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Australia's State of the Forests Report 2013

Five-yearly report

Prepared by the Montreal Process Implementation Group for Australia
and the National Forest Inventory Steering Committee
on behalf of the Australian, state and territory governments

AUSTRALIAN BUREAU OF AGRICULTURAL AND RESOURCE ECONOMICS AND SCIENCES

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Cover image: Blue Mountains National Park, New South Wales. Photo: iStockphoto.
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Above: View of the Atherton Tablelands, Queensland.

Right: Shining gum (*Eucalyptus nitens*) plantation.

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Michael F Ryan

Snowgums (*Eucalyptus pauciflora*) in Kosciuszko National Park, New South Wales.

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Foreword

Bark of *Corymbia henryi*.

Australia's forests are highly regarded for their environmental, social and economic values. Forests are biodiverse, protect soil and water resources, and contribute to the carbon cycle by storing carbon and offsetting greenhouse gas emissions. Forests are also an integral part of the cultural landscape. In addition, they contribute to the economic wellbeing of Australia through the production of timber, pulp and paper, and many non-wood products.

Australia's State of the Forests Report is produced every five years under a commitment made in 1992 in the National Forest Policy Statement. *Australia's State of the Forests Report 2013* is the fourth report in the series. It provides information for national and regional monitoring and reporting in relation to Australia's forests, delivers on a requirement of the Commonwealth *Regional Forest Agreements Act 2002*, and supports Australia's international reporting on forests and forestry.

Australia's State of the Forests Report 2013 reviews the management, conservation and use of Australia's forests across the period 2006–11. Among other things, it provides information on public, private and leasehold forests; native forests and plantations; forests managed for conservation and forests managed for wood production; and forests important for Australia's Indigenous people. It covers all of Australia's forests, including the closed tropical rainforests of Australia's north, the tall forests of eastern and south-western Australia, and the acacia and eucalypt woodland forests of inland Australia. The report brings fresh insight to the management of Australia's forests, with new information and the assessment of long-term trends.

Preparation of *Australia's State of the Forests Report 2013* has been coordinated by the Australian Bureau of Agricultural and Resource Economics and Sciences on behalf of the Montreal Process Implementation Group for Australia and the National Forest Inventory Steering Committee. The report is a product of close collaboration between the Australian, state and territory governments, as well as other agencies and individuals. *Australia's State of the Forests Report 2013* will be a key reference for managers, policy makers and the wider community, and it will provide a firm, factual basis for debate on the sustainable management of Australia's forests.

I thank all those who have contributed to the production of this comprehensive report.

Karen Schneider
Executive Director
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1 Contributors are listed according to their affiliation as at 30 September 2013.

2 From September 2013, the Department of the Environment.

3 Climate Change staff: from September 2013, at the Department of the Environment.

4 Tertiary Education staff: from September 2013, at the Department of Employment.

5 Indigenous Affairs staff: from September 2013, at the Department of the Prime Minister and Cabinet.

Acronyms and abbreviations[6]

ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences
ABS	Australian Bureau of Statistics
ACT	Australian Capital Territory
ANZECC	Australian and New Zealand Environment and Conservation Council
BRS	Bureau of Rural Sciences (Australian Government)
BREE	Bureau of Resources and Energy Economics (Australian Government)
CAPAD	Collaborative Australian Protected Areas Database
CAR	Comprehensive, Adequate and Representative
CCWA	Conservation Commission of Western Australia
CFI	Carbon Farming Initiative
C&I	criteria and indicators
COAG	Council of Australian Governments
CO_2	carbon dioxide
CO_2-e	carbon dioxide-equivalent
CPI	consumer price index
CRA	Comprehensive Regional Assessment
CRC	Cooperative Research Centre
CSIRO	Commonwealth Scientific and Industrial Research Organisation (Australian Government)
DAFF (Australia)	Department of Agriculture, Fisheries and Forestry (Australian Government)
DAFF (Queensland)	Department of Agriculture, Fisheries and Forestry (Queensland Government)
DCCEE	Department of Climate Change and Energy Efficiency (Australian Government)
DEC	Department of Environment and Conservation (Western Australian Government)
DENR	Department of Environment and Natural Resources (South Australian Government)
DEPI	Department of Environment and Primary Industries (Victorian Government)
DERM	Department of Environment and Resource Management (Queensland Government)
DEWHA	Department of Environment, Water, Heritage and the Arts (Australian Government)
DIA	Department of Indigenous Affairs (Australian Government)
DIICCSRTE	Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education (Australian Government)
DIISRTE	Department of Industry, Innovation, Science, Research and Tertiary Education (Australian Government)
DLCM	Dynamic Land Cover Mapping
DPaW	Department of Parks and Wildlife (Western Australian Government)
DPI (NSW)	Department of Primary Industries (New South Wales Government)
DPI (Victoria)	Department of Primary Industries (Victorian Government)
DPIPWE	Department of Primary Industries, Parks, Water and Environment (Tasmanian Government)
DSE	Department of Sustainability and Environment (Victorian Government)
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities (Australian Government)
EPA	Environment Protection Authority (New South Wales Government)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
ESDD	Environment and Sustainable Development Directorate (Australian Capital Territory Government)
FaHCSIA	Department of Families, Housing, Community Services and Indigenous Affairs (Australian Government)
FAO	United Nations Food and Agriculture Organization
FCNSW	Forestry Corporation of New South Wales
FFPC	Forestry and Forest Products Committee
FPA	Forest Practices Authority, Tasmania
FPC	Forest Products Commission of Western Australia
FT	Forestry Tasmania (Tasmanian Government Business Enterprise)
FTE	full-time-equivalent
FWPA	Forest and Wood Products Australia
GA	Geoscience Australia (Australian Government)

[6] A subsequent table relates agency names that applied during the SOFR 2013 reporting period, to agency names in use at 01 October 2013.

GDP	gross domestic product
GFCF	gross fixed capital formation
GFRA	Global Forest Resources Assessment
GVP	gross value of production
HWP	harvested wood products
ILC	Indigenous Land Corporation
IPA	Indigenous Protected Area
IUCN	International Union for Conservation of Nature
LA Act	*Land Administration Act 1997* (Western Australia)
LTER	long-term ecological research
LTERN	long-term ecological research network
MCFFA	Ministerial Council on Forestry, Fisheries and Aquaculture
MIG	Montreal Process Implementation Group for Australia
MLE	Multiple Lines of Evidence
MODIS	Moderate-resolution Imaging Spectroradiometer
Mt C	million tonnes of carbon
NCAS	National Carbon Accounting System
NCLD	National Conservation Lands Database
NCP	National Competition Policy
NFI	National Forest Inventory
NFISC	National Forest Inventory Steering Committee
NHL	National Heritage List
NIHSA	Non-Indigenous Heritage Sites of Australia
NNTT	National Native Title Tribunal
NPI	National Plantation Inventory
NRETAS	Department of Natural Resources, Environment, the Arts and Sport (Northern Territory Government)
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
OEH	Office of Environment and Heritage (New South Wales Government)
PIRSA	(from October 2011) Department of Primary Industries and Regions South Australia
PIRSA	(before October 2011) Department of Primary Industries and Resources South Australia
PJ	Petajoule (10^{15} joules)
Qld	Queensland
R&D	research and development
RFA	Regional Forest Agreement
RIRDC	Rural Industries Research and Development Corporation
RNE	Register of the National Estate
SA	South Australia
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
SoE	State of the Environment
SOFR	State of the Forests Report
Tas.	Tasmania
TERN	Terrestrial Ecosystem Research Network
UNESCO	United Nations Educational, Scientific and Cultural Organization
VFMP	Victorian Forest Monitoring Program
Vic.	Victoria
WA	Western Australia
WHL	World Heritage List

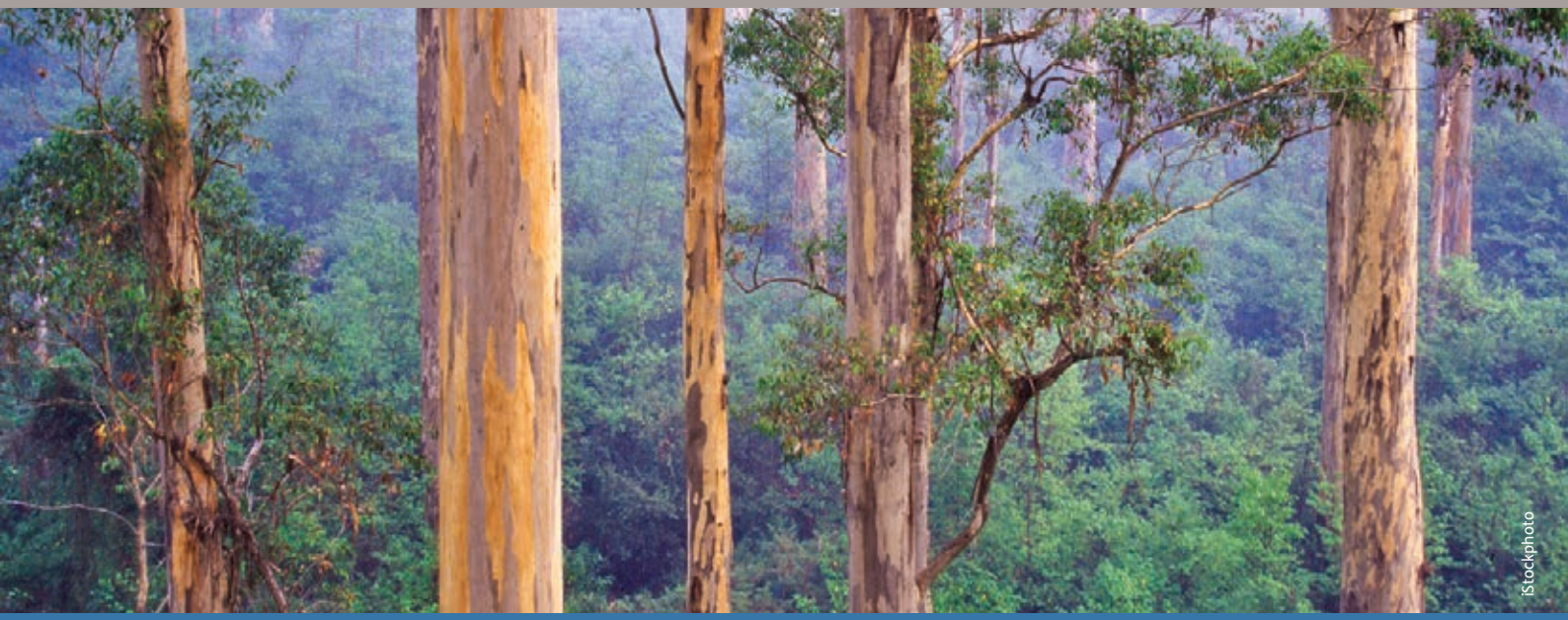
Agency name changes

Agency names used in this report are the names correct during the reporting period (July 2006 to June 2011). Where the reference is explicitly to an ongoing function or activity of the agency, the agency name as at 01 October 2013 is also given if different to the agency name used during the reporting period. This applies to the following agencies.

Jurisdiction	Agency name and acronym during SOFR 2013 reporting period 01 July 2006 to 30 June 2011		Agency name at 01 October 2013
Australian Government	Department of Agriculture, Fisheries and Forestry	DAFF	Department of Agriculture
	Department of the Environment, Water, Heritage and the Arts	DEWHA	Department of the Environment
	Department of Climate Change and Energy Efficiency – *climate change function*	DCCEE	Department of the Environment
	Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education – *climate change function*	DIICCSRTE	Department of the Environment
	Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education – *tertiary education function*	DIICCSRTE	Department of Employment
	Department of Industry, Innovation, Science, Research and Tertiary Education – *tertiary education function*	DIISRTE	Department of Employment
	Department of Sustainability, Environment, Water, Population and Communities	DSEWPaC	Department of the Environment
New South Wales	Forests NSW	Forests NSW	Forestry Corporation of New South Wales
Northern Territory	Department of Natural Resources, Environment, the Arts and Sport	NRETAS	Department of Land Resource Management
Queensland	Department of Environment and Resource Management – *forestry function*	DERM	Department of Agriculture, Fisheries and Forestry
South Australia	Department of Environment and Natural Resources	DENR	Department of Environment, Water and Natural Resources
	Department of Primary Industries and Resources South Australia	PIRSA	Primary Industries and Regions South Australia
Victoria	Department of Primary Industries	DPI	Department of Environment and Primary Industries
	Department of Sustainability and Environment	DSE	Department of Environment and Primary Industries
Western Australia	Department of Environment and Conservation – *forest management and conservation functions*	DEC	Department of Parks and Wildlife
	Department of Environment and Conservation – *environmental regulation function*	DEC	Department of Environment Regulation
	Department of Indigenous Affairs	DIA	Department of Aboriginal Affairs

iStockphoto

Executive summary



Australia's State of the Forests Report 2013 (SOFR 2013) is the fourth in a series of national five-yearly reports on Australia's forests, and presents data from a wide range of sources. Previous national reports were published in 1998, 2003 and 2008.

Warren National Park, Western Australia.

Australia's forests are recognised and valued for their diverse ecosystems and unique biodiversity, for their cultural heritage, and for the provision of goods and services such as wood, carbon sequestration, soil and water protection, and aesthetic values and recreational opportunities. Australia's forests are subject to a range of pressures, including extreme weather, drought, climate change, invasive weeds, pests and diseases, changed fire regimes, urban development, mining, agricultural management practices such as grazing, 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 condition, use and management.

The seven criteria for sustainable forest management used in SOFR 2013 are those developed by the international-level Montreal Process Working Group on Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests. The criteria address the following aspects of forest conservation and management:

1) biological diversity
2) the productive capacity of forest ecosystems
3) ecosystem health and vitality
4) soil and water resources
5) forest contribution to global carbon cycles
6) long-term multiple socioeconomic benefits
7) legal, institutional and economic framework.

Indicators grouped under these criteria allow the presentation of a substantial body of data, in a consistent and repeatable format, on Australia's forests, their condition, their management, and their importance for people. Reporting on the state of Australia's forests through SOFR 2013 will support progress towards the sustainable management of Australia's forests.

The material under each of the 44 indicators in SOFR 2013 includes a brief description of the context for the indicator, presents nationally compiled data for the reporting period July 2006–June 2011 (or as close to this period as the data allow), gives caveats on data quality, and in many instances includes one or more regional case-studies. Trends over time are presented for indicators for which suitable data are available over a sufficient period.

This Executive summary draws together into key themes the information presented in SOFR 2013.

Left: Forest near Bellingen, New South Wales.

Australia's forests

Australia's forests are dominated by eucalypt and acacia forests, and the majority are woodland forests.

Australia has 125 million hectares of forest, equivalent to 16% of Australia's land area, as determined at 2011. Australia's forest cover is shown on the map below. Australia has about 3% of the world's forest area, and the seventh largest reported forest area of any country worldwide. Data on Australia's forest estate are compiled in the National Forest Inventory. A new approach has improved the resolution of mapping and given a more accurate measure of Australia's forest area.

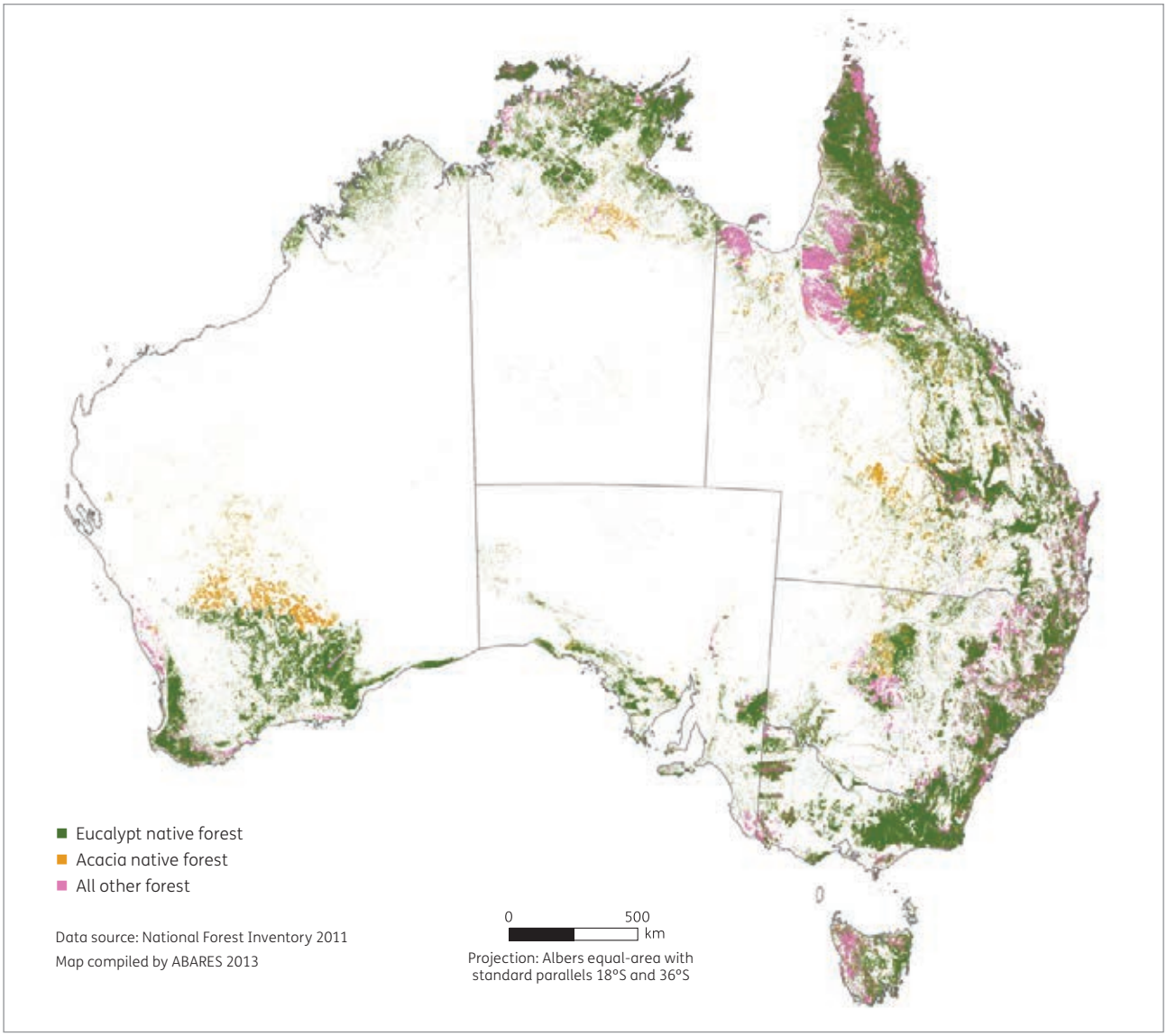
Australia's forests comprise 123 million hectares of native forests (98% of the total forest area), 2.02 million hectares of industrial plantations, and 0.15 million hectares of other forests. Australia's native forests are dominated by eucalypt forests (92 million hectares; 75% of the native forest area) and acacia forests (9.8 million hectares; 8%). The area of rainforest is 3.6 million hectares (3%).

About two-thirds of Australia's native forest (81.7 million hectares; 66.6%) is woodland forest with 20–50% crown cover.

An estimated 81.9 million hectares (66.8%) of Australia's native forest is privately managed on private and leasehold lands, including Indigenous owned and managed lands, or Indigenous managed lands (the term Indigenous is used in SOFR 2013 to refer to Aboriginal and Torres Strait Islander people).

Australia's Industrial plantations, for which data are compiled in the National Plantation Inventory, consist of similar areas of softwood species (1.03 million hectares, mostly pines) and hardwood species (0.98 million hectares, mostly eucalypts).

Australia's native forests are dominated by eucalypt forests and acacia forests.



SOFR 2013 reports Australia's total forest area as 125 million hectares, as shown in this map. Australia's 123 million hectares of native forests are dominated by eucalypt forests and acacia forests.

A new approach has improved the resolution of mapping and given a more accurate measure of Australia's forest area.

The forest area data for Australia presented in SOFR 2013 were derived using a 'Multiple Lines of Evidence' approach, which integrates forest cover data provided by state and territory land management agencies with data sourced from a variety of remote-sensing methods.

- This approach gives a higher level of certainty of reporting for areas of forest and areas of non-forest.
- The resultant National Forest Inventory forest cover dataset contains an updated and more rigorous and robust understanding of Australia's total forest area, the geographic distribution of national forest types, and the geographic distribution of forests of different tenure.

Australia's forest area reported in SOFR 2013, following application of the 'Multiple Lines of Evidence' approach, is 125 million hectares; Australia's forest area was reported in SOFR 2008 as 149 million hectares.

- Reporting a smaller forest area in SOFR 2013 does not mean that there has been a reduction in actual forest area, but rather results from improvements in technology that have enabled the use of better quality data on Australia's forests. The main reason is an improved resolution of forest mapping, resulting from the use of finer scale vegetation data, and often complemented by interpreted satellite imagery.
- Most of this improvement in resolution has occurred in Australia's less dense woodland forests, and has resulted from more careful delineation of the boundaries between woodland forest (with a crown cover of 20–50%) and other woody non-forest vegetation (with a crown cover of less than 20%). Much of the area previously reported as woodland forest in SOFR 2008 is now classified in SOFR 2013 as other woody non-forest vegetation.
- Another reason for reporting a smaller forest area is the incorporation of data on historical and recent land-use change for agriculture, mining or urban development.
- Most (83%) of the reduction in reported forest area between SOFR 2008 and SOFR 2013 is in the Northern Territory and South Australia, in forests generally managed under leasehold tenure.

SOFR 2013 reports no reduction in the areas of rainforest, multiple-use public forest, or forest in any of the Regional Forest Agreement regions compared with SOFR 2008.

- These areas have all been the subject of previous detailed forest mapping, and the Multiple Lines of Evidence approach led to only small amendments in their forest areas.

Continual improvements in understanding the extent of Australia's forests, and the reporting of forest area, have occurred since national figures were first reported in 1974.

- Australia's reported forest area has fluctuated between 105 million hectares and 164 million hectares since 1974, including across the three previous national State of the Forests reports in 1998, 2003 and 2008.
- These historical fluctuations in reported areas did not reflect actual changes in on-ground forest cover, but instead were mainly the result of changes in the basis of reporting (from only commercial forests to all forests), variability in state and territory data, mapping errors, and, before 1998, changes in the definition of forest.

The Multiple Lines of Evidence approach now adopted for the National Forest Inventory provides a forest area value, 125 million hectares, that is more accurate than previously reported values, and that is expected to be more suitable for the determination of changes in forest area over future reporting periods.

Change in forest area over time

Australia's forest cover changed over the period 2005–10, with a net loss estimated at 1.4 million hectares.

National figures for changes in on-ground forest cover are best determined using a single methodology applied consistently over time. The best available source of such data is currently satellite imagery interpreted for Australia's National Greenhouse Gas Inventory (previously known as the National Carbon Accounting System—NCAS). There are differences between the NCAS dataset used for carbon accounting, and the National Forest Inventory dataset used for the detailed recording and reporting of forest areas classified by forest structure, type and tenure. Overall, however, the NCAS dataset currently gives the most accurate measure of on-ground change in Australia's forest area.

Over the period 2005–10, the net loss of forest area calculated using the NCAS dataset is 1.4 million hectares (just over 1% of Australia's forest area). This was the result of land-use change for urban development and agriculture, plus short-term factors such as drought and fire. During this period, forest area decreased by 1.8 million hectares in 2005–08, then increased by 0.4 million hectares in 2009–10 as a result of recovery of forest from drought and fire.

Tenure and forest growth stage

The majority of Australia's native forests are in private and leasehold tenures. Smaller areas are held in formal nature conservation reserves and multiple-use public forests.

An estimated 81.9 million hectares (66.8%) of Australia's native forest is privately managed on private and leasehold tenures, while 21.5 million hectares of native forest (17.5%) is in formal nature conservation reserves. A further 10.2 million hectares of native forest (8.3%) is in multiple-use public forests. The remaining native forest (9.0 million hectares, 7.4%) occurs on other Crown land, or on land of unresolved tenure.

Regrowth karri (*Eucalyptus diversicolor*) forest in south-west Western Australia.

Woodland forest of snowgum (*Eucalyptus pauciflora*) in Kosciuszko National Park, New South Wales.

Nature conservation reserve and multiple-use public forest now both comprise a greater proportion of the native forest area than in SOFR 2008 (although for multiple-use public forest this is driven largely by forest tenure reclassification in Queensland), and there is a trend of progressive transfer of forest into reserves since the first SOFR in 1998. The distribution of native forest tenure types varies significantly across the different states and territories.

National data on native forest growth stage are available only for 15.4 million hectares of native forest, most of which is in Regional Forest Agreement regions in south-east and south-west Australia, where detailed measurements have been carried out. In this area of forest where growth stage is known, all four forest growth stages (regeneration, regrowth, mature and senescent) are present on all tenure types. More than 73% of Australia's identified old-growth forests are in formal or informal nature conservation reserves.

Protected forest areas on public and private land

A total of 39 million hectares (32% by area) of Australia's native forest is in areas protected for biodiversity conservation.

A total of 39 million hectares of Australia's native forest (32% of the native forest area) is designated as protected for biodiversity conservation. This comprises areas protected by prescription in multiple-use public forests, legally covenanted private land, formal and informal nature conservation reserves, and other protected areas on Crown-managed land.

Of this total protected area, the National Reserve System records 26 million hectares of forest (21% of Australia's forests) where nature conservation is the primary management intent (some types of protected area are not compiled into the description of the National Reserve System in the Collaborative Australian Protected Areas Database). All of the national native forest types in Australia, with the exception of Acacia forest, are represented at levels above the 10% area proportion target recommended by the International Union for Conservation of Nature.

Improved information on forest biodiversity and threats to forest species

Increases in the recorded national numbers of forest-dwelling species, and threatened forest-dwelling species, have resulted from improved information.

SOFR 2013 presents data from new national compilations of forest-dwelling vertebrate animals (2,212 species) and forest-dwelling vascular plants (at least 16,836 species), prepared from lists held by states and territories. The number of forest-dwelling species has generally increased in each jurisdiction since data were first reported in SOFR 1998, reflecting improved information from surveys. SOFR 2013 also presents data from a new national list of forest-dependent vertebrate animals (1,101 species) compiled from habitat data.

The national list of threatened species includes 1,431 forest-dwelling species (283 vertebrates, 32 invertebrates and 1,116 vascular plants). During 2006–11, a total of 89 forest-dwelling species were added to the national list of threatened species, and 21 forest-dwelling species were removed. Most removals (76%) were made because of better information about species populations, distributions or ecology that indicated that the species was not threatened, and the remaining removals (24%) resulted from taxonomic revisions. Among newly listed forest-dwelling species, the primary threats that led to their listing were historical land clearing for agriculture, grazing, and urban and industrial development, and associated habitat loss; predation by or competition from introduced fauna; small or localised populations; unsuitable fire regimes; and various mortality agents. Forestry operations pose a minor threat to nationally listed threatened forest-dwelling fauna and flora species compared with other identified threats.

No forest-dwelling species is known to have become extinct since the release of the first SOFR in 1998. Seven forest-dwelling plant species previously categorised as extinct were rediscovered during the SOFR 2013 reporting period.

Spider orchid (*Caladenia behrii*), an endangered forest-dwelling vascular plant found in South Australia.

Conservation and use of forest genetic diversity

Australia's forest genetic resources are conserved by a variety of means, are widely distributed internationally, and constitute the basis of tree improvement programs.

Australia's native forest genetic resources are primarily conserved in Australia's native forest, and to a lesser degree in arboreta, seed banks, seed orchards and plantations. Significant amounts of Australia's forest genetic material have been exported for use internationally in industry development and environmental protection. Tree-breeding, improvement and genetic conservation programs exist for more than 30 native Australian wood-producing and oil-producing species and varieties.

Echidna (*Tachyglossus aculeatus*), a forest-dwelling animal found in many of Australia's forests.

Eucalypt seedlings in tubestock.

Health and dynamics of Australia's forests

Many of Australia's forests were affected by drought and wildfire during the reporting period, and are currently recovering from these events. In both number and area, most wildfires occur in northern Australia. The Black Saturday bushfires in Victoria in 2009 had exceptionally serious impacts. There was an incursion of myrtle rust into Australia, with the potential to damage plantations and native forests.

Generally, Australia's forests are well adapted to disturbances such as fire, drought, cyclones and outbreaks of native pests and diseases, and impacts are followed by periods of recovery.

Damage caused to forests from native pests (mostly insects) and pathogens (mostly fungi) over the period 2005–10 was generally of low severity, and only occasionally widespread in extent. Most of the observed damage to forests was caused by exotic pests and pathogens that have become established in Australia. Occasionally, damage from outbreaks adversely affected commercial values in plantations.

Phytophthora cinnamomi and a number of other *Phytophthora* species remained a threat to a wide range of plant species, predominantly in regions with an average annual rainfall of more than 600 millimetres. Quambalaria shoot blight caused damage in spotted gum plantations in Queensland, while fungal leaf pathogens caused occasional significant defoliation in plantations in Tasmania, Victoria, Queensland and Western Australia. Teratosphaeria (Kirramyces) leaf spot became a major problem for eucalypt plantation establishment in the central-coast region of Queensland. Spotted gum canker emerged as a health issue for *Corymbia* species in New South Wales. Spring needle cast remained one of the major problems affecting the radiata pine plantation estate, while Dothistroma needle blight affected radiata pine plantations in Victoria and New South Wales.

The major new disease incursion in the reporting period was the establishment and spread of myrtle rust (*Puccinia psidii*[7]) in New South Wales, Queensland and Victoria. The myrtle rust pathogen has a wide range of hosts within the Myrtaceae, the plant family that includes eucalypts and many other Australian tree species. Rust spores are predominantly disseminated by wind, and the rust has spread rapidly to new areas (including native forest) after it was detected initially in nurseries, but its likely impact on Australia's plantations and native forests remains unclear.

A number of tropical cyclones caused significant damage to native forests and plantations in Queensland during the reporting period, including Cyclone Yasi, the largest and most powerful on the eastern coast of Australia since 1918. Drought affected large areas of western and south-eastern Australia for much of the reporting period, with significant impacts on forest health.

A series of intense wildfires affected large areas of forest in western and south-eastern Australia during the reporting period. The previous drought contributed to the intensity and extent of these fires. The fires are expected to have a range of impacts on wood flows and environmental values, including by affecting seed supply and forest regeneration, and water yield and quality. In Victoria, the Black Saturday bushfires of 07 February 2009 were exceptionally serious, burning more than 400,000 hectares, and resulting in the deaths of 173 people.

Overall, however, most bushfires, in terms of number and area, continue to occur in northern Australia: 77% of the forest area burnt over the period 2006–07 to 2010–11 was in the Northern Territory and Queensland, with some areas burning more than once during the reporting period. The estimated total area of forest burnt in the period 2006–07 to 2010–11 was 39.0 million hectares, an increase of 14.3 million hectares over that burnt in the period 2001–02 to 2005–06, with the increase also being mostly in the Northern Territory and Queensland. Of this total, unplanned fires burnt an estimated 31.6 million hectares of forest (81% of the total forest area burnt), and planned fires burnt an estimated 7.4 million hectares of forest (19%).

However, the long-term impacts of projected climate change on the broader native forest estate are unclear; it is possible that the greatest impacts will be through altered fire regimes, and changes in the incidence of pests and diseases. The performance of individual plantation species is predicted to change, which could lead to regional changes in plantation productivity.

Epicormic growth in a eucalypt forest following fire.

[7] *Puccinia psidii* sensu lato, previously referred to by the name *Uredo rangelii*.

Soil and water management

The forest practices systems in Australia's states and territories contain guidelines designed to protect forest soil and water resources.

Codes of forest practice, guidelines and other instruments in place for Australia's forests aim to protect soil values and maintain water supply and quality, including by preventing or mitigating soil erosion. A total of 29.8 million hectares of public forest (24% of Australia's total forest area) is managed primarily for protection, including of soil and water values, an increase of about 2% over the 2006–11 reporting period. A variety of national-level programs have encouraged re-establishment, restoration and maintenance of native vegetation, including forests, for protective functions.

Major wildfires in native forest during the reporting period caused temporary declines in water quality. Increased water use by the resultant natural regrowth is expected to reduce water yields in some affected catchments in coming years.

Forest streams provide clean water and contain aquatic biodiversity. This stream flows through mountain ash (*Eucalyptus regnans*) forest in a Victorian water-supply catchment.

Role of forests and forest management in sequestering carbon

Carbon stocks in Australia's forests increased slightly over the period 2005–10, as did transfers of carbon from forests to forest products in service and in landfill.

Forests are an important component of the global carbon cycle, because they store substantial amounts of carbon, sequester carbon during growth, and release carbon during fire and decay. Forest carbon stocks vary over time according to natural processes of growth, disturbance and regeneration, and are also affected by forest management activities. There was a small increase in carbon stocks in Australia's forests (from 12,831 to 12,841 million tonnes) over the period 2005–10, driven by the recovery of forest from wildfires in the previous five years. Plantations accounted for 171 million tonnes of the forest carbon stock in 2010.

Tall open eucalypt forest, Victoria.

In addition, in 2010 a total of 103 million tonnes of carbon derived from forests was present in wood and wood products, including paper, in service (7 million tonnes more than in 2005 and 14 million tonnes more than in 2000); a further 123 million tonnes was present in wood and wood products, including paper, in landfill (6 million tonnes more than in 2005 and 13 million tonnes more than in 2000). The transfer of carbon from forests to wood products thus increased during the reporting period. The total amount of greenhouse gases emitted by forestry operations in producing logs represents only 3–7% of the equivalent amount of carbon dioxide sequestered in those logs.

Industry resource base

A total of 36.6 million hectares of native forest was both available and suitable for commercial wood production in 2010–11, comprising 7.5 million hectares of multiple-use public forests and 29.1 million hectares of leasehold and private forests. Australia-wide, 2.0 million hectares of industrial plantations were available for commercial wood production in 2010–11, an increase from 1.8 million hectares in 2005–06.

The major source of native forest wood and wood-based products is multiple-use public forests in New South Wales, Queensland, Tasmania, Victoria and Western Australia. The majority of the native forest estate on leasehold and private land, including forests used predominantly for extensive grazing, does not contribute significantly to national wood supply.

The area of native forest both available and suitable for commercial wood production determines the forest sector's capacity to meet demand for native forest wood and wood-based products. The availability of an area for wood production is determined by its tenure; state and territory regulatory frameworks, including codes of forest practice; and other requirements, such as the protection of soil, water values and biodiversity. The area of native forest not legally restricted from wood harvesting decreased steadily over the period 2000–01 to 2010–11 as a result of the transfer of significant areas of multiple-use public forests to nature conservation reserves. The suitability of an area of native forest for wood harvesting is also limited by commercial reasons, including the absence of tree species marketable in commercial quantities, low site productivity, isolation from markets or processing facilities, operational harvesting difficulties, and other infrastructure constraints.

A new, national, forest commerciality database was used in SOFR 2013 to identify spatially the area of forest both available and suitable for harvesting. A total of 36.6 million hectares of native forest was both available and suitable for commercial wood production in 2010–11. Of this, 7.5 million hectares of public native forests is both available and suitable for commercial wood production; however, when additional local restrictions to maintain and manage non-wood values are taken into account, the net harvestable area in multiple-use public native forest is 5.5 million hectares. A substantially larger area (29.1 million hectares) of leasehold and private tenure forest is potentially available and suitable for commercial wood production, but this is subject to landholder intent, markets, regulatory frameworks, and environmental constraints.

Regeneration of mountain ash (*Eucalyptus regnans*) forest, Victoria.

Australia also had 2.0 million hectares of Industrial plantations available for commercial wood production in 2010–11, an increase from 1.8 million hectares in 2005–06. Australia's softwood plantation estate has been approximately 1.0 million hectares in size since 1990 (and was 1.03 million hectares in 2011). The increase in Australia's hardwood plantation estate started in around 1990, with the area reaching 1.0 million hectares in 2009 and then remaining approximately constant (and was 0.98 million hectares in 2011).

Ownership of trees in the Industrial plantation estate changed significantly between 2005 and 2011. Of the total Industrial plantation estate, the area proportion where the trees are government-owned decreased from 35% in 2006 to 24% in 2011, while the proportion where the trees are privately owned increased from 65% to 76%. Private ownership identified as ownership by institutional investors increased to 31% in 2011; ownership by managed investment schemes rose to a high of 36% in 2009, then fell to 24% in 2011; other private ownership types, including farm foresters, timber industry companies and other private entities, totalled 21% by area in 2011.

Harvesting of wood and non-wood forest products

Over the period 2006–07 to 2010–11, the annual area of multiple-use public native forest harvested for wood decreased by 32%, with associated decreases in the volumes of sawlogs and pulplogs produced from native forests. Nationally, actual sawlog harvest levels were below sustainable yield levels by 17% for the period 2006–11, and below sustainable yield levels by 6–18% for each of the four SOFR five-yearly reporting periods. Average annual sawlog harvests from multiple-use public native forests declined from 1.96 million cubic metres in the period 2001–06, to 1.4 million cubic metres in the period 2006–11.

In the period 2006–11, there was an increase in the volumes of sawlogs and pulplogs harvested from plantations. In 2010–11, plantations produced 76% of Australia's total log supply.

The area of multiple-use public native forest harvested annually for wood declined from 117 thousand hectares in 2006–07 to 79 thousand hectares in 2010–11, a decrease of 32%. Of the area harvested over the 10-year period 2001–02 to 2010–11, 85% was harvested using a variety of selection logging systems, 12% by clearfelling silviculture systems (clearfelling, fire-salvage harvesting and intensive silviculture), and 3% by shelterwood systems.

Average sustainable sawlog harvest yields from multiple-use public native forests declined by 47% nationally between 1992–96 and 2006–11. This was a consequence of increased forest reservation, increased restrictions on harvesting in codes of forest practice, revised estimates of forest growth and yield, and the impacts of broadscale wildfires. In parallel with this trend, actual sawlog and pulplog harvests from native

ForestrySA

Loading harvested radiata pine (*Pinus radiata*) logs in the Green Triangle region, South Australia.

forest both declined: for example, average annual sawlog harvests from multiple-use public native forests declined from 1.96 million cubic metres in the period 2001–06, to 1.4 million cubic metres in the period 2006–11. Nationally, the actual sawlog harvest levels were below sustainable yield levels by 17% for the period 2006–11, and below sustainable yield levels by 6–18% for each of the four SOFR five-yearly reporting periods.

In comparison, over the period 1992–96 to 2006–11, the sawlog and pulplog harvest from softwood plantations increased, as did the pulplog harvest from hardwood plantations. The sawlog harvest from hardwood plantations has been low but relatively stable over time, but the availability for harvest of plantation hardwood sawlogs is projected to increase over the next decade. In the period 2006–07 to 2010–11, plantations produced 71% of the total volume of logs harvested in Australia: hardwood plantations provided 35% of the pulplog supply and 1% of the sawlog supply, while softwood plantations provided 39% of the pulplog supply and 79% of the sawlog supply. In 2010–11, the final year of the SOFR 2013 reporting period, 76% of the volume of logs harvested in Australia was from plantations.

The residential use of firewood for heating and energy decreased slightly between 2006 and 2010, while industrial fuelwood use increased over this period.


Samantha Matthews

Blue gum (*Eucalyptus globulus*) plantation being harvested in the Eden region, New South Wales.

Australia also produces a wide range of non-wood forest products. High-value non-wood forest products include wildflowers, seeds, honey, and aromatic products derived from sandalwood. Generally, the extraction of non-wood forest products has a low environmental impact in Australia.

Trends in forest production

A total of 26.6 million cubic metres of logs was harvested in Australia in 2010–11, a decrease from 27.2 million cubic metres in 2006–07. This overall decrease was made up of a decrease in the harvest of native forest hardwood logs but an increase in the harvest of softwood and hardwood plantation logs.

The total value of logs harvested from native forests and plantations in 2010–11 was $1.85 billion. The wood and wood products industries contributed $8.3 billion or 0.59% of Australia's gross domestic product in 2010–11. Turnover of the Australian wood and wood products industries in 2010–11 was $24.0 billion. The trade deficit in wood products was $1.93 billion in 2010–11. The gross annual value of production of non-wood forest products in 2011–12 was estimated at $198 million.

A total of 26.6 million cubic metres of logs was harvested in Australia in 2010–11, a decrease from 27.2 million cubic metres in 2006–07. The volume of hardwood logs harvested from native forests declined by 26% over this period, from 8.55 million cubic metres to 6.3 million cubic metres. The volume of logs harvested in softwood and hardwood plantations (plus a small volume of softwoods harvested from native forests) increased by 8.1% over this period, from 18.4 million cubic metres to 20.2 million cubic metres; 76% of the volume of logs harvested in Australia in 2010–11 was from plantations.

Indexed to 2010–11 prices[8], the value of logs harvested from native forests and plantations decreased from $1.93 billion in 2006–07 to $1.85 billion in 2010–11, a decrease of 3.9%. Indexed to 2010–11 prices, the turnover (sales and service income) of the wood and wood products industries increased from $23.8 billion to $24.0 billion between 2006–07 and 2010–11, an increase of 0.9%. The value added by the wood and wood products industries was $7.4 billion in 2006–07, giving a contribution to Australia's gross domestic product of 0.68%. The value added was $8.3 billion in 2010–11, and the contribution to gross domestic product was 0.59%.

Australia is a net importer of wood and wood products. The trade deficit in wood products increased slightly over the reporting period, to $1.93 billion in 2010–11, due to an increase in imports linked to the strong Australian dollar, and an oversupply of wood products in international markets.

Recovery and recycling rates for paper and paperboard products increased over the reporting period, continuing a long-term trend.

8 Dollar amounts are only adjusted for inflation where specified.

Premium grade jarrah (*Eucalyptus marginata*) timber from Western Australia.

The gross annual value of production of non-wood forest products regarded as having high forest dependence was $198 million in 2011–12.

The value of benefits from forests other than provision of wood, such as biodiversity, carbon storage and sequestration, production of water and soil protection, is generally not integrated into an economic framework for forest conservation or management.

Investment in forests and forest research

The annual rate of establishment of new hardwood and softwood plantations declined from 87 thousand hectares in 2006–07 to 10 thousand hectares in 2010–11. Annual investment in new plantations thus decreased substantially over this period. Expenditure on research and development in forestry and forest products and associated capacity also declined.

Investment in new hardwood and softwood plantation establishment can be measured by the area of new plantations established. A total of 10 thousand hectares of new plantations was established in 2010–11, compared with 87 thousand hectares in 2006–07.

The forestry sector accumulated $6.0 billion of fixed capital between 2006–07 and 2010–11, including new plantations, equipment and buildings; over this period, fixed capital formation net of depreciation and amortisation was estimated at $1.08 billion.

Research, inventory and the development of assessment methodologies provide the basis for sustainable forest management by allowing an understanding of the characteristics and functions of Australia's forests, while forest products research and development aims to identify new forest-based products and processing methods. Between 2005–06 and 2008–09, total expenditure on research and development (R&D) reported by businesses in the forestry sector declined from $164 million to $137 million. Adjusted for inflation, and using a consistent methodology over time, there has been an overall decline in forestry and forest product R&D expenditure since 1982.

Changes in funding and delivery models by the Australian Government and by state and territory governments reduced forest R&D capacity across a number of national organisations and state and territory forest management agencies. The numbers of staff engaged in R&D activities fell, especially between 2008 and 2011; the reduction occurred in both the public and the private sectors, including CSIRO, state and territory governments, and academic institutions. An estimated 396 researchers and technicians were involved in forestry and forest products R&D in 2011, a reduction from 635 in 2008.

Indigenous forests

Approximately one-third of Australia's forests are Indigenous owned and managed, Indigenous managed, Indigenous co-managed or subject to Other special rights.

Access, management and ownership are key parts of the relationship of Indigenous people with land. Just over one-third of Australia's forests (41.9 million hectares, 34% by area) were identified as part of the Indigenous estate—that is, in one of four broad Indigenous land tenure and management categories: Indigenous owned and managed, Indigenous managed, Indigenous co-managed and Other special rights. About three-quarters of this forest area is in Queensland and the Northern Territory.

Interpretive sign, Walu Wugirriga, Daintree National Park, Queensland.

Non-Indigenous heritage

A total of 7.3 million hectares of forest is listed in the Non-Indigenous Heritage Sites of Australia dataset.

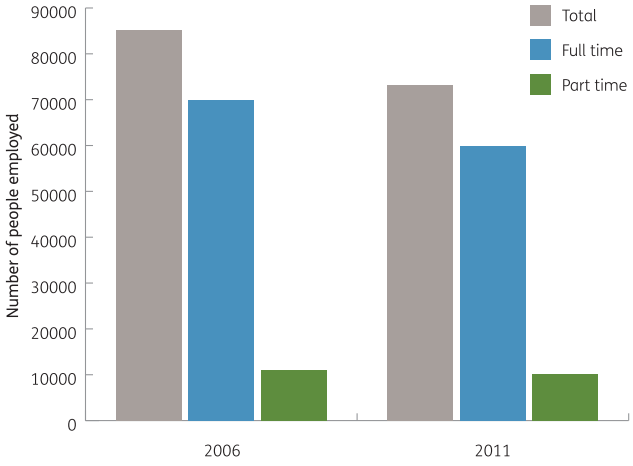
Australia's forests include many sites that provide evidence of the complex interactions between non-Indigenous people and forest landscapes. A total of 7.3 million hectares of forest is listed in the Non-Indigenous Heritage Sites of Australia dataset. Registered heritage sites occur in all tenure types, although many are not registered with the specific objective of protecting and conserving forests. Examples of larger sites with substantial protected forest components are Kakadu National Park, the Tasmanian Wilderness, the Gondwana Rainforests of Australia, and the Grampians National Park.

Forest-related employment

Total direct employment in the forest and wood products sector fell between 2006 and 2011, including in those Statistical Local Areas most dependent on these industries.

There was a fall in total direct employment in the forest and wood products sector over the reporting period, from 85 thousand people in 2006 to 73 thousand people in 2011, as reported in Australian census data. These figures comprise people employed full-time or part-time in forestry and logging; wood product manufacturing; pulp, paper and converted paper product manufacturing; forestry support services; and timber wholesaling. Direct employment in the forest and wood products sector also declined as a proportion of total national employment during this period. In Tasmania, forest-related employment fell by almost half between 2006 and 2011. The number of students commencing and graduating with forestry-specific university degrees also declined, and there were ongoing shortages of skilled workers across Australia's forest industry.

Total national employment in the forest and wood products sector, 2006 and 2011.



Note: Total employment may be higher than the sum of full-time and part-time employment because total employment includes people who were 'employed, but away from work' but for whom hours worked were not given. Source: Australian Bureau of Statistics.

In 2011, there were 28 Statistical Local Areas (SLAs) in which 4% or more of the working population (the level used to show medium-to-high relative community dependence on direct employment in the sector) was employed in forest and wood products industries. Of these 28 SLAs, 24 showed a decline in employment in the sector over the period 2006–11. Community adaptive capacity to change (resilience) can be affected by available human capital, social capital and economic diversity; of the SLAs with relatively high employment dependence on forest and wood products industries, several had relatively low rankings in an adaptive capacity index.

Visiting forests is a popular activity. Meroo National Park, New South Wales.

Public perceptions of forests

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

Public perceptions are divided over whether Australia's native forests are sustainably managed. Wood is generally viewed as an environmentally friendly material. Harvesting trees is viewed favourably only if the trees are replaced with new ones. Understanding of the role of forests in carbon storage is high, and understanding of the role of wood in carbon storage increased appreciably over the reporting period. Public perceptions of the acceptability of plantations as a rural land-use are also divided, although with regional variations.

Policy and regulation

Australia has a well-established framework for forest management, including policy and legislative instruments, and codes of forest practice. The area of forest in which forest management is certified has continued to increase over the reporting period.

Australia's National Forest Policy Statement (1992) underpins a well-established policy and legislative framework for the conservation and sustainable management of Australia's forests, both nationally and at state and territory levels. Public native forest is governed and managed under state or territory regulatory frameworks and management plans. The management of forests on private land is also regulated under various native vegetation Acts. Twenty-six million hectares (21%) of Australia's forests are covered by management plans relating to their conservation and sustainable management. Fifteen million hectares of forest in the National Reserve System (56% of the area of forest in the National Reserve System) have management plans in place.

Codes of forest practice vary in their legal status and coverage, but generally they provide specific operational guidance for sustainable forest management practices in public and private forests available for wood production, including plantations.

The area of forest in which forest management is certified under either the Australian Forest Certification Scheme or the Forest Stewardship Council has continued to increase. In 2011, about 10.7 million hectares of native forests and plantations were certified, with some areas certified under both schemes.

New national data compilations, and remaining knowledge gaps

The analysis in SOFR 2013 of a number of new, national, forest-related datasets with improved coverage and quality has allowed improvements in reporting across a range of indicators, and has enabled a more complete description of trends over time. Data gaps remain in some indicators, especially for private and leasehold forests.

A number of new social, economic and environmental datasets have been compiled, analysed and presented in SOFR 2013. Compared with SOFR 2008, the coverage and quality of data presented in SOFR 2013 has improved for almost half (21) of the 44 national reporting indicators. These changes have increased the quality of the information, and confidence in its accuracy. For 16 indicators, data were sufficient to allow comparisons of metrics over longer periods of time, enabling analysis and presentation of trends.

However, quantitative information is not available equally across social, economic and environmental indicators, and a number of gaps remain in the data compiled for SOFR 2013. Some data are collected nationally, and other data are provided by states and territories. In addition, the ability to measure, monitor and report on forests varies considerably by tenure. Reliable and comprehensive information across a range of parameters is available for industrial plantations, and for native forests on multiple-use public tenure; data are more limited in other native forest tenure categories, including some nature conservation reserves and, especially, leasehold and private forests.

Overall, SOFR 2013 addresses its purpose of being a 'comprehensive national report', and provides the reader with information to assess progress towards sustainable forest management in Australia.

Forest officers inspecting a timber harvest operation, Victoria.

Introduction

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

Eucalypt forest in a subalpine environment, Dinner Plain, Victoria.

Occurring in a broad range of geographic landscapes and climatic environments, Australia's native forests contain a wide array of mostly endemic species (that is, species naturally found nowhere else) combining to form unique and complex ecosystems.

Australia's native forests provide a range of wood and non-wood products that are used by Australians in their everyday lives. They also provide clean water; protect soil; provide opportunities for recreation and tourism, and scientific and educational pursuits; and support cultural, heritage and aesthetic values. Australia's plantation forests are a major source of commercial wood products.

In 1992, the Australian Government and state and territory governments issued 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 prepare a review of 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 gives effect to these commitments. *Australia's State of the Forests Report 2013* (referred to as SOFR 2013) is the fourth report in this series; three earlier reports (referred to as SOFR 1998, SOFR 2003 and SOFR 2008, respectively) were published in 1998, 2003 and 2008.

The role of SOFR 2013 is to inform the public about Australia's forests, their management and use, and, where possible, to track changes or monitor trends over time. SOFR 2013 also assists Australia report the state of its forests internationally.

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.

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

The 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.

[a] Commonwealth of Australia (1992)

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.

Australia's forests are subdivided into closed, open and woodland forests to provide a better understanding of their characteristics. 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 more than 50% and up to and including 80% of the land area; and woodland forest is forest where the tree canopies cover between 20% and up to and including 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 categorised as non-forest carrying other woody vegetation.

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 harvesting for wood production) to be identified as part of the forest estate.

The definition of plantations used in this report is the same as 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.*

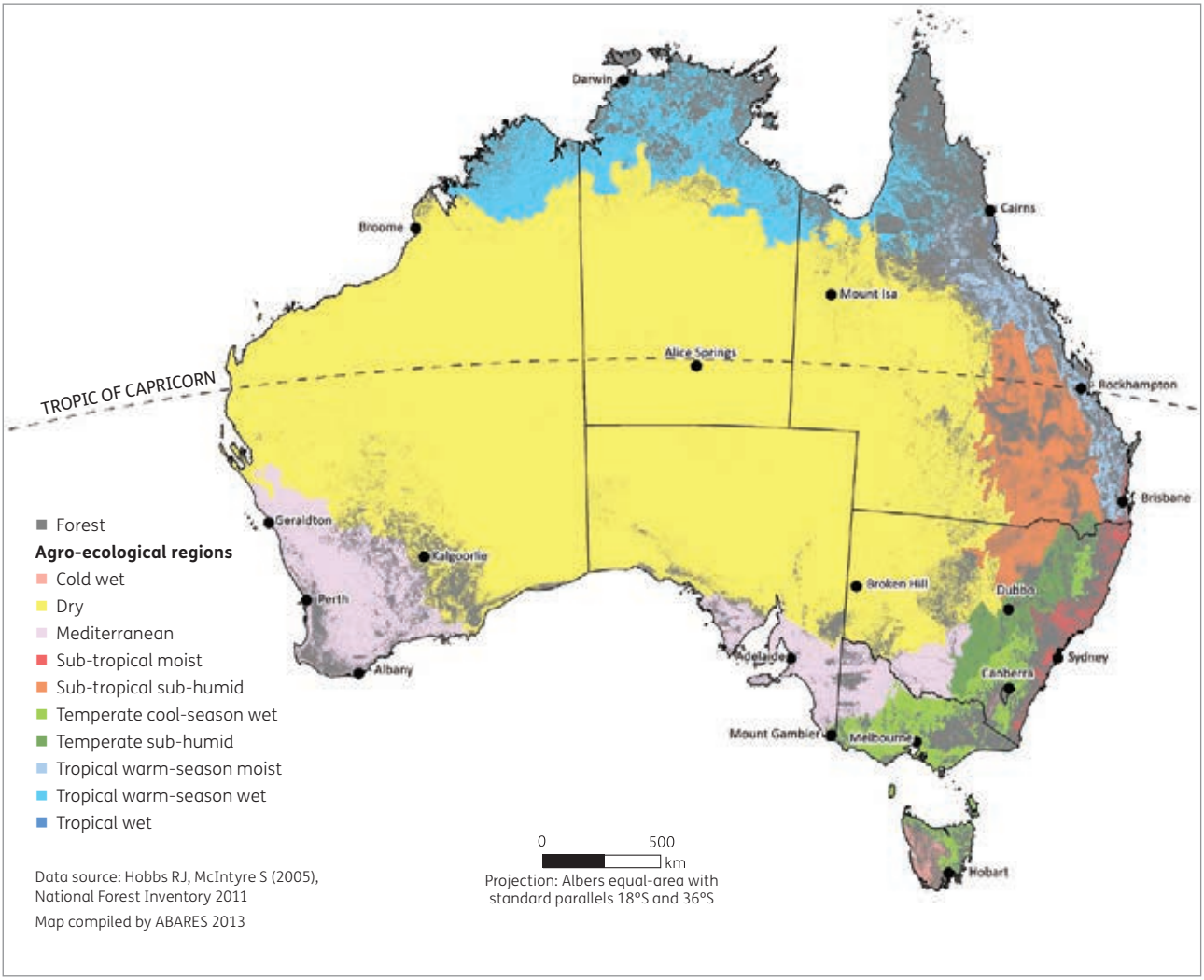
Australia's forests

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 (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 recent, fertile soils of volcanic origin.

Across the wide range of rainfall and soil conditions that support forest, more than 80% of Australia's 'Native forest' category of forest is dominated by eucalypts and acacias. Native forests are categorised in Australia's National Forest Inventory 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.

In addition to 'Native forest', Australia's National Forest Inventory recognises two other categories of forest. 'Industrial plantations' are plantations grown on a commercial scale for wood production. 'Other forest' includes non-industrial plantations and planted forest of various types.

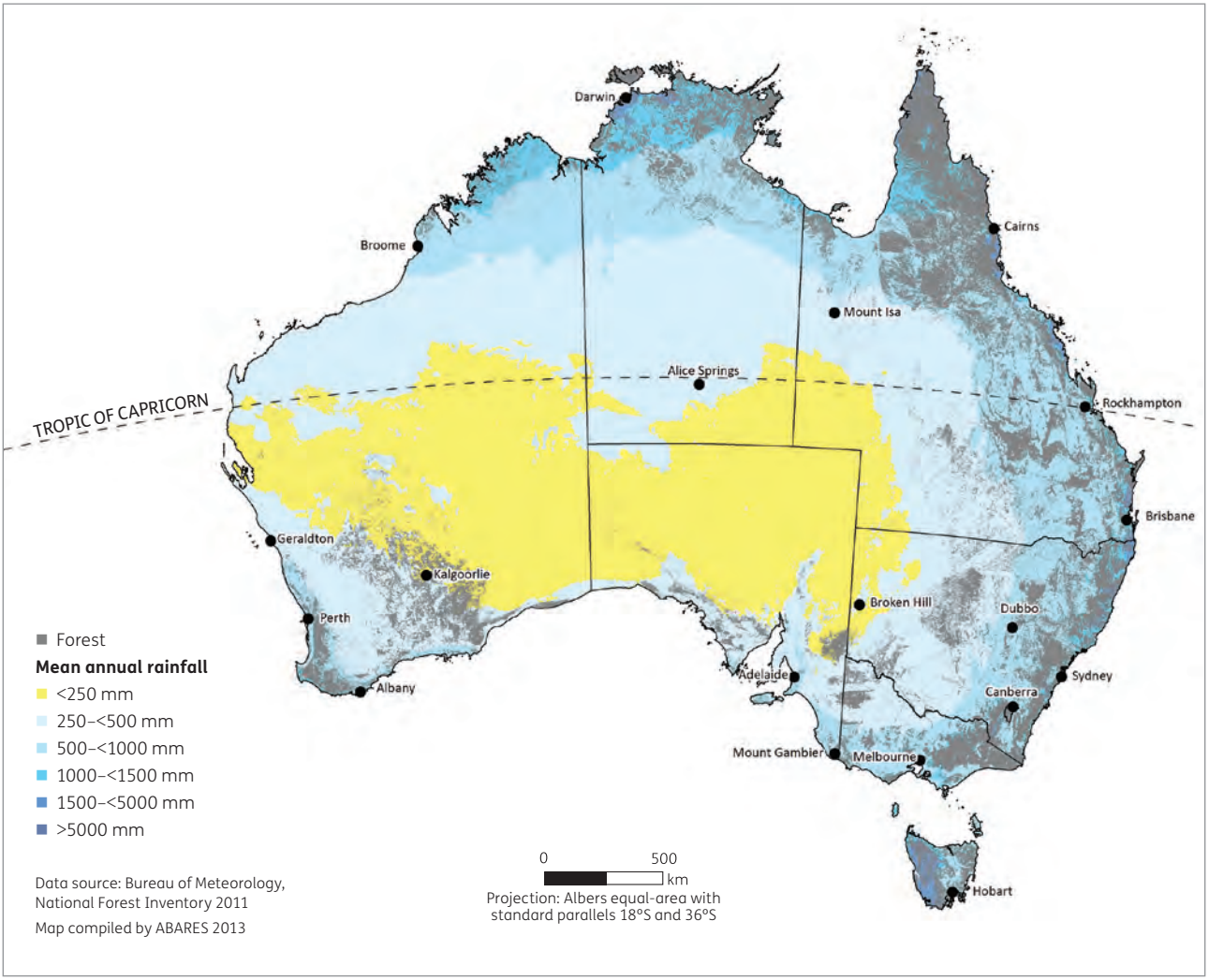
Figure I.i: Agro-ecological regions of Australia



Note: Grey shading across agro-ecological regions shows forest.

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

Figure I.ii: Mean annual rainfall across Australia



Note: Grey shading across rainfall zones shows forest.

Spotted gum (*Corymbia maculata*) forest in New South Wales.

Native forests

The eight national forest types are described below[9].

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 species with spreading forms to trees that are more than 30 metres tall.

Acacia forests are Australia's second most common 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, but are also present in wetter areas: in Tasmania, for example, blackwood (*Acacia melanoxylon*) dominates stands of swamp forest on poorly drained sites. Mulga (*A. 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. Both mulga and brigalow form forest and non-forest communities.

Callitris

The *Callitris* genus 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, species of *Callitris* are present in Acacia, Casuarina and Eucalypt forest types over a shrubby, grassy or herbaceous understorey.

Casuarina

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

Only some casuarina species form forest communities; others grow in vegetation too short or sparse to be classified as forest. 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 she-oak (*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 (low, medium or tall) and crown cover (closed, open or woodland, also shown in Figure I.iii).

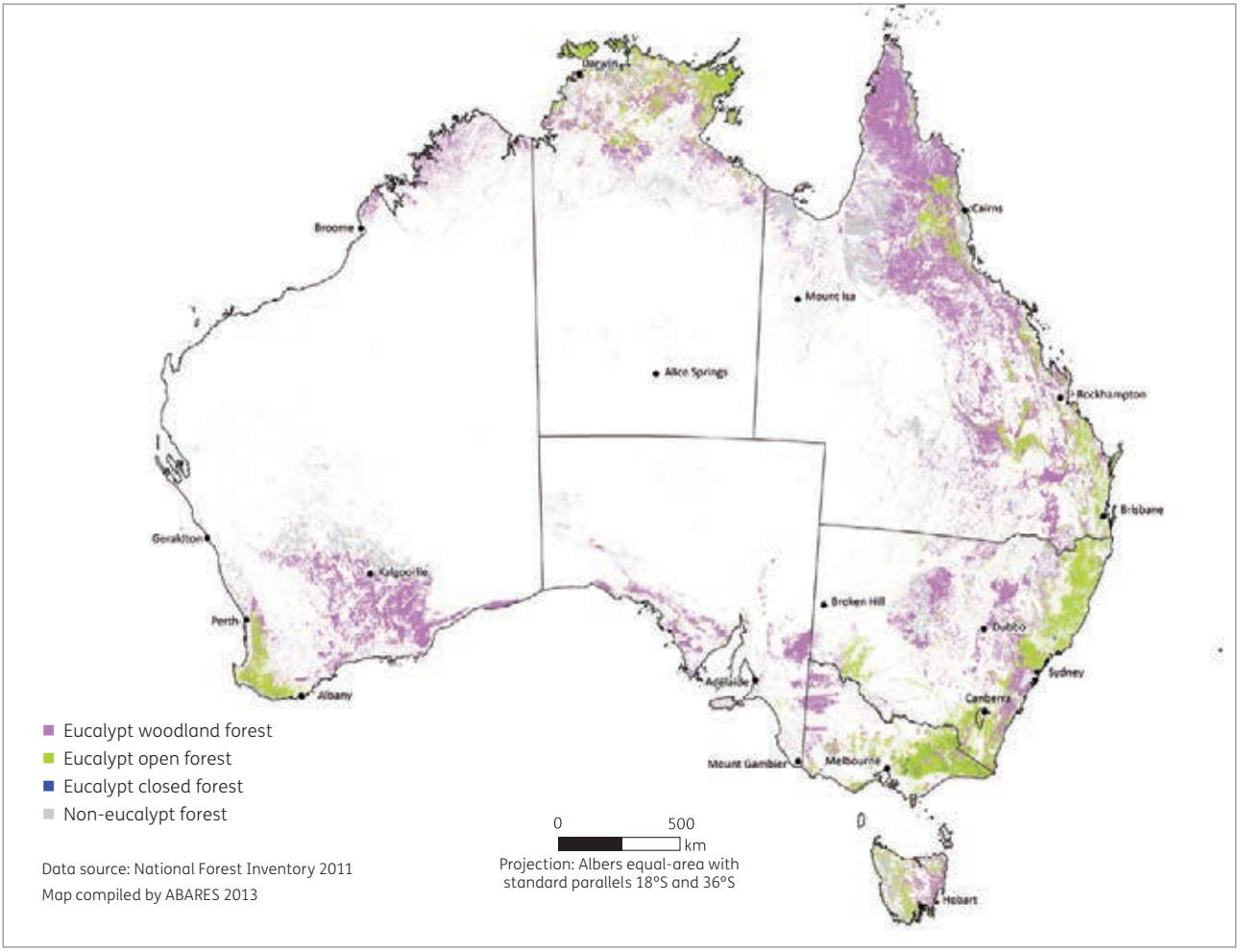
Eucalypts evolved from rainforest ancestors, adapting to an environment in which drought, nutrient-poor soils and fire were increasingly common. Eucalypt species have oil-rich foliage that burns readily, and they display a range of strategies to survive and recover from fire. The majority of eucalypt 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. tetrodonta*). Many species of mallee eucalypts are found across the inland regions of southern Australia (Figure I.iv).

Eucalypt mallee woodland forest, Eyre Peninsula, South Australia.

[9] 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). The related formal genus names are italicised and have capitalised initial letters (e.g. *Acacia*).

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



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.

Australian mangrove forests contain 41 species of mangrove from 19 plant families, and more than half the world's mangrove species occur naturally in Australia. White mangrove (*Avicennia marina*) is the most widespread and common species.

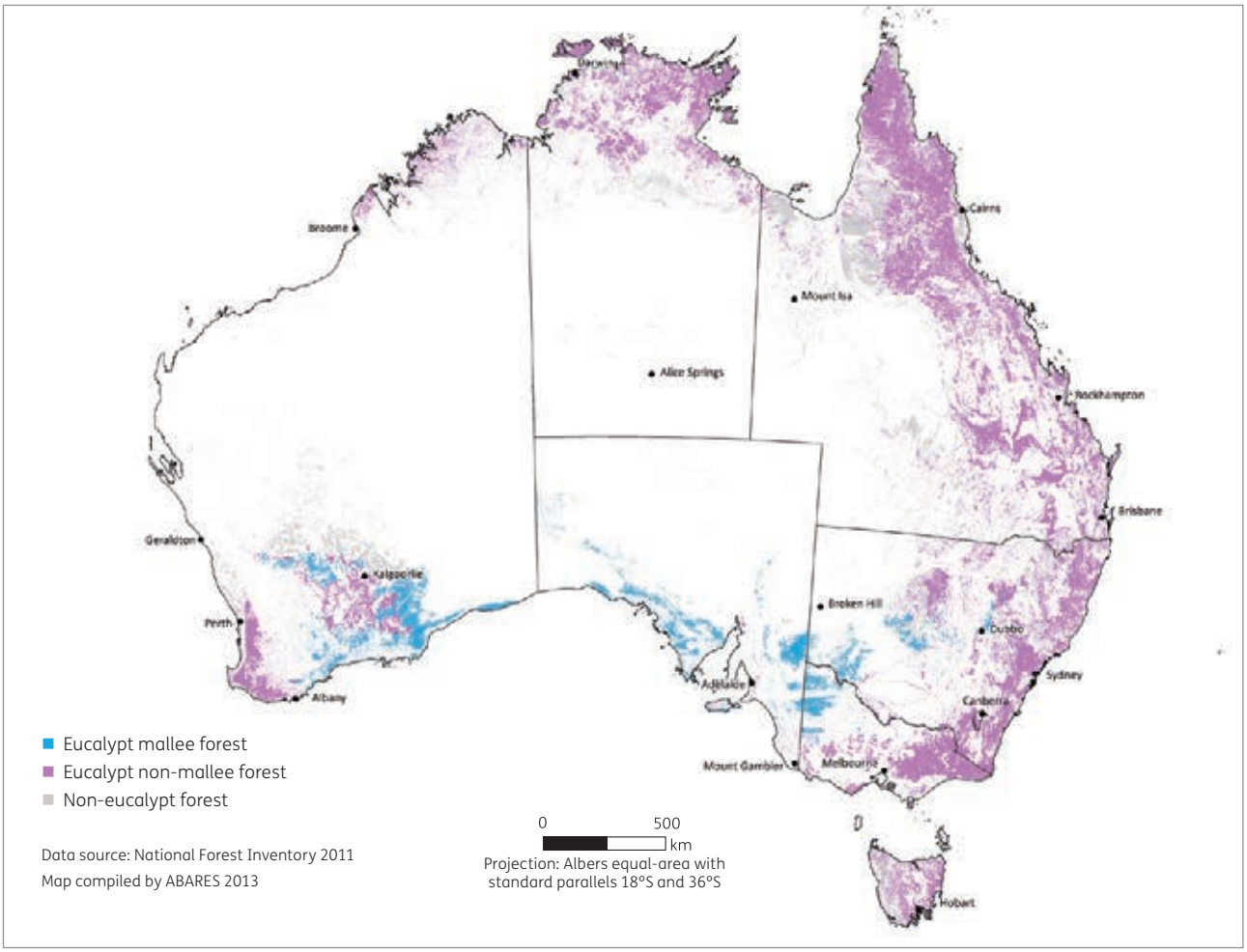
Mangrove forest, Cape Tribulation, Daintree National Park, Queensland.

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 to be classified as forests; the taller species are known as tea-trees or paperbarks. Common species include broad-leaved paperbark (*M. 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. Swamps dominated by melaleuca also occur on poorly drained sites on the east coast of mainland Australia, and in north-western Tasmania.

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



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 above the rainforest canopy. Tree species of the rainforest canopy are shade-tolerant when 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.

Rainforests support a significant part of Australia's biodiversity, including many of Australia's unique plant families. The tropical rainforests in far north Queensland are also rich in marsupial, frog and butterfly species.

Rainforest, Curtain Fig National Park, Queensland.

Other native forest

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

Industrial plantations

Australia's Industrial plantations comprise both softwood species (predominantly radiata pine, *Pinus radiata*) and hardwood species (with the most common species being 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. Industrial 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. Industrial 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, illustrating that wood flows are not constrained by state or territory boundaries.

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

Other forest

Other forest comprises small areas of mostly non-industrial plantations and planted forests of various types, including sandalwood plantations, 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

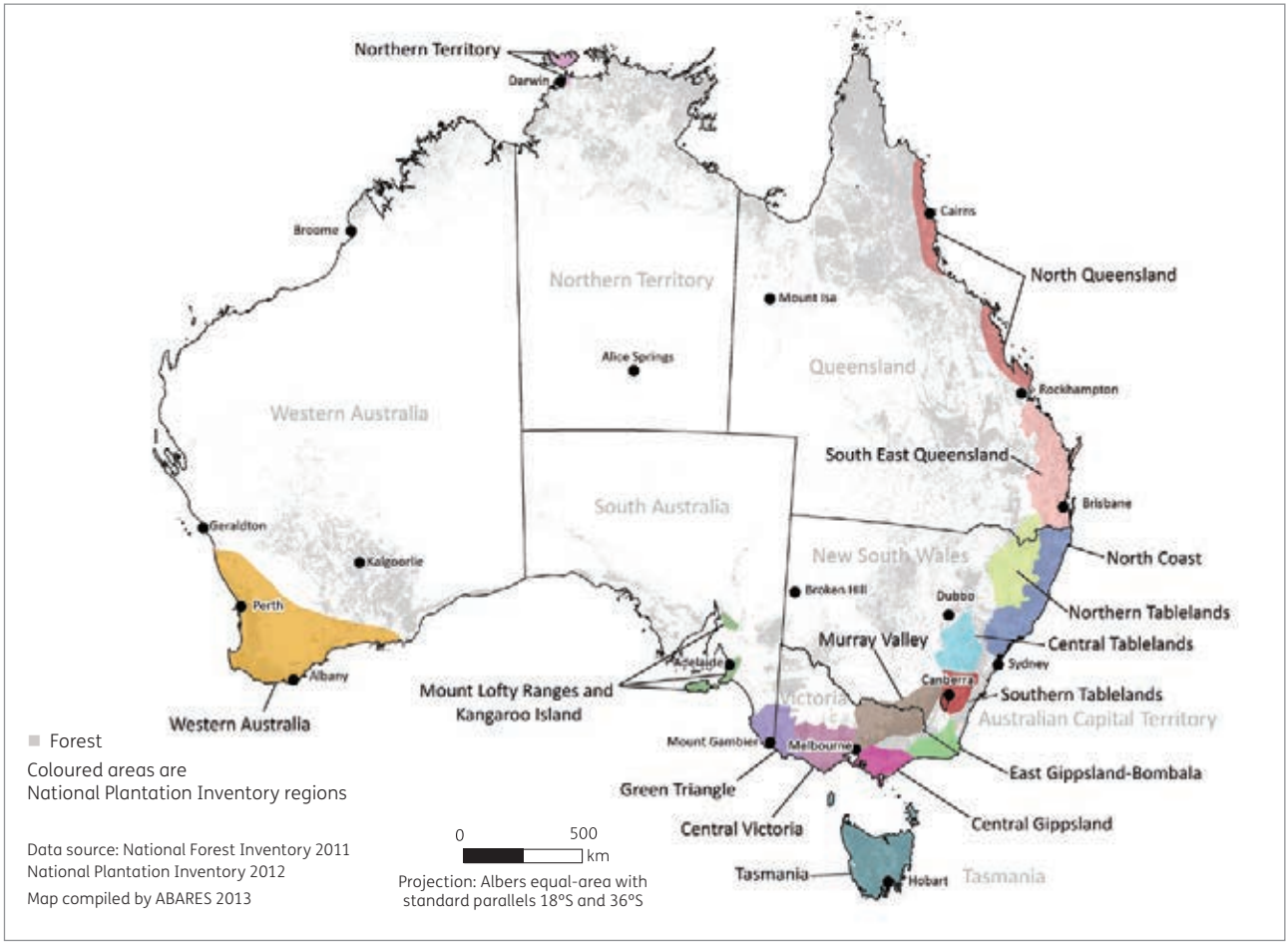
The ownership of a forest, especially native forest, has a major bearing on its management. The six tenure classes used for forests in the National Forest Inventory are amalgamations of the wide range of classes used by various state and territory jurisdictions. The classes can be grouped on the basis of ownership as public or private, with a small area of unresolved tenure. Publicly owned forests include 'nature conservation reserve', 'multiple-use public forest' and 'other Crown land'. 'Leasehold forest' is forest on Crown land (land that belongs to a national, state or territory government) that is typically privately managed. Some forests on private land are publicly managed as conservation reserves. For Industrial plantations, the ownership of the land can be different from ownership of the trees, and management arrangements can be complex.

Radiata pine (*Pinus radiata*) plantation, New South Wales.

The six tenure classes are described as follows:

- **Multiple-use public forest:** publicly owned state forest, timber reserves and other forest areas, 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 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 Aboriginal and Torres Strait Islander communities (referred to collectively as Indigenous communities in SOFR 2013).
- **Private forest:** forest on land held under freehold title and private ownership, and usually privately managed. This class includes land with special conditions attached for designated Indigenous communities.
- **Leasehold forest:** forest on Crown land held under leasehold title, and generally privately managed. This class includes land held under leasehold title with special conditions attached for designated Indigenous communities.
- **Unresolved tenure:** forests where data are insufficient to determine land ownership status.

Figure I.v: National Plantation Inventory regions of Australia



Farm forestry stand of trees planted by multiple generations of one family, Kyogle, New South Wales.

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 (in addition to the six states, there are two self-administered mainland territories: the Australian Capital Territory and the Northern Territory); and local (city-based or regionally based). The traditional law-making and land-management processes of Aboriginal and Torres Strait Islander people (referred to in SOFR 2013 as Indigenous people) also apply in some areas. The term 'jurisdiction' is used to denote any of the Australian, state or territory governments.

The state and territory governments have responsibility for land allocation and land management, including forest management. The Australian 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. 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.

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 some individual state governments. RFAs are 20-year plans 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 methodology and Comprehensive Regional Assessments (CRAs) were used to determine forest allocation for different uses and to underpin forest management strategies. The RFAs are designed to provide certainty for forest-based industries, forest-dependent communities and conservation. Certain obligations of the Commonwealth under RFAs were given effect through the Commonwealth *Regional Forest Agreements Act 2002*.

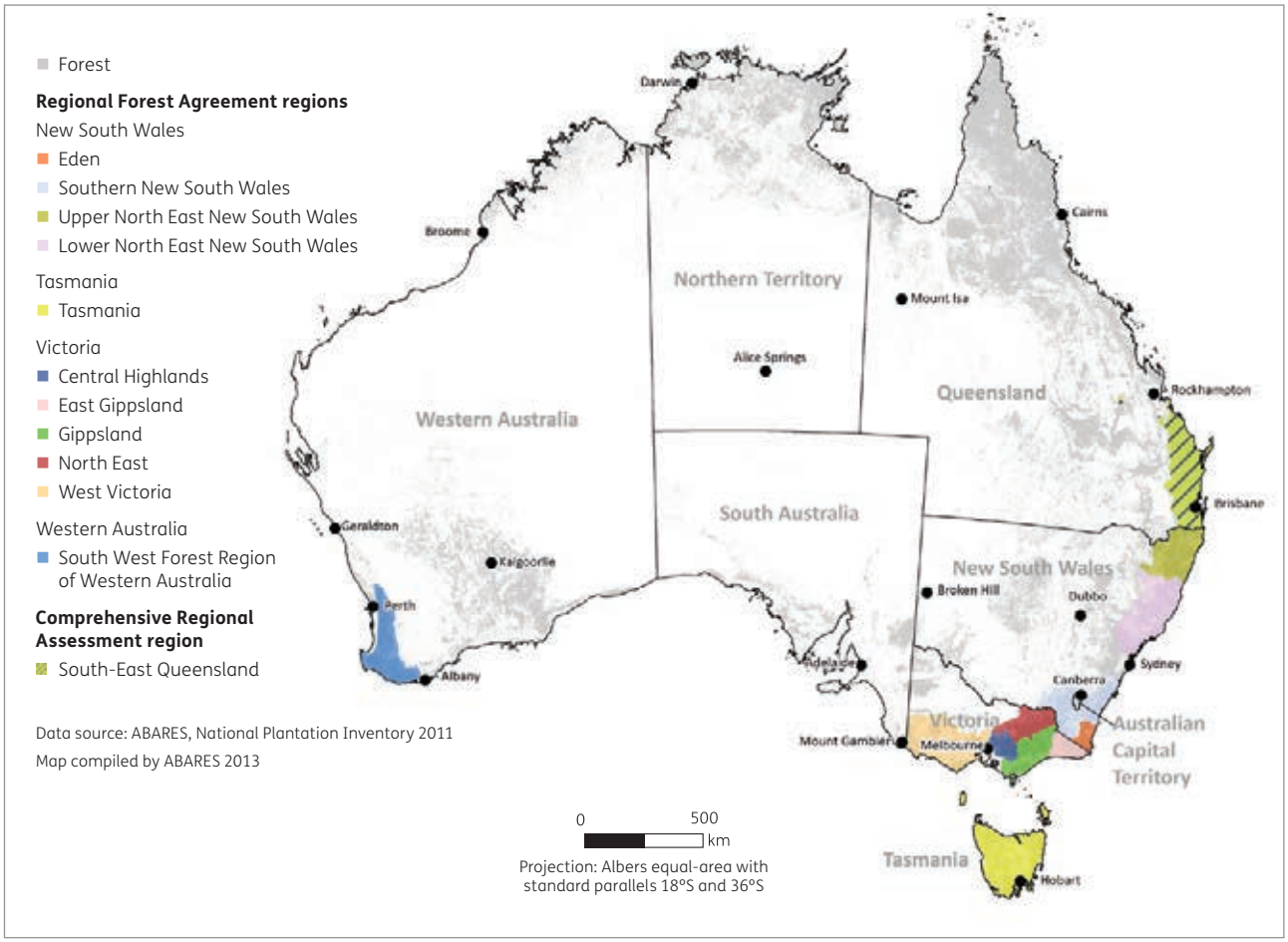
Ten RFAs were negotiated bilaterally between the Australian Government and four of the six state governments (New South Wales, Tasmania, Victoria and Western Australia— Figure I.vi). The Australian and Queensland governments completed a CRA for south-east Queensland but did not sign an RFA.

Forest inventory

The National Forest Inventory was established in 1988 as an entity that enabled the calculation of nationally consistent and comprehensive attributes describing Australia's forests. This was a critical step in developing a national approach to measuring and monitoring sustainable forest management. The National Forest Inventory is guided by a steering committee (NFISC) composed of members representing state, territory and Australian government bodies involved in forest information management.[10]

Forest description and measurement (inventory) activities have been taking place in Australian forests for more than a century, mainly in publicly owned native forests managed for wood production and in plantations, but also to a lesser extent in nature conservation reserves. Less has been done to inventory privately managed native forests—this has led to substantial gaps in the data available to describe these forests. Tenure can therefore be used as a broad surrogate for the availability, comprehensiveness and currency of native forest inventory data in Australia (Howell et al. 2008).

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



Note: Grey shading across regions shows forest.

[10] Queensland withdrew from the NFISC in 2010.

Sustainable forest management and forest reporting

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

This approach reflects the principal objectives of the United Nations Convention on Biological Diversity, 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 convention 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.

Criteria and indicators provide a common understanding of what is involved in sustainable forest management, and a common framework for describing, assessing and evaluating a country's progress towards sustainable forest management. The criteria represent broad forest values, while the indicators represent measurable aspects of these criteria. 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 Forests has been adopted in Australia. As with the international Montreal Process, Australia's framework includes the following seven criteria for sustainable forest management (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 suit the particular characteristics of Australian forests, the goods and services they provide and the people who depend on or use them. This set was used in SOFR 2008 and is used again in SOFR 2013. Appendix A lists the 44 indicators used in Australia and shows the alignment with the 54 indicators of the international Montreal Process framework.

The SOFR 2013 process

SOFR 2013 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[11], and coordinated by the NFISC and the Montreal Process Implementation Group for Australia (MIG).

In August 2011, 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 DAFF[12] and other Australian Government agencies were invited to participate in a drafting group, which met in 2012 to review manuscripts and provide supplementary information. The draft SOFR 2013 report was then reviewed by the MIG and the NFISC, as well as by relevant Queensland agencies, and was endorsed in 2013 by the national Forestry and Forest Products Committee, which reports to the Council of Australian Governments through the Productivity and Regulatory Reform Committee, the Primary Industries Standing Committee, and the Standing Council on Primary Industries.

Eucalypt tall open forest, south-western Western Australia.

[11] Before September 2013, the Department of Agriculture, Fisheries and Forestry (DAFF).

[12] After September 2013, the Department of Agriculture.

The SOFR series

The SOFR series constitutes a system for reporting the state of Australia's forests, as well as the directions of change across a range of social, economic and environmental aspects 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 2013 presents data for the five-year period between 01 July 2006 and 30 June 2011. The reporting period for SOFR 2003 was 01 July 1997 to 30 June 2001, and the reporting period for SOFR 2008 was 01 July 2001 to 30 June 2006 (SOFR 1998, the first in the series, had no specific coverage period). Thus, the three most recent reports comprise a continuous series on the state of Australia's forests spanning 15 years, and SOFR 2013 contains more information on trends over time than any previous report. However, the varied nature of the data sources across the 44 indicators means that not all data conform to these periods.

The forest area data presented in SOFR 2013 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 2013. For the purposes of this report, forest data for Jervis Bay (administered by the Australian Capital Territory) are included in New South Wales data.

How to use this report

This report is organised by the seven criteria for sustainable forest management listed above. Within each criterion, various indicators address specific forest parameters and values. A synthesis of key findings across the indicators within each criterion is given at the start of that criterion. Each criterion is presented as a separate chapter of SOFR.

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. References, a glossary and an index are included at the end of the report.

SOFR 2013 and the three previous SOFRs are available at the Forests Australia website (www.daff.gov.au/forestsaustralia) and the ABARES publications website (www.daff.gov.au/abares/publications).

Young radiata pine (*Pinus radiata*) plantation.