue gum, *Eucalyptus globulus*). Their primary purpose is commercial wood production, and they produce the majority of the volume of logs harvested annually in Australia. Commercial plantations also provide a range of environmental services, such as salinity and erosion control, and support regional employment. Plantations provide habitat for some native flora and fauna species that generally do not inhabit cleared agricultural land, although the population densities of forest-dwelling species are usually lower in plantations than in native forests. Commercial plantations are identified in the National Plantation Inventory.

Fifteen plantation regions are used by the National Plantation Inventory to represent economic wood supply zones (Figure I.v). Five of the National Plantation Inventory regions span a state or territory border.

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

Figure I.iv: Eucalypt mallee, eucalypt non-mallee and non-eucalypt native forest



Note: Grey and coloured shading shows the forest coverage presented in Indicator 1.1a of SOFR 2018.

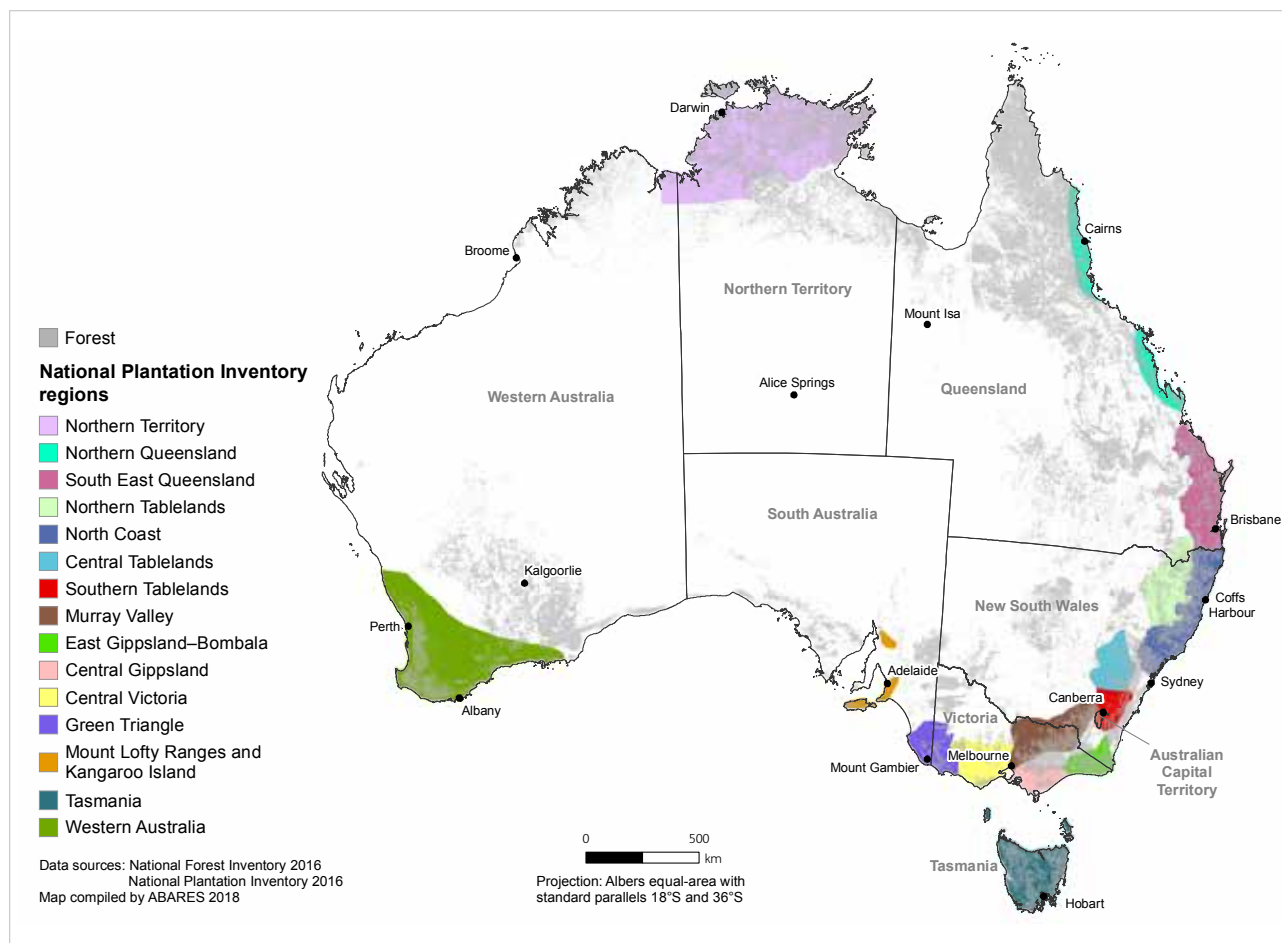
A higher resolution version of this map is available via www.doi.org/10.25814/5be3bc4321162

Table I.i. Main commercial plantation species by climatic region and rainfall, and main uses

Region	Rainfall	Main species	Main uses
Softwoods			
Tropical, subtropical	High	Hoop pine (<i>Araucaria cunninghamii</i>)	Sawn timber for building, joinery, furniture, plywood, other high-value uses, posts and poles; residues used for paper, particleboard and other panels
	Medium	Caribbean pine (<i>Pinus caribaea</i>), slash pine (<i>P. elliottii</i>), hybrid pines	Sawn timber for building, joinery, furniture, plywood, other high-value uses, posts and poles; residues used for paper, particleboard and other panels
Temperate	Medium	Radiata pine (<i>P. radiata</i>)	Sawn timber for building, joinery, furniture, plywood, other high-value uses, posts and poles; residues used for paper, particleboard and other panels
	Low to medium	Maritime pine (<i>P. pinaster</i>)	Sawn timber for building, joinery, furniture, plywood, other high-value uses, posts and poles; residues used for paper, particleboard and other panels
Hardwoods			
Tropical	High	Mangium (<i>Acacia mangium</i>)	Paper products, veneer and sawn timber
		African mahogany (<i>Khaya senegalensis</i>), teak (<i>Tectona grandis</i>), some native eucalypt species	Sawn timber for building and furniture and other high-value uses
Subtropical	Medium	Blackbutt (<i>Eucalyptus pilularis</i>), Flooded gum (<i>E. grandis</i>), Dunn's white gum (<i>E. dunnii</i>)	Paper products, veneer and sawn timber
Temperate	Medium	Southern (Tasmanian) blue gum (<i>E. globulus</i>), shining gum (<i>E. nitens</i>)	Paper products, veneer and sawn timber
Several regions	Low to medium	Various eucalypts	Sawn timber for building and furniture and other high-value uses

Source: Adapted from SOFR 2008

Figure I.v: National Plantation Inventory regions of Australia



Note: Grey shading shows the forest coverage presented in Indicator 1.1a of SOFR 2018.

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

Other forest

The 'Other forest' category comprises small areas of mostly non-commercial plantations and planted forests of various types, including plantations of sandalwood (*Santalum* spp.), some smaller farm forestry and agroforestry plantations, environmental plantings, plantations within the reserve system, and plantations regarded as non-commercial. Non-planted forest dominated by introduced species is also included in the Other forest category.

Tenure

The ownership or tenure of forest land, especially native forest, has a major bearing on its management. Different types of ownership are linked to who has the right to use and occupy land, the right to use forest resources, and the conditions that may be attached to these rights.

The six national land tenure classes used to classify land in the National Forest Inventory are as follows:

- **Leasehold forest:** Crown land held under leasehold title, and generally privately managed, although state and

territory governments may retain various rights over the land, including over forests or timber on the land. This class includes land held under leasehold title with special conditions attached for designated Aboriginal and Torres Strait Islander communities (referred to collectively as Indigenous communities in SOFR 2018).

- **Multiple-use public forest:** publicly owned state forest, timber reserves and other land, managed by state and territory government agencies for a range of forest values, including wood harvesting, water supply, biodiversity conservation, recreation and environmental protection.
- **Nature conservation reserve:** publicly owned lands managed by state and territory government agencies that are formally reserved for environmental, conservation and recreational purposes, including national parks, nature reserves, state and territory recreation and conservation areas, and some categories of formal reserves within state forests. This class does not include informal reserves (areas protected by administrative instruments), areas protected by management prescription, or forest areas pending gazettal to this tenure. The harvesting of wood and non-wood forest products generally is not permitted in nature conservation reserves.

- **Other Crown land:** Crown land reserved for a variety of purposes, including utilities, scientific research, education, stock routes, mining, use by the defence forces, and to protect water-supply catchments, with some areas used by Indigenous communities.
- **Private forest:** land held under freehold title and private ownership, and usually privately managed. This class includes land with special conditions attached for designated Indigenous communities.
- **Unresolved tenure:** land where data are insufficient to determine land ownership status.

All land in each state and territory is allocated by ABARES to one of these six tenure classes using state, territory and national datasets of land titles and land tenure, then intersected with the national forest coverage to determine the areas of forest land in each tenure class.

These six national tenure classes are amalgamations of the wide range of classes used by various state and territory jurisdictions. The classes can be grouped on the basis of land ownership as public or private, with a small area of unresolved tenure. Publicly owned tenures include 'multiple-use public forest', 'nature conservation reserve' and 'other Crown land'. 'Leasehold forest' is Crown land (land that belongs to a national, state or territory government) that is privately managed, although state and territory governments may retain various rights over the land, including over forests or timber on the land. Some forests on private land are publicly managed as conservation reserves, for example Kakadu National Park in the Northern Territory. For commercial plantations, the ownership of the land can be different from ownership of the trees, and management arrangements can be complex.

Forest administration in Australia

Australia has three levels of government: Commonwealth or federal (also referred to as the Australian Government or the national government); state and territory; and local (city-based or regionally based). The term 'jurisdiction' is used in SOFR 2018 to denote any of the states or territories.

Australia's state and territory governments have responsibility for land allocation and land management, including forest management. The Commonwealth Government has limited forest management responsibilities, but may influence management through legislative powers associated with foreign affairs (particularly treaties and international agreements), commodity export licensing, taxation, and biodiversity conservation, and through targeted spending programs to meet environmental, social or economic objectives. Such programs are generally developed cooperatively with state and territory governments. Australia's forest policy, together with the management of Australia's forests, is guided by the *National Forest Policy Statement* (Commonwealth of Australia 1992), signed jointly by the Australian Government and state and territory governments (see Box I.i).

Australia's First Peoples

Preferences in terminology when referring to Australia's First Peoples can vary across Australia, and can change over time. Throughout SOFR 2018, the term Indigenous is used when describing Aboriginal and Torres Strait Islander peoples and communities. The term Indigenous is also used for consistency in titles of indicators, datasets, programs or reports, including Australia's framework of criteria and indicators¹⁵; this usage originated at the time this framework was published (2008).

Regional Forest Agreements

A key outcome of the *National Forest Policy Statement* was the negotiation of Regional Forest Agreements (RFAs) between the Australian Government and four state governments. Davey (2018a) describes the origins and development of Australia's RFAs. RFAs are 20-year agreements for the conservation and sustainable management of specific regions of Australia's native forests, and resulted from substantial scientific study, consultation and negotiation with a diverse range of stakeholders. Science-based methodologies and Comprehensive Regional Assessments (CRAs) were used to determine forest allocation for different uses and to underpin forest management strategies. The RFAs were designed to provide certainty for forest-based industries, forest-dependent communities and nature conservation. Certain obligations of the Commonwealth under RFAs were given effect through the Commonwealth *Regional Forest Agreements Act 2002*.

Ten RFAs were negotiated between the Australian Government and the New South Wales, Tasmania, Victoria and Western Australia State Governments (Figure I.vi). The Upper North East and Lower North East RFA regions of New South Wales were covered by a single RFA. The Australian and Queensland governments also completed a CRA for south-east Queensland.



River red gum (*Eucalyptus camaldulensis*) forest, Murray River, New South Wales.

¹⁵ *Australia's Sustainable Forest Management Framework of Criteria and Indicators 2008 – Policy Guidelines*, available at www.agriculture.gov.au/abares/forestsaustralia/Documents/ciframework.pdf

Forest inventory

Australia's National Forest Inventory was established in 1988 to collect and report data and information about Australia's forests. The National Forest Inventory is guided by the National Forest Inventory Steering Committee (NFISC) composed of members representing state, territory and Australian government bodies involved in forest information management¹⁶.

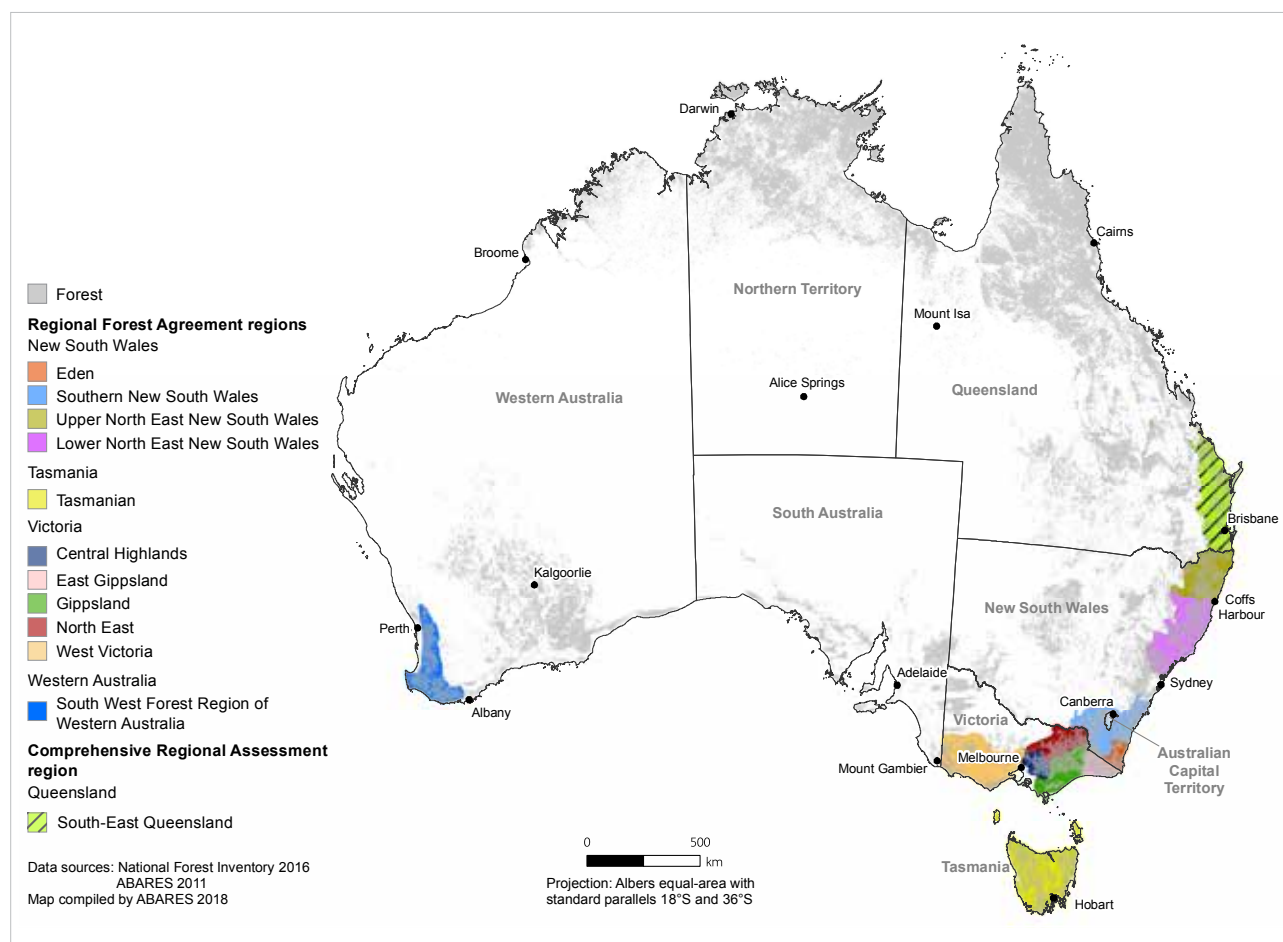
Forest description and measurement (inventory) activities have been undertaken in Australian forests for more than a century, mainly in publicly owned native forests managed for wood production and in plantations, and to a lesser extent in nature conservation reserves. Less is known about Australia's native forests on private or leasehold land.

Sustainable forest management and forest reporting

Sustainable forest management seeks to achieve environmental outcomes, promote economic development, and maintain the social values of forests, to meet the needs of society without compromising the ability of future generations to meet their needs.

This approach reflects the principal objectives of the United Nations Convention on Biological Diversity (CBD), to which Australia is a signatory – namely, the conservation and sustainable use of biological diversity, and the fair and equitable sharing of benefits arising from its use. The CBD recognises that the key to maintaining biological diversity is using it in a sustainable manner (Secretariat of the Convention on Biological Diversity 2005). Sustainably managed forests thus maintain a broad range of values into the future, and the Australian, state and territory governments have a range of processes to help meet this goal.

Figure I.vi: Regional Forest Agreement and related regions in Australia



Note: Grey shading under NPI regions shows the forest coverage presented in Indicator 1.1a of SOFR 2018.

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

¹⁶ See www.agriculture.gov.au/abares/forestsaustralia/australias-national-forest-inventory/national-forest-inventory-steering-committee. Queensland withdrew from the NFISC in 2010.

Criteria and indicators provide a common understanding of the components of sustainable forest management, and a common framework for describing, assessing and evaluating progress towards sustainable forest management. The criteria represent broad forest values that society seeks to maintain, while the indicators describe measurable aspects of those criteria (MIG 1998). The framework of criteria and indicators for sustainable forest management developed by the international-level Montreal Process Working Group on Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests¹⁷ was adopted in Australia in 1998. Development and application of these criteria and indicators in Australia occurs through the Montreal Process Implementation Group for Australia (MIG).

As with the international Montreal Process, Australia's framework includes the following seven criteria (Commonwealth of Australia 2008):

- conservation of biological diversity
- maintenance of productive capacity of forest ecosystems
- maintenance of ecosystem health and vitality
- conservation and maintenance of soil and water resources
- maintenance of forest contribution to global carbon cycles
- maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies
- legal, institutional and economic framework for forest conservation and sustainable management.

A set of 44 indicators for use in Australia was adapted from the Montreal Process Working Group's broader list of indicators, to better suit the particular characteristics of Australian forests, the goods and services they provide and the people who depend on or use them. These indicators now provide the standard reporting format for the Australia's State of the Forests Reports series. Appendix A lists the 44 indicators used in Australia, and shows the alignment with the 54 indicators of the international Montreal Process framework.

The National Forest Inventory and the SOFR series also provide the data for Australia's international forest reporting requirements. These include reporting through the Global Forest Resources Assessment run by the United Nations Food and Agriculture Organization (UN FAO)¹⁸, the State of the World's Forest Genetic Resources¹⁹ (also under the UN FAO), the Global Forest Goals of the UN Strategic Plan for Forests²⁰, and the UN Sustainable Development Goals²¹.

The SOFR 2018 process

SOFR 2018 is the result of collaboration among the Australian, state and territory governments, led by the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) within the Australian Government Department of Agriculture and Water Resources, and coordinated by the National Forest Inventory Steering Committee (NFISC) and the Montreal Process Implementation Group for Australia (MIG).

In 2016, ABARES requested data from each of the states and territories to populate SOFR indicators. On the basis of responses to these requests and information obtained from national agencies and other sources, ABARES prepared summary tables, figures and text for each indicator, paying particular attention to changes and trends over time. The state and territory governments, through the MIG and the NFISC, and officers from Australian government agencies were invited to participate in a drafting group, which met in 2017 to review manuscripts and provide supplementary information. In 2018, the draft SOFR 2018 was reviewed by the MIG, the NFISC and relevant government agencies, and was endorsed by the national Forestry and Forest Products Committee under the Council of Australian Governments.

The SOFR series

The SOFR series is a system for reporting the state of Australia's forests, as well as changes in a range of social, economic and environmental values of forests. The SOFR series is therefore a resource for exploring the implications of such changes for sustainable forest management.

To the greatest extent possible, SOFR 2018 presents data for the five-year period between July 2011 and June 2016, continuing the five-yearly pattern of previous reports in the SOFR series. SOFR 2018 contains more information on trends over time than previous reports. However, the varied nature of the data available for the 44 indicators means that not all data conform to the standard five-year SOFR periods.

The forest area data presented in SOFR 2018 cover Australia's states and mainland territories and their close off-shore islands, but not the external territories of Norfolk Island, Lord Howe Island, Cocos (Keeling) Islands and Christmas Island. However, data for forest-dwelling species in these areas are reported in SOFR 2018. For the purposes of this report, forest data for the Jervis Bay Territory (administered by the Australian Capital Territory) are included in New South Wales data.

¹⁷ www.montrealprocess.org/

¹⁸ www.fao.org/forest-resources-assessment/en/

¹⁹ www.fao.org/forestry/fgt/en/

²⁰ www.un.org/esa/forests/documents/un-strategic-plan-for-forests-2030/index.html

²¹ www.un.org/sustainabledevelopment/sustainable-development-goals/



Eucalyptus rossii, Black Mountain, Australian Capital Territory.


How to use this report

SOFR 2018 is organised by the seven criteria for sustainable forest management listed above. Each criterion is presented as a separate chapter of SOFR 2018.

Within each criterion, various indicators address specific forest aspects and values. Individual indicators can be read as stand-alone papers by readers interested in particular aspects of Australia's forests and their management. A summary of key points is given at the start of each indicator, and case studies are presented within indicators as illustrations and to provide regional information.

The Executive Summary at the front of the report gives an overview of the state of Australia's forests across the seven criteria, and is followed by this Introduction. References, a Glossary and an Index are included at the end of the report.

SOFR 2018 and the four previous SOFRs are available at the Forests Australia website (www.agriculture.gov.au/abares/forestsaustralia) and the ABARES publications website (www.agriculture.gov.au/abares/publications).

 This icon indicates data, maps or graphics from Australia's State of the Forests Report 2018 that are available for electronic download. Higher resolution versions of maps in the Introduction are available via www.doi.org/10.25814/5be3bc4321162.

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