STATE OF THE FORESTS
2018 REPORT

Commissioner *for* Environmental Sustainability Victoria

VICTORIA State Government

Traditional Owners

The Office of the Commissioner for Environmental Sustainability (OCES) proudly acknowledges Victoria's Aboriginal community and their rich culture and pays respect to their Elders past and present.

We acknowledge Aboriginal people as Australia's first peoples and as the Traditional Owners and custodians of the land and water on which we rely. We recognise and value the ongoing contribution of Aboriginal people and communities to Victorian life, and how this enriches us.

We embrace the spirit of reconciliation, working towards the equality of outcomes and ensuring an equal voice.

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Dr Gillian Sparkes
Commissioner for
Environmental Sustainability, Victoria

Foreword

I am proud to introduce the latest Victorian State of the Forests report. State of the Forests reports are produced every five years to evaluate and report on the condition of Victoria's forests. This 2018 report builds on the scientific evidence base of previous reports, and continues to align Victoria with international environmental reporting frameworks. It assesses the health of Victoria's forests at a time of unprecedented population growth and climate risk.

Victoria's forests are precious natural assets, with many social, economic and environmental benefits. These include conservation of threatened native species, natural carbon sequestration, and unique cultural and social experiences.

The Victorian State of the Forests report is a requirement under the *Sustainable Forests (Timber) Act 2004*. Earlier reports were produced in 2003 and 2008 by Department of Sustainability and Environment, and 2013 by Department of Environment, Land, Water and Planning. State of the Forests 2018 is the first iteration prepared and issued by the Commissioner for Environmental Sustainability, and is the most rigorous yet.

To monitor and evaluate Victoria's progress to achieve sustainable forest management, 45 indicators under seven criteria have been developed, based on the Montreal Process – a voluntary agreement between nations for the conservation and sustainable management of forests. These indicators were developed under the *Framework of Regional (Sub-National) Level Criteria and Indicators of Sustainable Forest Management in Australia*.

Of the 45 indicators in this report, 20 were reported on in the Forests chapter in the Victorian State of Environment (SoE) 2018 report. Information in the Forests chapter of the SoE 2018 are reproduced in this report, along with the balance of the 25 other relevant Montreal indicators.

Over the past year, my scientists have been working with our partners and collaborators across the community and government to establish rigorous baseline environmental science reports for Victoria. Across portfolios, we are aligning our reporting and science to be more effective, meaningful and productive and aligning Victoria with international environmental reporting frameworks, such as the United Nation's Sustainable Development Goals and System of Environmental–Economic Accounting (SEEA).

As a comprehensive environmental report, with recommendations for systemic and policy reforms, SoE 2018 describes an overarching approach to environmental reporting in Victoria. This State of the Forests 2018 report, and its recommendations, align with SoE 2018. This report is a starting place to apply the recommendations of SoE 2018 to guide continuous improvement in the environmental condition of Victorian public forests.

My job as Commissioner is to provide independent and objective reporting to inform policy-makers, regulators, environmental managers, scientists and the wider Victorian community about the state of our natural environment, and to advise government accordingly. Another critical part of my job is to shine a light on the areas of the environment that are working well and on those we need to improve.

This report supports me to fulfil these requirements. It provides an assessment of the available science on Victoria's forests and a synopsis of the challenges ahead, enabling me to make recommendations for future focus. It has been prepared according to the principles outlined in the *State and Benefit: Framework for the Victorian State of the Environment 2018 Report* tabled in the Victorian Parliament in December 2015.

Sustainable Development Goals

The 17 United Nations Sustainable Development Goals (SDGs) are referred to throughout the report, demonstrating our work to align Victoria with international environmental reporting frameworks. This is part of the work needed to 'rewire' the system and increase the policy coherence, so that the SDGs frame environmental monitoring and reporting in Victoria, and inform ecologically sustainable development over the next decade.

I see the SDGs as the 'missing link' in bringing the intent of the *Commissioner for Environmental Sustainability Act 2003* to life by providing an operating framework to bring effect to a key objective – to facilitate ecologically sustainable development in Victoria. It is exciting work, allowing for much richer data analyses and more meaningful conversations with the community, underpinned by the SDGs and clear targets for ecologically sustainable development over the next decade.

Environmental–economic accounting

This report is also informed by the United Nations System of Environmental–Economic Accounting (SEEA), with expertise provided by the Victorian Department of Environment, Land, Water and Planning. The SEEA framework integrates economic and environmental data to more accurately assess the benefits and costs of assets such as forests, and is critical for future environmental reporting and indicator selection.

To adopt SEEA in Victoria would fulfil a key objective of the *State and Benefit* Framework: to transition State of the Environment and related reports, such as the State of the Forests, to assess not only the **condition** of Victoria's natural assets, but also myriad ways they **benefit** the state.

Future focus

The four recommendations in this report are informed by, and aligned with, the recommendations in SoE 2018. They aim to leverage effort and investment, build on current initiatives, and target improvements to deliver on the government's legislative framework for Victorian public forest management, including the *Forests Act 1958, Sustainable Forests (Timber) Act 2004, Flora and Fauna Guarantee Act*

Table 1. Comparison of the status, trend and data quality of the 52 indicators assessed

Status	Indicators %	Trend	Indicators %	Data Quality	Indicators %
Good	19	Improving	25	Good	50
Fair	50	Stable	16	Fair	29
Poor	10	Deteriorating	24	Poor	21
Unknown	21	Unclear	35		

1988, Regional Forest Agreements and National Parks Act 1975. They are informed by recommendations from other respected reports, align with achieving the SDGs' ecologically sustainable development targets, and support the development of a system of environmental–economic accounts for Victoria.

I expect this report will inform and inspire community, government and business leaders, guide our future focus, and assist all Victorians to keep working hard to protect and preserve our forests.

I would like to thank the science experts who contributed their time and academic expertise, and generously helped peer-review multiple iterations of the scientific assessments included in this report.

I also thank Dr Kangmin Moon the lead author of this report along with the other members of my incredibly dedicated and hard-working science team: Dr Scott Rawlings, Jenny Jelbart, Dr Rebecca Koss and Andrew Marshall, together with our communications expert Emily Ross.

We are indebted to our DELWP colleagues for their time, expertise and support, and to wider stakeholder groups, including the Monash Sustainable Development Institute, for support with our work to implement the SDGs.

To the members of the Commissioner's Reference Group, the Environmental Reporting Project Control Board and the Technical Advisory Group, who have generously volunteered their time and expertise in the four years since the groups were established: your guidance and feedback has been invaluable to achieving the reforms and reports produced by my team since 2015.

It is an honour to serve my community as Victoria's Commissioner for Environmental Sustainability. I am pleased to present State of the Forests 2018, and hope that the findings and recommendations are utilised in ways that benefit Victoria's forests and communities for many years to come.

I invite you to download the report and explore environmental case studies, news and information via our website (www.ces.vic.gov.au), and stay informed of our work via social media.

Dr Gillian Sparkes

Commissioner for
Environmental Sustainability, Victoria

Our thanks go to the following individuals and organisations for the considerable contribution to the development and review of the State of the Forests 2018.

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Department of Environment, Land, Water and Planning	Sustainability Victoria
Wilderness Society Victoria Inc.	Trust for Nature
Victorian Aboriginal Heritage Council	VicForests

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ABC	Actions for Biodiversity Conservation
ACHLMAs	Aboriginal Cultural Heritage Land Management Agreements
ABARES	Australian Bureau of Agricultural and Resource Economics
ABS	Australian Bureau of Statistics
AO	Allocation Order
ARI	Arthur Rylah Institute
BNHCRC	Bushfire and Natural Hazards Co-operative Research Centre
BoM	Bureau of Meteorology
BRRAT	Bushfire Rapid Risk Assessment Team
CAM Mou	Intergovernmental Memorandum of Understanding Agreement on a Common Assessment Method for Listing of Threatened Species and Threatened Ecological Communities
CCS	Carbon Capture and Storage
CES Act	Commissioner for Environmental Sustainability Act 2003
CMA	Catchment Management Authority/ies
CWD	Coarse Woody Debris
DEDJTRQ	Victorian Department of Economic Development, Jobs, Transport and Resources
DELWP	Victorian Department of Environment, Land, Water and Planning
DHHS	Victorian Department of Health and Human Services
DEPI	Victorian Department of Primary Industries
EFG	Ecological Fire Group
EMV	Emergency Management Victoria
EPA	Environment Protection Authority, Victoria
ESD	Ecologically Sustainable Development
EVCs	Ecological Vegetation Classes
EVDs	Ecological Vegetation Divisions
FGC	Fractional Ground Cover
FFG Act	Flora and Fauna Guarantee Act
FFDI	Forest Fire Danger Index
FIs	Forest Industry Surveys
FTE	Full-Time Equivalent
GDP	Gross Domestic Product
GHG	Green House Gas
GMA	Game Management Authority
GMZ	General Management Zone
GSP	Gross State Product
HDM	Habitat Distribution Models
IBRA	Interim Biogeographic Regionalisation for Australia
IFER	Integrated Forest Ecosystem Research
IGEM	Inspector General for Emergency Management Victoria

ISC	Index of Stream Conditions
IUCN	International Union for Conservation of Nature
LGAs	Local Government Areas
LiDAR	Light Detection and Ranging
LOS	Level of Service
LULUCF	Land use, land-use change and forestry
MFB	Metropolitan Fire Brigade
NFI	National Forest Inventory
NFPS	National Forest Policy Statement
NRM	National Resource Management
OCES	Office of the Commissioner for Environmental Sustainability
PV	Parks Victoria
PWSC	Prescribed Water Supply Catchment
R&D	Research and Development
RFAs	Regional Forest Agreements
RiverMAP	River Monitoring and Assessment Program
RO	Resource Outlook
SDGs	United Nations Sustainable Development Goals
SECP	South East Coastal Plain
SEEA	United Nations System of Environmental-Economic Accounting
SEFS	School of Ecosystem and Forest Science
SFM	Sustainable Forest Management
SMZ	Special Management Zone
SoE	Victorian State of the Environment Report
SoF	Victorian State of the Forests Report
SPZ	Special Protection Zone
SV	Sustainability Victoria
THEZ	Timber Harvesting Exclusion Zone
TOLMA	Traditional Owner Land Management Agreement
UN	United Nations
VAGO	Victorian Auditor-General's Office
VAHC	Victorian Aboriginal Heritage Council
VAHR	Victorian Aboriginal Heritage Register
VBA	Victorian Biodiversity Atlas
VCMC	Victorian Catchment Management Council
VEAC	Victorian Environmental Assessment Council
VEFMAP	Victorian Environmental Flow Monitoring and Assessment Program
VET	Vocational Education and Training
VFMP	Victorian Forest Monitoring Program

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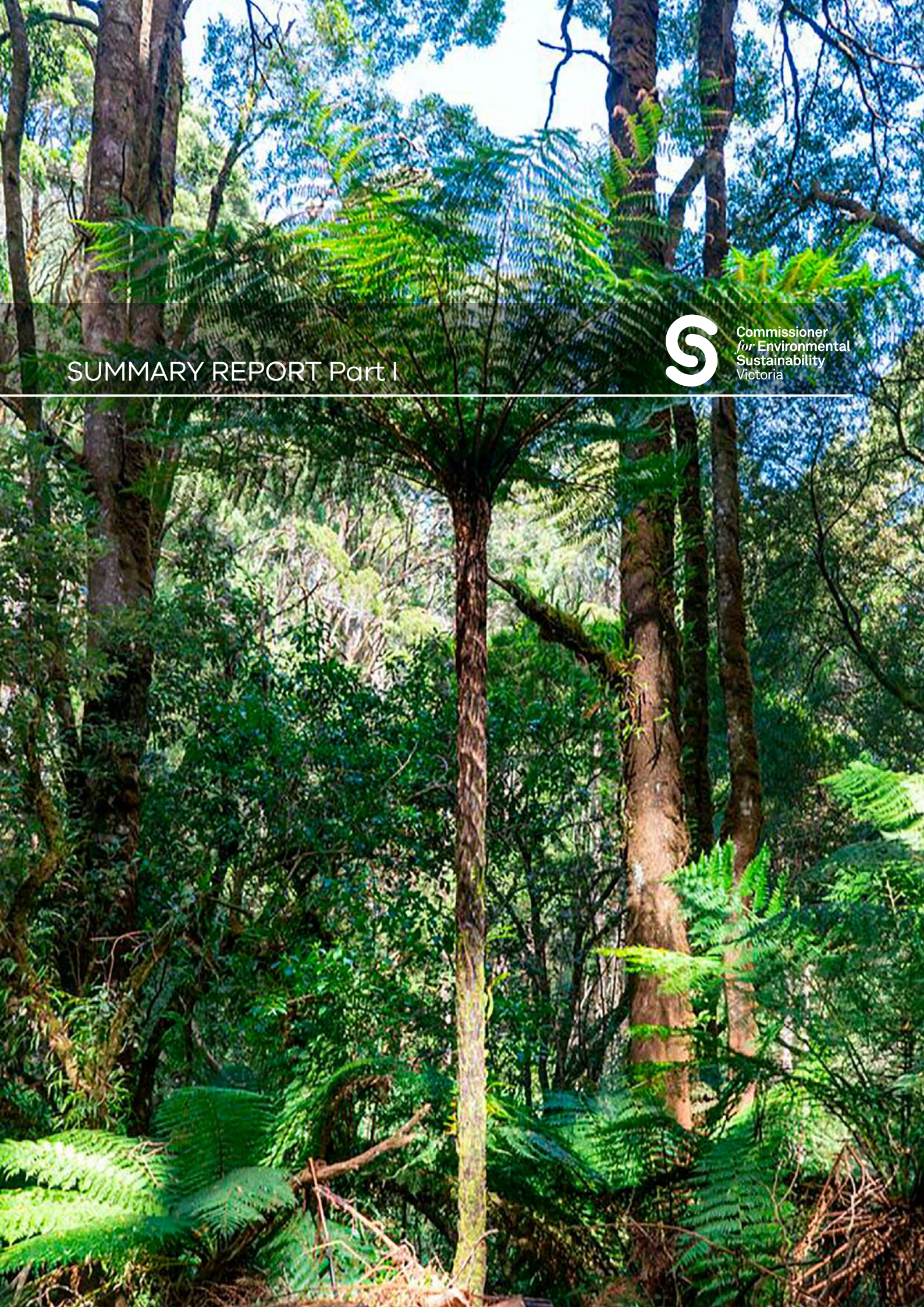

SUMMARY REPORT Part I

Commissioner *for* Environmental Sustainability Victoria

Status summary

For 52 indicators (45 indicators and 7 sub-indicators) (Table 2 and Figure 1), 11 indicators were assessed as 'good'. Criterion 6 had seven 'good' status assessments; criterion 2 and 3 had no 'good' status assessments. Half of the indicators were accorded 'fair' status, and about one-third were rated 'poor' or 'unknown'.

Trend summary

A trend assessment cannot be applied to indicator 6.2c (Extension and use of new and improved technologies), as its purpose is to summarise the latest technologies. Hence 51 of the 52 indicators (Table 3 and Figure 2) were assessed.

The trend expresses whether the status of the indicator is deteriorating, improving or remaining stable. About half of the total number of indicators (49%) were assessed as either 'improving' or 'deteriorating'. A trend could not be ascertained for one-third, or 18 indicators.

Data quality summary

Out of all 52 indicators (Table 4 and Figure 3), half are supported by 'good' data, which means that the status and trend assessments for these indicators are presented with confidence. Nearly one-third of all indicators (29%) have been assessed as having 'fair' data, meaning that approximately 80% of the indicators have 'good' or 'fair' data to make an assessment of status or trends.

There are 11 indicators remain that have very little evidence to make an assessment: this is a gap to be addressed.

Performance

High performance consolidates indicators with a 'good' status assessment, a 'stable' or 'improving' trend assessment, and 'good' data quality (Figure 4). 'High' suggests that not only is the indicator performing well, and expected to continue to do so, but that there is a high level of confidence in the assessment. Eight indicators were assessed as 'high-performing'. Six of these eight were related to a socio-economic theme in Criterion 6.

Low performance consolidates indicators with a 'poor' status assessment, 'stable' or 'deteriorating' trend assessment, and 'good' data quality (Figure 5). This suggests not only that the indicator is of concern and is not demonstrating improvement, but also that there is a high level of confidence in the assessment that the indicator is showing poor condition, and will remain so without intervention.

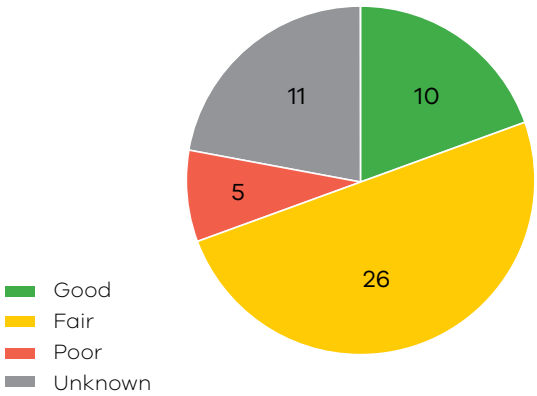

Figure 1. Indicator assessments status summary

*Table 2. Indicator assessments status summary**

Status	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Criterion 5	Criterion 6	Criterion 7	Total indicators	Proportion
Good	1	0	0	1	0	7	1	11	19%
Fair	7	3	3	1	1	7	4	26	50%
Poor	1	1	0	0	1	2	0	5	10%
Unknown	3	1	1	1	0	5	0	10	21%
Total	12	5	4	3	2	21	5	52	100%

** There are seven sub-indicators included in this table.*

Table 3. Trend summary

Trend	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Criterion 5	Criterion 6	Criterion 7	Total indicators	Proportion
Improving	3			1	1	7	1	13	25%
Stable	1	2	1			3	1	8	16%
Deteriorating	2	2	1	1		5	1	12	24%
Unclear	6	1	2	1	1	5	2	18	35%
Total	12	5	4	3	2	20	5	51	100%

** Note: One indicator in Criterion 6 is not applicable for trend assessment and is not included.*

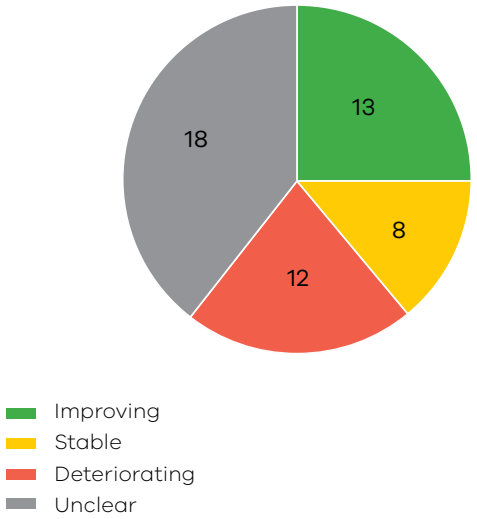

Figure 2. Trend summary

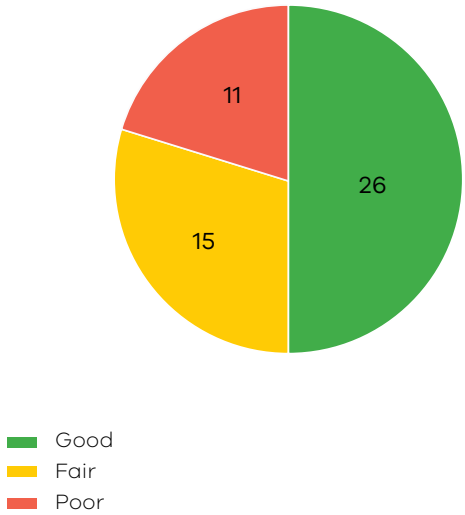

Figure 3. Data quality summary

Table 4. Data quality summary

Trend	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Criterion 5	Criterion 6	Criterion 7	Total indicators	Proportion
Good	5	4	2	2	1	11	1	26	50%
Fair	4		1		1	6	4	15	29%
Poor	3	1	1	1		4		11	21%
Total	12	5	4	3	2	21	5	52	100%

** Note: One indicator in Criterion 6 is not applicable for trend assessment and is not included.*

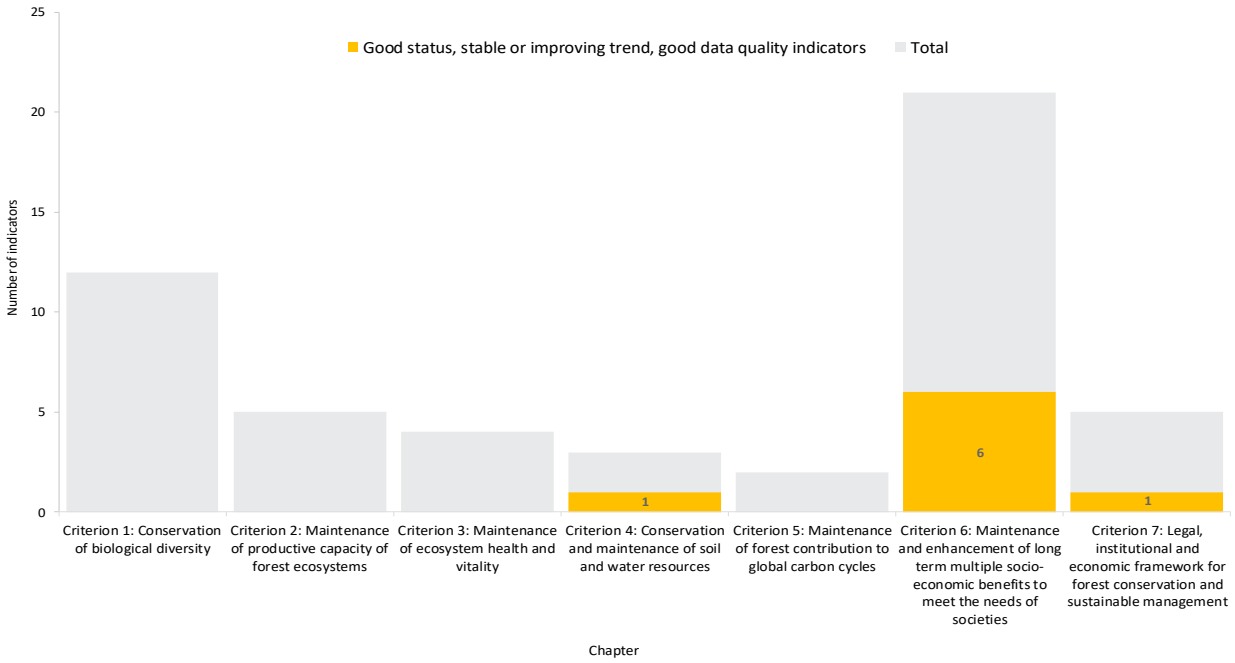

Figure 4. High-performing areas

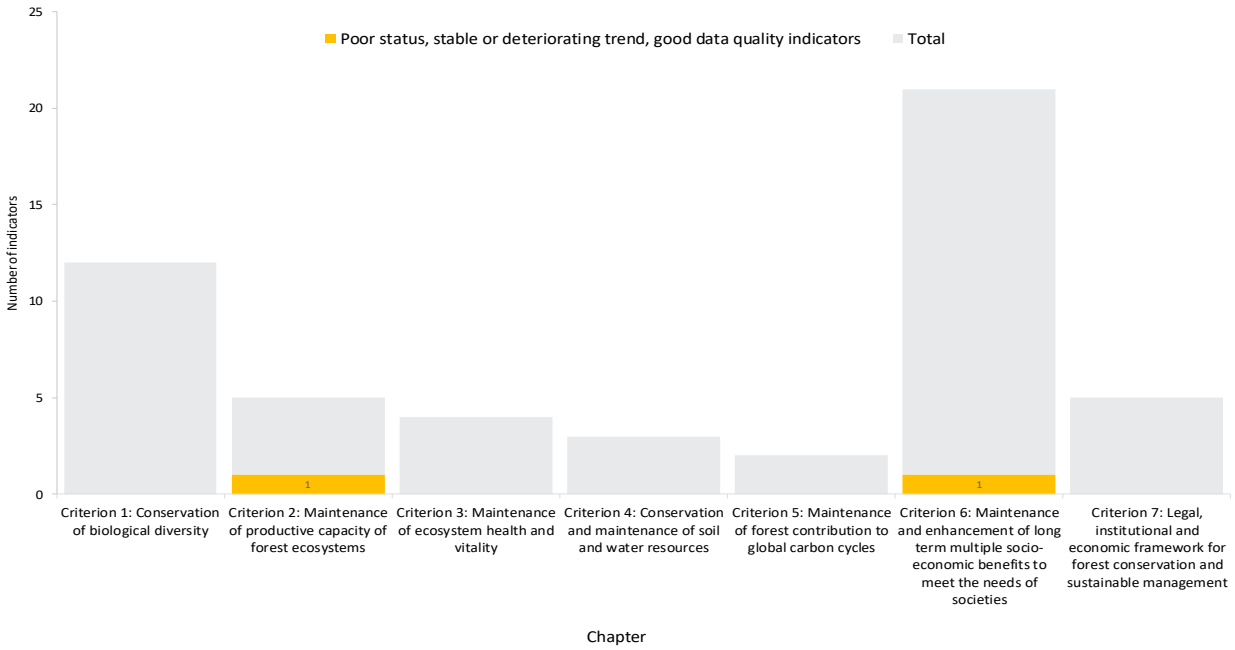

Figure 5. Low-performing areas

Legend

Status

N/A **Not Applicable**
The indicator assessment is based on future projections or the change in environmental condition and providing a status assessment is not applicable. Only a trend assessment is provided.

Unknown
Data is insufficient to make an assessment of status and trends.

Poor
Environmental condition is under significant stress, OR pressure is likely to have significant impact on environmental condition/ human health, OR inadequate protection of natural ecosystems and biodiversity is evident.

Fair
Environmental condition is neither positive or negative and may be variable across Victoria, OR pressure is likely to have limited impact on environmental condition/human health, OR moderate protection of natural ecosystems and biodiversity is evident.

Good
Environmental condition is healthy across Victoria, OR pressure is likely to have negligible impact on environmental condition/ human health, OR comprehensive protection of natural ecosystems and biodiversity is evident.

Trend

N/A **Not applicable**
This indicator assessment is based on current environmental condition only and it is not applicable to provide a trend assessment. Only a status assessment is provided.

? **Unclear** ↘ **Deteriorating** → **Stable** ↗ **Improving**

Data quality

Poor
Evidence and consensus too low to make an assessment

Fair
Limited evidence or limited consensus

Good
Adequate high-quality evidence and high level of consensus

Criterion 1: Conservation of biological diversity

	Status (UNKNOWN / POOR / FAIR / GOOD)	Trend	Data Quality
1.1a Area of forest by type and tenure - forest canopy cover and canopy height classes Data Custodian DELWP	Unknown	?	DATA QUALITY Poor
1.1a Area of forest by type and tenure - forest type Data Custodian DELWP	Fair	↗	DATA QUALITY Good
1.1a Area of forest by type and tenure - plantation forest in private land Data Custodian ABS	Fair	→	DATA QUALITY Good
1.1b Area of forest type by growth stage Data Custodian DELWP	Fair	↗	DATA QUALITY Good
1.1c Area of forest type by growth stage distribution in protected zones Data Custodian DELWP, Parks Victoria	Fair	↗	DATA QUALITY Fair
1.1d Fragmentation of native forest cover Data Custodian DELWP	Poor	?	DATA QUALITY Fair
1.2a The status of forest-dependent species at risk of not maintaining viable breeding populations, as determined by legislation or scientific assessment. Data Custodian DELWP	Fair	↘	DATA QUALITY Good
1.2b Area of habitat available for forest-dependent indicator species Data Custodian DELWP	Fair	?	DATA QUALITY Poor
1.2c Representative indicator species from a range of habitats monitored at scales relevant to regional forest management Data Custodian DELWP	Good	?	DATA QUALITY Fair

	Status (UNKNOWN / POOR / FAIR / GOOD)	Trend	Data Quality
1.2d Degree of disturbance to native-forest species caused by invasive species **Data Custodian** DELWP	FAIR	↘	DATA QUALITY Good
1.3a The number of forest dependent species at risk from isolation that may lead to loss of genetic variation **Data Custodian** Deakin University, Australian National University	UNKNOWN	?	DATA QUALITY Poor
1.3b Number of in-situ and ex-situ conservation efforts for forest-dependent species **Data Custodian** DELWP	UNKNOWN	?	DATA QUALITY Poor

Criterion 2: Maintain of productive capacity of forest ecosystems

	Status (UNKNOWN / POOR / FAIR / GOOD)	Trend	Data Quality
2.1 Area and percentage of forest and net area of forest available and suitable for wood production **Data Custodian** VicForests, DELWP	POOR	↘	DATA QUALITY Good
2.2 Volume of wood by forest type in State forest that is available and suitable for timber production **Data Custodian** DELWP, DEDJTR, VicForests	FAIR	→	DATA QUALITY Good
2.3 Annual production of wood products from State forests compared to sustainable harvest levels **Data Custodian** VicForests, DELWP	FAIR	↘	DATA QUALITY Good
2.4 Annual production of non-wood forest products **Data Custodian** DELWP, DEDJTR	UNKNOWN	?	DATA QUALITY Poor
2.5 Proportion of timber harvest area successfully regenerated, by forest type **Data Custodian** VicForests, DEDJTR	FAIR	→	DATA QUALITY Good

Criterion 3: Maintain of ecosystem health and vitality

	Status (UNKNOWN / POOR / FAIR / GOOD)	Trend	Data Quality
3.1 Scale and impact of agents and processes affecting forest health and vitality - mortality, dieback, canopy health Data Custodian DELWP	FAIR	?	DATA QUALITY Fair
3.1 Scale and impact of agents and processes affecting forest health and vitality - bushfire affected area and climate Data Custodian DELWP, BoM	FAIR	↘	DATA QUALITY Good
3.2 Area and type of human-induced disturbance - planned burns Data Custodian DELWP	FAIR	?	DATA QUALITY Good
3.2 Area and type of human-induced disturbance - grazing Data Custodian DELWP	UNKNOWN	→	DATA QUALITY Poor

Criterion 4: Conservation and maintenance of soil and water resources

	Status (UNKNOWN / POOR / FAIR / GOOD)	Trend	Data Quality
4.1 Area and percentage of forest by activity type, systematically assessed for risk to soil attributes Data Custodian DELWP	GOOD	↗	DATA QUALITY Good
4.2 Change in forested catchment water yield characteristics through time Data Custodian DELWP	FAIR	↘	DATA QUALITY Good
4.3 Change in forested catchment river health characteristics through time Data Custodian DELWP	UNKNOWN	?	DATA QUALITY Poor

Criterion 5: Maintenance of forest contribution to global carbon cycles

	Status (UNKNOWN / POOR / FAIR / GOOD)	Trend	Data Quality
5.1 Total forest ecosystem biomass and carbon pool by forest type, age class and successional stages Data Custodian DELWP	FAIR	?	DATA QUALITY Fair
5.2 Contribution of forest ecosystems to the global greenhouse gas balance Data Custodian DELWP	POOR	↗	DATA QUALITY Good

Criterion 6: Maintenance and enhancement of long term multiple socio-economic benefits to meet the needs of societies

	Status (UNKNOWN / POOR / FAIR / GOOD)	Trend	Data Quality
6.1a Value of wood products Data Custodian VicForests; Australian Government	FAIR	↘	DATA QUALITY Good
6.1b Value and yield of non-wood forest products - game-hunting and apiary business Data Custodian Game Management Authority	UNKNOWN	↗	DATA QUALITY Fair
6.1b Value and yield of non-wood forest products - the other non-wood forest products Data Custodian DELWP	UNKNOWN	?	DATA QUALITY Poor
6.1c Value ($) of forest-derived ecosystem services Data Custodian DELWP	FAIR	?	DATA QUALITY Fair
6.1d Degree of reuse and recycling of wood products Data Custodian Sustainability Victoria	GOOD	↗	DATA QUALITY Good
6.2a Investment and expenditure in forest management Data Custodian DELWP	FAIR	→	DATA QUALITY Good

	Status (UNKNOWN / POOR / FAIR / GOOD)	Trend	Data Quality
6.2b Investment in research and development and education **Data Custodian** DELWP, ForestWorks, Forest and Wood Products Australia	FAIR	↘	DATA QUALITY Fair
6.2c Extension and use of new and improved technologies **Data Custodian** DELWP, CSIRO, University of Melbourne	GOOD	Not applicable	DATA QUALITY Good
6.3a Area and quality of forest actively utilised for recreation and tourism - quality of state forests **Data Custodian** DELWP	UNKNOWN	?	DATA QUALITY Poor
6.3a Area and quality of forest actively utilised for recreation and tourism - parks and conservation reserves and area for state forests **Data Custodian** DELWP, Parks Victoria	GOOD	↗	DATA QUALITY Good
6.3b Range of use of recreation and tourism opportunities that are available within forests **Data Custodian** DELWP, Parks Victoria	FAIR	→	DATA QUALITY Fair
6.3c Number of visits per annum - state forests **Data Custodian** DELWP	UNKNOWN	?	DATA QUALITY Poor
6.3c Number of visits per annum - national parks and conservation reserves **Data Custodian** Parks Victoria	GOOD	↗	DATA QUALITY Good
6.4a Area of forest to which indigenous people have access and rights that protect their cultural heritage and are recognised through formal and informal management practices **Data Custodian** DELWP	GOOD	↗	DATA QUALITY Good

	Status (UNKNOWN / POOR / FAIR / GOOD)	Trend	Data Quality
6.4b Proportion of places of indigenous and non-indigenous cultural values in forests formally managed to protect these values **Data Custodian** DELWP, Parks Victoria	FAIR	↗	DATA QUALITY Fair
6.5a Direct and indirect employment in the forest sector, and forest-sector employment as a proportion of total employment **Data Custodian** ABS, ABARES, Australian Forest and Wood Products	POOR	↘	DATA QUALITY Fair
6.5b Average wage rates and injury rates in major employment categories within the forest sector **Data Custodian** ABS	GOOD	↗	DATA QUALITY Good
6.5c Resilience of forest-dependent communities to changing social and economic conditions **Data Custodian** ABS	FAIR	↘	DATA QUALITY Good
6.5d Resilience of forest-dependent Indigenous communities to changing social and economic conditions **Data Custodian** The National Centre for Vocational Education Research, ABS	POOR	↘	DATA QUALITY Good
6.5e Area of forest available and accessible for indigenous people to exercise their inherent rights to meet subsistence or individual and family cultural and spiritual needs **Data Custodian** None	UNKNOWN	?	DATA QUALITY Poor
6.6a Extent to which the management framework includes the exercise of customary, custodial, traditional and native title rights as an essential component in achieving sustainable forest management **Data Custodian** DELWP	GOOD	→	DATA QUALITY Good

Criterion 7: Legal, institutional and economic framework for forest conservation and sustainable management

	Status (UNKNOWN / POOR / FAIR / GOOD)	Trend	Data Quality
7.1 Extent to which the legal framework (laws, regulations, guidelines) supports the conservation and sustainable management of forests **Data Custodian** DELWP	FAIR	↗	DATA QUALITY Fair
7.2 Extent to which the institutional framework supports the conservation and sustainable management of forests **Data Custodian** DELWP	FAIR	↘	DATA QUALITY Fair
7.3 Extent to which the economic framework supports the conservation and sustainable management of forests **Data Custodian** DELWP	FAIR	?	DATA QUALITY Fair
7.4 Capacity to measure and monitor changes in the conservation and sustainable management of forests **Data Custodian** N/A	FAIR	unavailable	DATA QUALITY Fair
7.5 Capacity to conduct and apply research and development aimed at improving forest management, including development or scientific understanding of forest ecosystem characteristics and functions **Data Custodian** DELWP	GOOD	→	DATA QUALITY Good

Future focus

The recommendations included in this Future Focus section are aligned with those presented in the Victorian State of the Environment (SoE) 2018 report developed from the science presented in this report. The recommendations are intended to support improvement of Victoria's forest management system over the next decade to 2030. This is not an arbitrary time horizon. It aligns the recommendations of the Commissioner's other reports (State of the Environment (SoE) 2018, State of the Yarra and its Parklands (SoY) 2018) and this report with the *2030 Agenda for Sustainable Development* and the reporting arrangements of the UN agreed SDGs and their relevant targets. Although most of the recommendations in the SoE 2018, this report do not specifically suggest precise delivery timelines, except where noted, it is anticipated that they would be fully implemented by 2030, with clear progress evident within five years, commensurate with the next State of the Forest reports which is due in 2023.

The selection of these recommendations was based principally on the evidence base presented across this report, and the identified knowledge gaps and improvements to data collection and monitoring regimes revealed through the analysis. Recommendation selection has also been informed by global megatrends, and the findings of the SoE 2018 report.

The Megatrends and the Victorian Environment 2018 report was prepared by Deloitte Access Economics and is published at www.ces.vic.gov.au/Publications[1]. It analyses the anticipated key trends that will influence and impact natural capital, and our management of it, in Victoria to 2030 and beyond. The SoE 2018 report contains an abridged version of the Deloitte report, with a focus on the key insights.

These 'megatrends' have informed the Future Focus priorities and recommendations arising from the assessments across this report. The megatrends have enabled a top-down analysis, while the scientific assessments have provided a foundational, bottom-up evidence base. Combined, these analyses have identified the most important priorities for the Victorian forests over the next decade and beyond.

The five megatrends identified by Deloitte Access Economics are:

1. the physical impacts of climate change
2. reducing our carbon footprint
3. clued-up citizens shaping business and government practices
4. disruptive technologies
5. natural resource constraints.

The following principles and criteria were applied to the recommendations in this report to:

- prioritise those that improve multiple environmental outcomes
- focus on improving the evidence base to deliver key legislative and policy frameworks
- be informed by the findings of other respected reports (OCES acknowledges the significant research undertaken by others, including the Victorian Environmental Assessment Council, Victorian Auditor-General's Office (VAGO) and Victorian Catchment Management Council)
- align with achieving ecologically sustainable development and SDG targets by 2030, and support the development of a system of environmental-economic accounts for Victoria.

The recommendations can broadly be grouped into the following strategic capabilities:

- Science impact – This is about 'knowing what we need to know, when we need to know it' in a format that is useful for scientists, regulators, managers, economists and the community. This includes responding to systemic environmental challenges and emerging global megatrends, and developing environmental-economic accounting as a core skill for government.

1. Deloitte Access Economics 2018, 'Megatrends and the Victorian Environment 2018', Melbourne, Victoria www.ces.vic.gov.au/Publications Accessed 19 March 2019.

- Coordination and governance – This focuses on improving the clarity of roles and responsibilities, and reviewing allocation of existing funding models and accountabilities to deliver priorities. New money is not always needed: improving the coordination of existing resources, effort and investments will enable better outcomes.
- Delivery – A comprehensive suite of policy and action plans have been developed by the Victorian Government since 2014. Focus must now shift to delivery of this policy regime and better investment in underpinning science and skills to enable adaptive management.
- Data, monitoring, spatial information and analytics – More investment in skills and capabilities is needed from DELWP and portfolio agencies.
- Citizen science and education – Building community understanding, participation and awareness can improve policy and environmental outcomes.

Recommendations

This report includes four recommendations. Three of the four recommendations are aligned with, or derivations of, the recommendations that are included in the SoE 2018 report.

Understand the impacts of forest fragmentation on biodiversity and improve assessment of protected areas

A systematic approach to understanding the status and future trends of Victorian public forests is critical. DELWP developed the Victorian Forest Monitoring Program (VFMP) in 2011. The VFMP completed its first full cycle of field measurements in 2015 and is expected to complete its second cycle by 2020. It is critical that minimal changes to the VFMP data-collection methods occur following the completion of the second full cycle of data retrieval. Consistency in methodology, with only essential amendments, would allow the identification of underlying trends and improve the utility of the evidence base. Any changes to data collection and analysis methods to achieve more accurate data must not disrupt comparative analysis with existing datasets or future trend analyses.

Furthermore, although the VFMP maps forest fragmentation at the state scale (including private forests), it does not provide a complete assessment of forest fragmentation and its impacts on biodiversity in native forests. Long-term monitoring and detailed spatial research have been conducted to explore impacts of fragmentation on native forests and forest-dependent species at the regional scale (such as mountain ash forests in the Central Highlands) and this research has demonstrated that forest fragmentation is becoming intensified, and its impact on threatened species has been increasing[2,3,4,5,6]. The study of biodiversity impacts from forest fragmentation is also impeded by the lack of an authoritative list of Victorian forest-dependent species.

Further research is critical as a complement to VFMP mapping and to understand the impact of forest fragmentation on biodiversity at the state scale. This research program would also assist in the establishment and management of protected areas. The International Union for Conservation of Nature (IUCN) protected areas in Victoria increased by 140,000 hectares between 2004 and 2016. However, there is little evidence of the level of long-term species protection provided by the classification of these areas. A viability analysis, for example, would provide risk assessment and management options to better protect target species in protected areas. Such analysis would also provide an indication of species conservation benefits if an increase in protected areas was to occur.

2. Lindenmayer DB, Blair D, McBurney L, Banks S 2015, 'Mountain Ash: Fire, logging and the future of Victoria's giant forests', CSIRO Publishing, Melbourne, Victoria.
3. Blair D, McBurney L, Lindenmayer DB, Banks S, Blanchard W 2017, 'The Leadbeater's Possum review', Australian National University, Canberra, Australia.
4. Blair D, McBurney L, Lindenmayer DB 2018, 'Failing to conserve Leadbeater's Possum and its Mountain Ash forest habitat', Australian Zoologist, 39(3), pp. 442-448.
5. Lindenmayer DB, Blanchard W, Blair D, McBurney L 2018, 'The road to oblivion – quantifying pathways in the decline of large old trees', Forest Ecology and Management, 430, pp. 259-264.
6. Meney B, Cunningham S, Weston MA, Whisson DA 2018, 'Woodland birds and rural towns: artificial clutch survival in fragmented Box-Ironbark forests', The Royal Society of Victoria, 130, pp. 7-17.

Recommendation 1: That DELWP maintain its commitment to resourcing and maintaining the VFMP and enhance it to (i) improve statewide understanding of the impacts of forest fragmentation on forest-dependent species (including the development of an authoritative list of Victorian forest-dependent species), and (ii) improve assessment of protected areas by conducting detailed research to identify the benefits of various types of IUCN-protected areas for target species. Any amendments to the VFMP must not disrupt future trend analyses.

This recommendation is repeated in the State of the Environment 2018 report (Recommendation 8).

For further detail, see the Forests chapter in the SoE 2018 report and the analysis in this report.

Develop spatial information capability

Spatial information provides fundamental and essential information that informs Victorian Government planning and decision-making across the environment portfolio. It can also be applied to assess regulatory compliance. Technological advances in spatial information has led to significant increases in accuracy. However, legislative and regulatory reform is not keeping pace with this technological advance.

This inconsistency generates several risks including:

- outdated and unreliable data sources
- a reliance on physical maps that can be lost or degraded in the field
- confusion across and within government agencies as there is no single and accepted source of truth, resulting in each group developing their own spatial information database with varying levels of accuracy.

A spatial information resource that can be used as a single source of truth, that is regularly and routinely updated and can be accessed on a shared database across and within government agencies, and be publicly available, will help mitigate the above risks and reduce misinformation in the media and the public domain.

The Victorian government has committed to providing more detailed spatial information maps for any future allocation orders[7] in response to an ABC investigation regarding timber harvesting activity by VicForests).[8,9]

Recommendation 2: That DELWP develop its spatial information capability and database, and ensure it is regularly and routinely updated, to inform decision-making across the environment portfolio.

This recommendation is repeated in SoE 2018 (Recommendation 18).

For further detail, see the Megatrends section of Part II, and the Forests chapter of Part III, in SoE 2018 and the analysis in this report.

Establish a system of environmental–economic accounts for Victoria

A key feature of this report is the exploration of the use of the United Nations System of Environmental Economic Accounting (SEEA). Environmental-economic accounting expertise (provided by DELWP) has informed this SoF report, with every scientific assessment chapter including a discussion of data requirements to inform a future set of environmental–economic accounts for Victoria.

The *State and Benefit* framework for this SoF report aims to transition Victoria's environmental reporting regime from focusing solely on the **state** of Victoria's natural capital, to emphasise the direct and indirect **benefits** that Victorians and the Victorian economy derive from healthy and sustainable ecosystems. Reflecting this logic, environmental–economic accounting becomes a critical tool to achieve this and support investment in, and management and protection of, the environment.

7. Australian Broadcasting Corporation 2018, 'Joint statement from Minister for Environment Lily D'Ambrosio and Minister for Agriculture Jaala Pulford, November 17', https://www.documentcloud.org/documents/5194121-Joint-Ministerial-Response.html Accessed 5 December 2018.
8. Australian Broadcasting Corporation 2018, 'Australia's endangered forests are being 'stolen' and sold in hardware and office stores' https://www.abc.net.au/news/2018-11-21/victorian-forests-appear-to-have-been-logged-illegally/10496424#statements Accessed 5 December 2018.
9. Australian Broadcasting Corporation 2018, 'Government-owned logging company accused of illegally logging state forest' https://www.abc.net.au/7.30/government-owned-logging-company-accused-of/10520270 Accessed 5 December 2018.

In the past, the measurement of environmental assets and the benefits they provide has occurred separately, and the results could not be combined easily for policy and decision-making. Using the SEEA guidelines and standards to integrate the state and benefit components provides a robust approach to assessing multiple benefits and trade-offs among alternative policy or management options.

In 2015, DELWP produced a plan to deliver a set of environmental–economic accounts by 2020: *Valuing and Accounting for Victoria's Environment: Strategic Plan 2015–2020*.[10] Although it is unclear if DELWP will be able to meet the 2020 deadline, commitment to the vision of the plan remains important. Subsequent to the release of the plan, the Victorian Government has been a leader in the interjurisdicational effort of environment ministers to release *A Common National Approach to Environmental-Economic Accounting: Strategy and Action Plan* (2017).[11]

Recommendation 3: That DELWP establishes environmental–economic accounting as a core capability and delivers a set of environmental-economic accounts for Victoria by 2022, consistent with the SEEA guidelines, the DELWP *Valuing and Accounting for Victoria's Environment* strategy and aligned with the agreed common national approach. Further, that the Minister for Environment include in the Statement of Expectations to the Commissioner for Environmental Sustainability a requirement to incorporate reporting against Victoria's environmental-economic accounts in State of the Forests reporting for Victoria from 2023.

This recommendation is a forests-specific derivation of Recommendation 19 in the SoE 2018.

For further detail, see the System of Environmental–Economic Accounts section in Part II of SoE 2018 and the analysis in this report.

An analysis of knowledge gaps and a review of the current criteria and indicators for forests reporting

The current arrangement of SoF indicators, nested under seven criteria, was determined in 2007 based on the seven criteria outlined by the Montreal Process.[12] These indicators have been consistently used since the SoF 2008. As the original SoF indicators and criteria were established more than a decade ago, it is timely to review the current suite of 45 indicators and ensure the evidence base reflects modern forest science and the needs of local communities.

New emerging issues have been raised over the past decade, including a stronger emphasis on climate change. The Victorian government has set a net zero emission target by 2050, and has established the *Climate Change Act 2017*. In addition, discoveries and technological advances in science that are relevant to these targets such as remote sensing techniques have been developed. Citizen science programs have also been growing in interest and reflect the Victorian community's interest in native forests. Citizen science provides an opportunity for public participation and collaboration in scientific research. There is a need to review these emerging issues and community interests and reflect on the knowledge needs of sustainable forest management and review the current set of criteria and indicators. This review process will complement the currently underway effort to modernise Regional Forest Agreements.

One of the findings from experts since the last report is that the Montreal Process has consistently overlooked several values, including critical social values in relation to reporting on forests.[13,14]

10. DELWP 2015, 'Valuing and accounting for Victoria's environment: Strategic Plan 2015-2020', Melbourne, Victoria https://www.environment.vic.gov.au/__data/assets/pdf_file/0030/49809/DELWP-Strategic-Plan-Valuing-and-accounting-for-the-environment-2016-V7.pdf Accessed 24 December 2018.
11. Australian Government Department of the Environment and Energy 2018, 'A Common National Approach to Environmental-Economic Accounting: Strategy and Action Plan', Canberra, Australia http://www.environment.gov.au/system/files/resources/f36c2525-fb63-4148-8f3c-82411ab11034/files/environmental-economic-accounting-strategy.pdf Accessed 24 December 2018.
12. Department of Sustainability and Environment 2007, 'Criteria and indicators for sustainable forest management in Victoria: Guidance document', Melbourne, Victoria https://www.forestsandreserves.vic.gov.au/__data/assets/pdf_file/0022/30865/Vic_Indicators_for_SFM_Guidance.pdf Accessed 24 December 2018.
13. Anderson N, Ford RM, Bennett LT, Nitschke C, Williams KJH 2018, 'Core values underpin the attributes of forests that matter to people', Forestry, 91, pp. 629-640.
14. Ford RM, Anderson NM, Nitschke C, Bennett LT, Williams KJH 2017, 'Psychological values and cues as a basis for developing socially relevant criteria and indicators for forest management', Forest Policy and Economics, 78, pp. 141-150.

Social values attached to forests can help provide a basis for public acceptance of forest management and policy.[15] Although this report provides relevant information on the socio-economic benefits of Victorian public forests in Criterion 6, critical social values related to experiences in forests are not adequately addressed. The prospective contribution to human health and wellbeing provided by forests, among other social values, should be investigated to understand the full benefits of forests for management purposes in Victoria.

This report has also recognised a need to review the current criteria and indicators for SoF reporting on social and cultural values, including their effectiveness in reporting since 2003 and their future utility. This is particularly important for issues and values in relation to Traditional Owners, Aboriginal populations and native title. For example, indicator 6.4a (Area of forest to which Indigenous people have access and rights that protect their cultural heritage and are recognised through formal and informal management regimes) and indicator 6.5e (Area of forest available and accessible to Indigenous people to exercise their inherent rights to meet subsistence or individual and family cultural and spiritual needs) were combined due to a lack of data and poor differentiation.

In addition, this report has identified several social indicators where a lack of data has prevented meaningful assessment. Some examples are:

- Indicator 6.3a (Area and quality of forest actively utilised for recreation and tourism): no data was found in relation to the quality of Victorian state forests for recreation and tourism uses
- Indicator 6.3c (Number of visits per annum): visitor numbers in state forests are not monitored
- Indicator 6.4b (Proportion of places of Indigenous and non-Indigenous cultural values in forests formally managed to protect those values): non-indigenous values are not being formally registered in national parks and state forests, making it difficult to manage and protect these values.

Addressing these knowledge gaps would allow for the development of an important evidence base to assess the social benefits of Victorian public forests. Review of the social and cultural indicators would emphasise alignment with existing reporting metrics, such as the Victorian Government Aboriginal Affairs report,[16] which provides clear targets and indicators relevant to the Victorian context, and international frameworks such as the UN Sustainable Development Goals and targets.

Recommendation 4: That DELWP review the current criteria and indicators for State of the Forests reporting especially socio-cultural indicators, and align reporting with relevant Victorian legislation, policy and programs and the UN Sustainable Development Goals and targets. Further, identification of the knowledge gaps in monitoring the social benefits of forests will be critical for managing forests for all Victorians.

15. Clement JM, Cheng AS 2011, 'Using analyses of public value orientations, attributes and preferences to inform national forest planning in Colorado and Wyoming', Applied Geography, 31(2), pp. 393-400.
16. Department of Premier and Cabinet 2018, 'Victorian Government Aboriginal affairs report 2018', Melbourne, Victoria https://www.vic.gov.au/system/user_files/Documents/av/VGAAR_A4_DIGITAL_v7(1).pdf Accessed 24 December 2018

Table 5. Summary of recommendations, challenges and SDG targets for future reporting by theme

Lead themes	Recommendations	Challenges the recommendation addresses	UN SDG targets for future reporting
Statewide forest monitoring	1: That DELWP maintain their commitment to resourcing and maintaining the VFMP and enhance it to (i) improve statewide understanding of the impacts of forest fragmentation on forest-dependent species (including the development of an authoritative list of Victorian forest-dependent species), and (ii) improve assessment of protected areas by conducting detailed research to identify the benefits of various types of IUCN-protected areas for target species. Any amendments to the VFMP must not disrupt future trend analyses.	The state-scale assessment of forest fragmentation is incomplete, and does not provide sufficient information about the effects of fragmentation on biodiversity in native forests. There is little evidence of the level of long-term species protection provided by the classification of IUCN-protected areas. Inconsistency in methodologies has been disrupting comparative analysis between existing datasets, and may disrupt future trend analyses.	15.1, 15.5
Megatrends	2. That DELWP develop its spatial information capability and database, and ensure it is regularly and routinely updated, to inform decision-making across the environment portfolio.	Technological advances in spatial information have led to significant increases in accuracy. However, legislative and regulatory reform is not keeping pace. This generates several risks, including: • outdated and unreliable data sources • a reliance on physical maps, which can be lost or degraded in the field • confusion across and within government agencies, as there is no single and accepted source of truth. (This has resulted in groups developing different spatial information databases, which have varying levels of accuracy.)	6.6 9.4 12.2, 12.8 15.1,15.2,15.5

Lead themes	Recommendations	Challenges the recommendation addresses	UN SDG targets for future reporting
International frameworks: UN SEEA	1: That DELWP maintain their commitment to resourcing and maintaining the VFMP and enhance it to (i) improve statewide understanding of the impacts of forest fragmentation on forest-dependent species (including the development of an authoritative list of Victorian forest-dependent species), and (ii) improve assessment of protected areas by conducting detailed research to identify the benefits of various types of IUCN-protected areas for target species. Any amendments to the VFMP must not disrupt future trend analyses.	The state-scale assessment of forest fragmentation is incomplete, and does not provide sufficient information about the effects of fragmentation on biodiversity in native forests. There is little evidence of the level of long-term species protection provided by the classification of IUCN-protected areas. Inconsistency in methodologies has been disrupting comparative analysis between existing datasets, and may disrupt future trend analyses.	15.1, 15.5
A review of the current criteria and indicators, and minimising knowledge gaps	4: That DELWP review the current criteria and indicators for State of the Forests reporting especially socio-cultural indicators, and align reporting with relevant Victorian legislation, policy and programs and the UN Sustainable Development Goals and targets. Further, identification of the knowledge gaps in monitoring the social benefits of forests will be critical for managing forests for all Victorians.	As the original SoF indicators and criteria were established more than a decade ago, it is timely to review the current suite of 45 indicators and ensure the evidence base reflects modern forest science and the needs of local communities. New issues and new technologies have emerged over the past decade, including a stronger emphasis on climate change. This review process will complement the Victorian government's effort to modernise Regional Forest Agreements. In addition, little or no data was available for assessing the important social and cultural values of Victoria's public forests.	11.4 12.2 15.2

RESEARCH SYNTHESIS Part II

Commissioner *for* Environmental Sustainability Victoria

Forests and the services they provide are essential for the health and wellbeing of all Victorians. Forests maintain Victoria's water quality, purify the air and store carbon, stabilise and nourish soil, assist agriculture, and support economies vital for regional communities and businesses. Forests have also been an essential part of history and culture for Victoria's Traditional Owners and Aboriginal Victorians. The definition of 'forest' used by Australia's National Forest Inventory, established in 1988, is:

> 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.[17]

Victoria has 7.9 million hectares of public land (excluding marine and coastal areas). Parks and Reserves, and State Forest, account for 3.7 million and 3.2 million hectares of land respectively and both have approximately 3 million hectares of forest cover. Other Crown land, which accounts for the remaining 1 million hectares of public land, has 0.4 million hectares of forest cover, bringing the total area of forest across the public land estate to 6.4 million hectares (Figure 6).[18] Since European settlement, more than 14 million hectares (60%) have been cleared, mainly for agriculture and settlements.[19] Victoria's population growth and subsequent urban expansion will increase the pressure on Victorian forests through elevated water demand from forest catchments and timber harvesting. [20]

In managing these forests, a range of actions are identified to achieve the principles of sustainable forest management. This was defined in 1993 at the Ministerial Conference on the Protection of Forests in Europe as:

> the stewardship and use of forests and forest lands in a way, and at a rate, that maintains their biodiversity, productivity, regeneration capacity, vitality and their potential to fulfil, now and in the future, relevant ecological, economic and social functions, at local, national, and global levels, and that does not cause damage to other ecosystems.[21]

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17. Australian Department of Agriculture and Water Resources ABARES, 'Australia's forests', Canberra, Australia http://www.agriculture.gov.au/abares/forestsaustralia/australias-forests Accessed 3 December 2018.
18. Forest and land area statistics are provided by DELWP in 10 January 2019, using public land management datasets (PLM25).
19. Commissioner for Environmental Sustainability 2013, 'State of the Environment report 2013', Melbourne, Victoria http://www.ces.vic.gov.au/sites/default/files/publication-documents/2013%20SoE%20report%20full.pdf Accessed 3 December 2018.
20. Lindenmayer DB, Sato C 2018, 'Hidden collapse is driven by fire and logging in a socioecological forest ecosystem', Proceedings of the National Academy of Sciences, 115, pp. 5181-5186.
21. Second Ministerial Conference on the Protection of Forests in Europe 1993, 'Resolution H1: general guidelines for the sustainable management of forest in Europe', Helsinki, Finland https://www.foresteurope.org/docs/MC/MC_helsinki_resolutionH1.pdf Accessed 3 December 2018.

Figure 6. Victorian state forest, and parks and reserves (Data source: DELWP 2018)

The Montreal Process is a voluntary agreement between nations to monitor and report on agreed criteria and indicators for the conservation and sustainable management of forests. Australia has accepted the criteria and developed indicators that best represent Australia's unique forest conditions in the Framework of Regional (Sub-National) Level Criteria and Indicators of Sustainable Forest Management in Australia (the framework).

Victoria has developed 45 indicators under the framework for reporting on Victoria's forest management.[22] To ensure accurate and consistent performance-reporting against the criteria, the Department of Environment, Land, Water and Planning (DELWP) has produced three iterations of Victoria's State of the Forests (SoF) report every five years since 2003.

The current literature identifies several major issues for long-term sustainable forest management in Victoria:

- Climate change – There is considerable scientific evidence predicting damage to the vitality and health of Australia's forests due to climate change.[23,24,25,26] Forests are an important element of the global carbon cycle; therefore, monitoring carbon stocks in forests is an essential part of sustainable forest management.

22. Department of Sustainability and Environment 2007, 'Criteria and indicators for sustainable forest management in Victoria: guidance document', Melbourne, Victoria https://www.forestsandreserves.vic.gov.au/__data/assets/pdf_file/0022/30865/Vic_Indicators_for_SFM_Guidance.pdf Accessed 9 January 2018.
23. Madsen T, Ujvari B, Shine R, Olsson M 2006, 'Rain, rats and pythons: climate-driven population dynamics of predators and prey in tropical Australia', Austral Ecology, 31(1), pp. 30-37.
24. Donohue RJ, McVicar TR, Roderick L 2009, 'Climate-related trends in Australian vegetation cover as inferred from satellite observations, 1981-2006', Global Change Biology, 15(4), pp. 1025-1039.
25. Johnson BJ, Miller GH, Fogel ML, Magee JW, Gagan MK, Chivas AR 1999, '65,000 years of vegetation change in central Australia and the Australian summer monsoon', Science, 284(5417), pp. 1150-1152.
26. Hughes L 2003, 'Climate changes and Australia: trends, projections and impacts', Austral Ecology, 28(4), pp. 423-443.

- Changing fire regimes – more frequent and severe fires as a result of changing climate are expected to cause tree mortality, regeneration and seed viability in the fire-sensitive forest types,[27] including eucalypt forests (such as *Eucalyptus pauciflora*[28] and *Eucalyptus delegatensis subsp. delegatensis*[29]).
- Biodiversity – In Victoria, nearly 250 fauna species are listed as 'threatened' in the *Flora and Fauna Guarantee Act 1988* (FFG Act). Of these, approximately 20% are forest-dependent species. While disturbance and regeneration are fundamental to forest maintenance, significant shifts in the frequency, scale and intensity of these processes can disrupt the health of forests.[30]
- Fragmentation – Forest-dwelling fauna species, including endangered species, are impacted by the fragmentation of native forests.[31] This loss of forest connectivity eventually leads to the geographic isolation of a species' population, and reduces the species' genetic diversity. This has significant implications for the survival of many iconic and forest-dependent species.
- Economy – Forests provide a resource for several economically significant industries in Victoria. These include forest products, agriculture (agroforestry) and tourism. The forest products industry alone provides an estimated 15,696 jobs, of which 14,475 are directly related to forests.[32] Victoria has the largest total area of plantations in Australia, compared to other states and territories, with 433,000 hectares of commercial hardwood and softwood plantations in 2013–14, up 13% from 2003–04.[33] Successful management of Victoria's forest/timber resources is vital to the state's economy.
- Legal framework – Management of Victoria's forests is delivered within a complex legal and policy framework. Relevant legislation includes the *Sustainable Forests (Timber) Act 2004, National Parks Act 1975* and *Forests Act 1958*.[34]

Critical challenges for sustainable forest management in Victoria, now and in the future, include:

- establishing long-term monitoring of key aspects of forest conditions, such as loss of species population and genetic diversity due to fragmentation of native forests
- understanding the changes in patterns of natural disturbances, including fire, flood and drought, and any increase in variability and intensity of these disturbances due to climate change
- understanding the impacts of altered disturbance patterns on forest productivity and forest-related biophysical and social values
- understanding Victoria's forest carbon cycle, and increasing the carbon storage capacity of forests
- improving complex and outdated forest management legislation that cause inconsistencies, overlaps and gaps, and lead to confusion for land managers and communities

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27. Fairman T, Nitschke CR, Bennett LT 2016, 'Too much, too soon? A review of the effects of increasing wildfire frequency on tree mortality and regeneration in temperate eucalypt forests', International Journal of Wildland Fire, 25(8), pp. 831-848.
28. Fairman, TA, Bennett LT, Tupper S, Nitschke CR 2017, 'Frequent wildfires erode tree persistence and alter stand structure and initial composition in a fire-tolerant sub-alpine forest', Journal of Vegetation Science, 28(6), pp. 1151-1165.
29. Doherty MD, Gill AM, Cary GJ, Austin MP 2017, 'Seed viability of early maturing alpine ash (Eucalyptus delegatensis subsp. delegatensis) in the Australian Alps, south-eastern Australia, and its implications for management under changing fire regimes', Australian Journal of Botany, 65, pp. 517-523.
30. Keenan R J and Nitschke C 2016, 'Forest management options for adaptation to climate chance: a case study of tall, wet eucalypt forests in Victoria's Central Highlands region', Australian Forestry, 79(2), pp. 96-107.
31. Riitters KH, Wickham JD, O'Neill R, Jones B, Smith E 2000, 'Global-scale patterns of forest fragmentation', Conservation Ecology, 4(2), p. 3.
32. Schirmer J, Mylek M, Magnusson A, Yabsley B, Morison J 2018, 'Socio-economic impacts of the forest industry Victoria (exc. The Green Triangle)', Forest and Wood Products Australia, Melbourne, Victoria https://www.fwpa.com.au/resources/reports/other/1631-socio-economic-impacts-of-the-forest-industry-victoria-exc-the-green-triangle.html Accessed 3 December 2018.
33. VAFI 2015, 'Industry review 2015', Melbourne, Victoria http://www.vafi.org.au/wp-content/uploads/2015/12/VAFI015-Victorian-Forest-Industry-Review-2015-FINAL.pdf Accessed 3 December 2018.
34. Victorian Environmental Assessment Council 2017, 'Conservation values of state forests: assessment report', Melbourne, Victoria http://www.veac.vic.gov.au/documents/Complete%20report%20for%20web%20page.pdf Accessed 3 December 2018.

- managing forests for a range of social, cultural, economic and ecological values and uses
- enhancing the protection and management of forests with attributes important to ecological conservation and carbon storage[35]
- characterising the optimal restoration targets (location, maturity stages) in post-fire and/or logged regrowth forests to reduce fire proneness[36]
- achieving sustainable native-timber production while protecting threatened species such as Leadbeater's possum
- defining forest-logging to fire-severity relationships as mediated by regrowth stage, tree abundance and density
- being consistent, multi-tiered and multi-valued in monitoring approaches and data acquisition strategies for sustainable forest management.

35. Lindenmayer DB, Blair D, McBurney L, Banks S 2015, 'Mountain Ash: fire, logging and the future of Victoria's giant forests', CSIRO Publishing, Melbourne, Victoria.
36. Ibid

Current Victorian Government Settings: Legislation, Policy, Programs

Victoria's forests are managed in accordance with Victorian legislation, including the *National Parks Act 1975, Forests Act 1958, Conservation, Forests and Land Act 1987, Flora and Fauna Guarantee Act 1988, Crown Land (Reserves) Act 1978, Land Act 1958*, and *Sustainable Forests (Timber) Act 2004*, along with related regulations, codes of practice, management plans and policy initiatives.[37] The system undertakes to balance management of the multiple values of Victoria's forests, including environmental values.

Recent policy measures that address or overlap with the issues above include:

- *Protecting Victoria's Environment – Biodiversity 2037 (Biodiversity 2037)* which sets out a 20-year vision and goals for biodiversity in Victoria
- review of the *Flora and Fauna Guarantee Act 1988 (FFG Act)*, so that it can more effectively protect Victoria's biodiversity in the face of existing and emerging threats
- amendments to regulation of native vegetation with the aim of providing for better consideration of biodiversity elements in decision-making, including habitat for rare or threatened species, large trees, endangered ecological vegetation classes (EVCs), sensitive wetlands and coastal areas.

In 2017, the Victorian Environmental Assessment Council (VEAC) recommended the following be undertaken within five years:

- state forests be administered under one Act
- the *National Parks Act 1975* be expanded to include revised categories of national parks, conservation parks, nature reserves, marine protected areas, and other categories and overlays classified as protected areas, to become the 'National Parks and Conservation Reserves Act'
- a new public land Act be developed to replace the current *Land Act 1958, Crown Land (Reserves) Act 1978* and *Forests Act 1958*.

The Victorian Government has accepted these recommendations.

Elements of Victoria's forest management framework are accredited by the Commonwealth under five Regional Forest Agreements (RFAs).[38] The RFAs were a key outcome of the National Forest Policy Statement (1992) through which the federal, state and territory governments committed to the sustainable management of all Australian forests.

RFAs endeavour to maintain a comprehensive, adequate and representative reserve system, to manage forests on an ecologically sustainable basis, and provide for the long-term stability of forests and forest industries. All five Victorian RFAs are due to expire in March 2020.

The Victorian Government endorsed a program to modernise Victoria's RFAs. Over the next two years, the Department of Environment, Land, Water and Planning (DELWP) has committed to engaging with Victorian communities on how they value Victoria's forests. DELWP will also complete assessments of forest values, including environmental values, Aboriginal heritage values, economic values, social values and principles of ecologically sustainable management.

It is anticipated that the outcomes of the engagement and assessments processes will inform the modernisation of Victoria's RFAs and the planning and regulatory frameworks they accredit.

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37. Forest and Wood Products Australia 2011, 'Management of Victoria's Publicly-owned Native Forest for Wood Production', Melbourne, Victoria http://www.fwpa.com.au/images/resources/PRC174-0910_Research_Report_Native_forest_project.pdf Accessed 24 December 2018.
38. DELWP 2018, 'Modernising Victoria's regional forest agreements', Melbourne, Victoria https://www.forestsandreserves.vic.gov.au/forest-management/regional-forest-agreements Accessed 24 December 2018.

Criteria and Indicators

To address the challenges listed above, this report identifies trends by comparing current data with data in previous State of the Forests reports. It also identifies gaps in information. The report is structured according to Montreal Process criteria, outlined below. (Victoria has developed 45 indicators to address the criteria[39].)

Criterion 1: Conservation of biological diversity

Identification of species considered to be rare or threatened is used as an indication of forest health. Changes in the conservation status of a species is also used as an indication of the effectiveness of sustainable biodiversity management, and of individual species recovery programs. In this report, indicators under this criterion focus on forest-dwelling species, and their conservation status, to assess disturbance to native forest species by invasive species. Case studies – including about Victoria's faunal emblem, the Leadbeater's possum, which was thought to be extinct but has re-emerged – highlight species conservation efforts.

Criterion 2: Maintenance of productive capacity of forest ecosystems

The wood production industry is an important part of Victoria's regional economy. The productive capacity of forests is influenced by growth rates, silviculture and climate (which may influence the frequency and severity of fires, and the availability of water in the long-term). Timber harvesting is conducted in Victoria's state forests by VicForests, a state-owned business responsible for the sustainable harvest, regrowing and commercial sale of timber on behalf of the Victorian Government.

Indicators under this criterion report on the available area and volume of timber to harvest, and the regeneration rate, and evaluates the sustainability of the process. Information about native forest on private land is not provided, as there is no comprehensive data on wood production from private land.

Criterion 3: Maintenance of ecosystem health and vitality

Indicators under this criterion focus on the impact of natural and human-induced disturbances on forest health and vitality. Disturbances include fire, climatic events, planned burning and road management.

Criterion 4: Conservation and maintenance of soil and water resources

Soil and water resources underpin forest ecosystem productivity and functions. Indicators under this criterion demonstrate forest management activities and regulatory framework/s in Victoria that could alter forest soils, water yield and river health.

Criterion 5: Maintenance of forest contribution to global carbon cycles

Forests contribute to carbon stocks. Maintaining and increasing forests, and thereby carbon stocks, is a key part of sustainable forest management. Indicators under this criterion use various forest parameters to investigate the contribution of forest ecosystems to the global greenhouse gas balance and carbon distribution.

39. Department of Sustainability and Environment 2007, 'Criteria and indicators for sustainable forest management in Victoria: guidance document', Melbourne, Victoria https://www.forestsandreserves.vic.gov.au/__data/assets/pdf_file/0022/30865/Vic_Indicators_for_SFM_Guidance.pdf Accessed 11 January 2019.

Criterion 6: Maintenance and enhancement of long-term multiple socioeconomic benefits to meet the needs of society

Forests provide significant benefits to the social, cultural and economic fabric of Victoria. However, these benefits can be difficult to quantify, and translating ecosystem services into economic values is challenging. One of the difficulties is in understanding the non-market values that forests provide, and the current state of those values. Indicators under this criterion describe the current state of ecosystem services that are derived from forests in Victoria and provide existing economic information for these services.

Criterion 7: Legal, institutional, and economic frameworks for forest conservation and sustainable management

Legal, institutional and economic frameworks guide long and short-term sustainable forest management and conservation. They provide the capacity to monitor change and to conduct and apply research and development. Indicators under this criterion describe and contextualise relevant forestry legislation, institutional capacity and economic arrangements.

Victorian Forest Monitoring Program

DELWP's Victorian Forest Monitoring Program (VFMP) was established in 2011. It measures and monitors landscape-level trends in forest ecosystems in the Victorian public land estate, and is the only broad-scale forest-monitoring process operating in Australia.[40] It aims to provide relevant information for the Montreal Process, and contribute to policy development and decision-making related to carbon, biomass and ecosystem-service accounting, water-yield modelling, habitat structure, forest health and productivity, and the impacts of disturbances such as fire.

The VFMP comprises a network of 786 permanent ground plots, which are stratified or grouped into 21 distinct regions according to Victoria's 11 bioregions (Table 6)[41] and by public tenure ('state forests' and 'parks and conservation reserves'). The field measurement process achieved 84% (662 plots) of the 786 ground plots, with the remaining plots not measured due to various constraints such as accessibility or other hazards (Table 6). Location of sampling units for Victorian Forest Monitoring Program is described in Figure 7.

The results of the VFMP's first full cycle of measurements, completed in November 2015, are reported here. The second measurement cycle is to be completed in 2020.

Note that comparison of results between this report and SoF 2013 is limited due to changes to data collection, and improvements in data quality. For example, when SoF 2013 was prepared, only 337 plots (or approximately 50%) had been measured (Table 6). While important, increased sample sizes and improved accuracy have introduced analytical 'noise'. More accurate trend analysis for all VFMP metrics will be possible from 2020 onwards, once two full measurement cycles have been completed.

VFMP evaluates its performance against a quality assurance and quality control (QA/QC) protocol.[42] The protocol involves a training and audit program that assesses a minimum 15% of plots per year – an increase of 7 percentage points from the previous report.[43] The QA/QC program is important to avoid any bias from data interpretation for evaluating natural and human-induced disturbance and the efficacy of management actions and policy decisions about public forests.

SoF reports prior to 2013 were produced based on data sources with varying spatial and temporal scales and a bias towards commercial state forests in eastern Victoria.[44] The VFMP is intended to help DELWP improve its forest monitoring activities with a more consistent and comprehensive monitoring approach across tenure (state forest/national park). However, the program has limitations, which have been acknowledged by its design team.[45] A relatively low sample size (786 at the time of the evaluation), determined by the available budget, means the program must leverage a three-tiered remote-sensing approach to improve its forest-area estimates. Consequently, the program's application to finer-scale or discrete metrics is not recommended. Rather, the program is designed to observe broad-scale, long-term trends in forest health and condition. It could be improved by investments in separate but complementary monitoring activities specific to important/relevant sites.

Note that DELWP has increased the sample size by 73 plots (from 786 to 859) since the evaluation was conducted, as a result of tenure change in the Riverina and improvements to spatial data accuracy.

Continuous improvement is necessary for the program to remain a useful tool to assist public land managers to observe the influence of tenure-specific management interventions (across national parks and state forests) at the bioregion level.

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40. Haywood A, Thrum K, Mellor A, Stone C 2017, 'Monitoring Victoria's public forests: implementation of the Victorian Forest Monitoring Program', Southern Forests, 2620, pp. 1–10.
41. Australian Department of the Environment and Energy, 'Australia's bioregions (IBRA)', Canberra, Australia http://www.environment.gov.au/land/nrs/science/ibra Accessed 3 December 2018.
42. DELWP 2017, 'Standard operating procedures field guide (v2.1.0): Victorian Forest Monitoring Program', Melbourne, Victoria.
43. Haywood A, Thrum K, Mellor A, Stone C 2017, 'Monitoring Victoria's public forests: implementation of the Victorian Forest Monitoring Program', Southern Forests: Journal of Forest Science, 80(2), pp. 185-194.
44. Ibid
45. Ibid

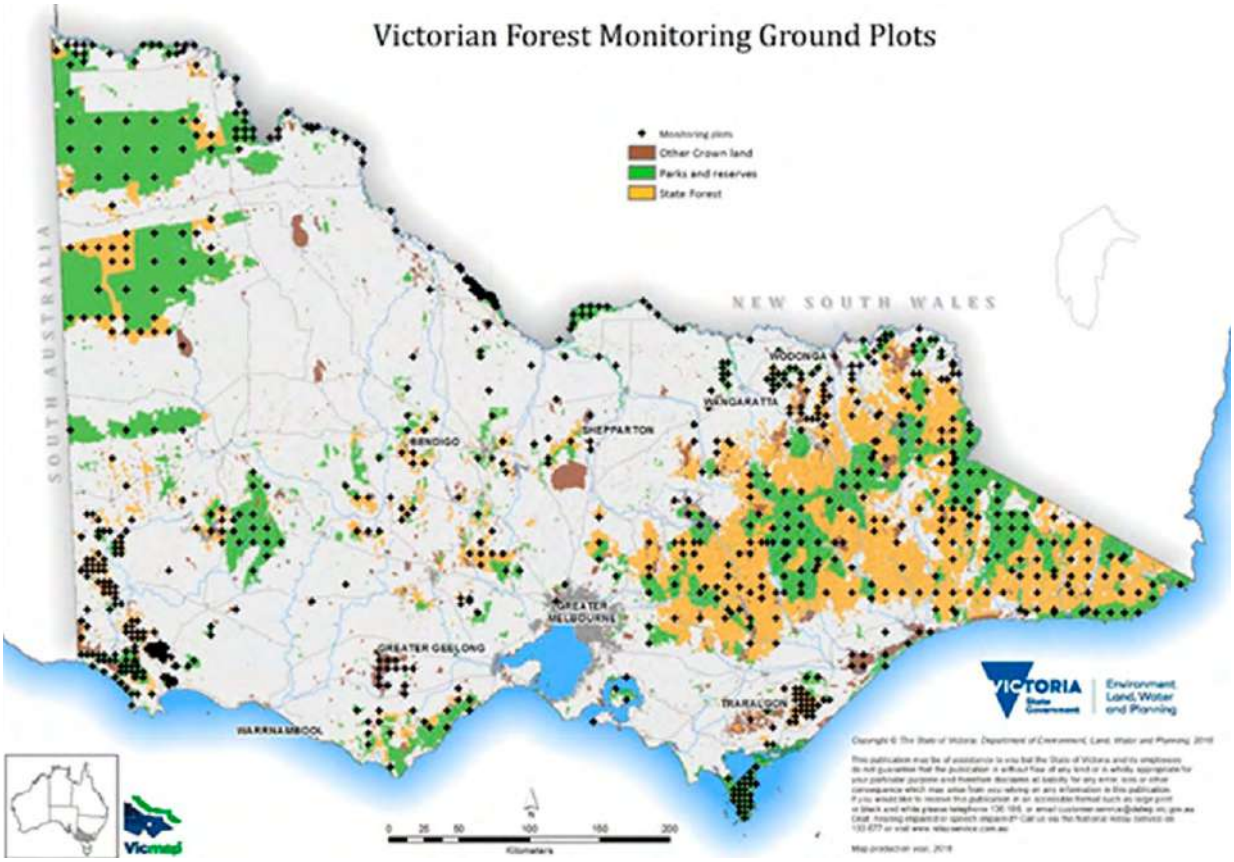


Figure 7. Location of sampling units for Victorian Forest Monitoring Program (Data source: DELWP 2018)

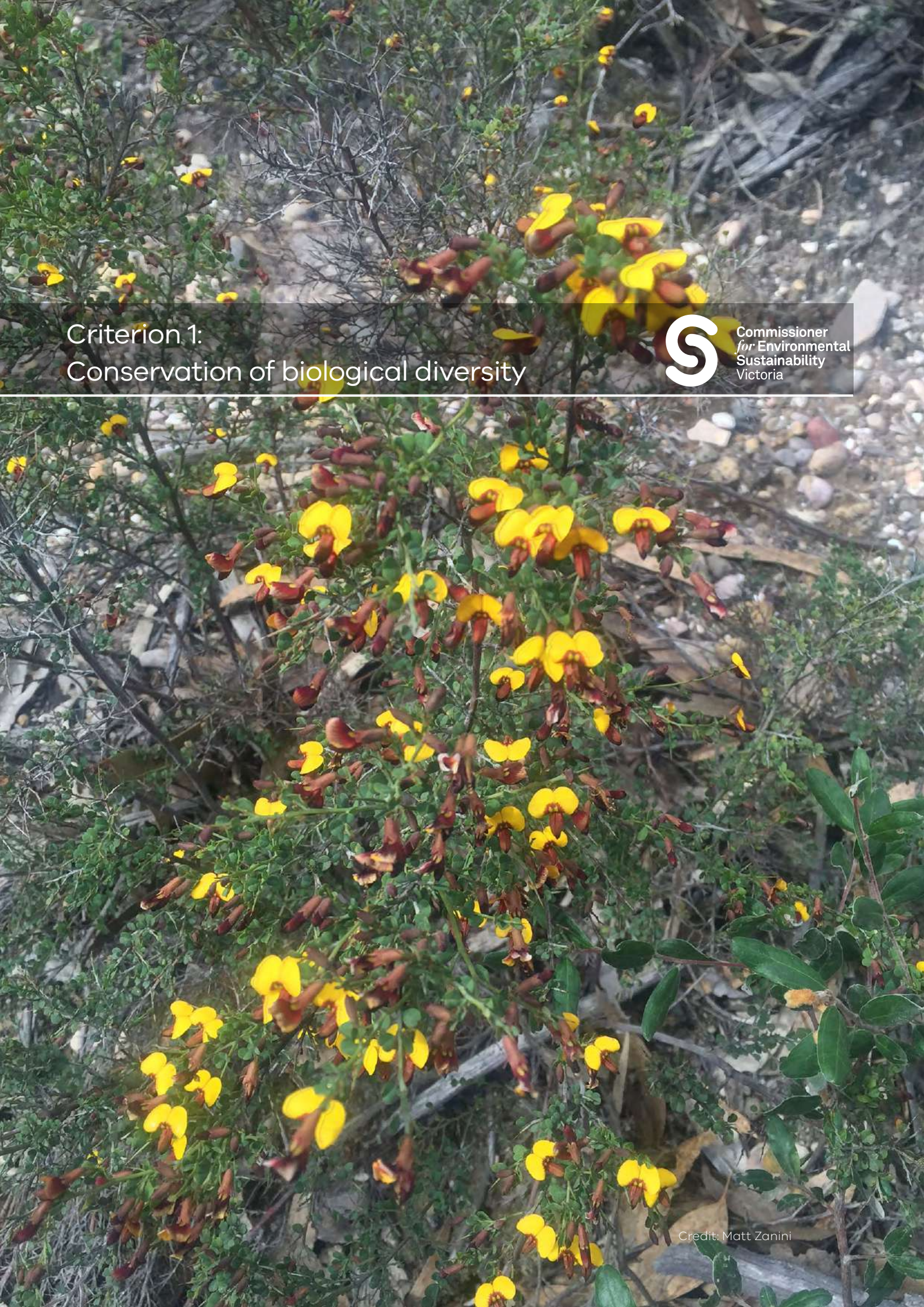
Table 6. Number of VFMP permanent sample plots per bioregion

Bioregion	2013 VFMP plots	2018 VFMP plots
Australian Alps	61	76
Flinders	9	19
Murray–Darling Depression	21	58
Naracoorte Coastal Plain	32	79
NSW South Western Slopes	27	65
Riverina	27	69
South East Coastal Plain	24	40
South East Corner	29	66
South Eastern Highlands	50	74
Victorian Midlands	36	66
Victorian Volcanic Plain	21	50
Total	**337**	**662**

(Data source: DELWP 2018)

Criterion 1:
Conservation of biological diversity

Commissioner *for* Environmental Sustainability Victoria



Credit: Matt Zanini

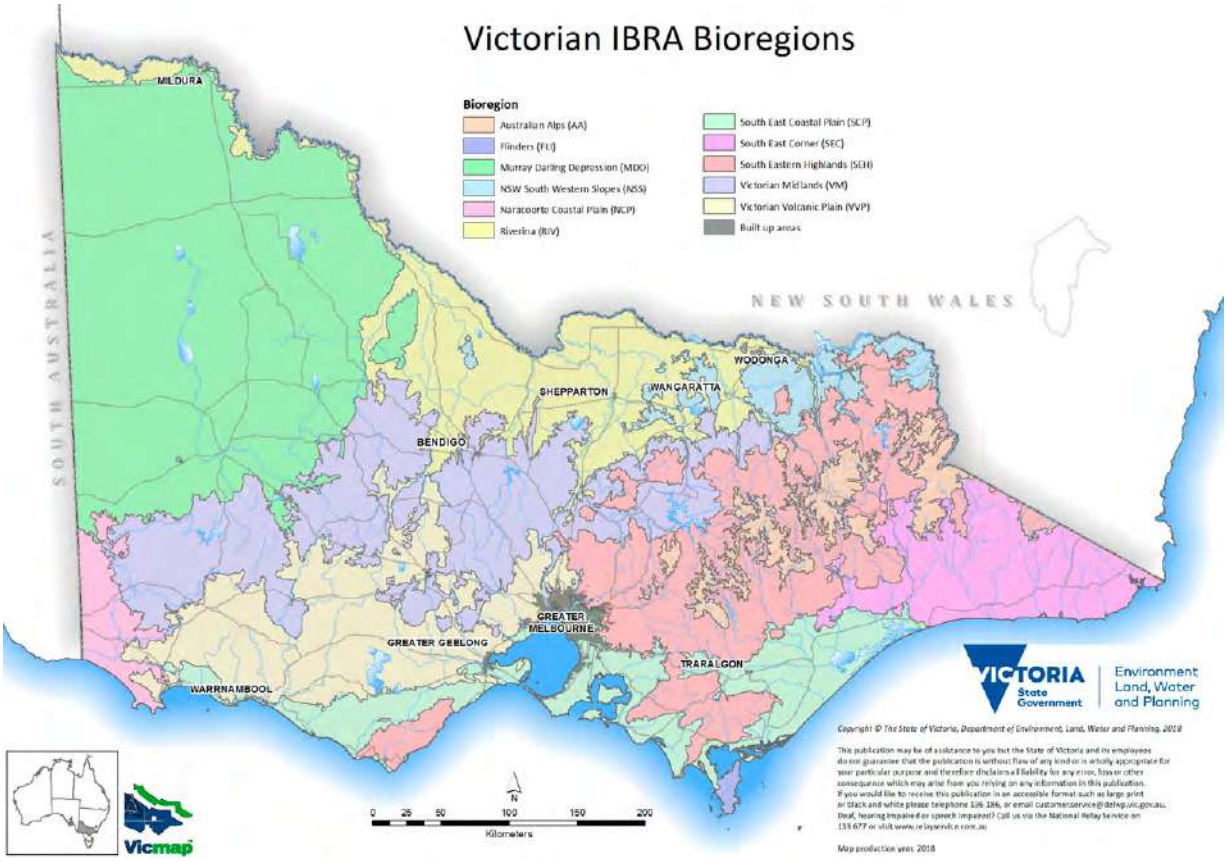


Figure 8. Interim biogeographic regionalisation for Australia bioregions in Victoria (Data source: DELWP 2018)

To effectively manage Victorian forests, it is necessary to understand forest area by type, as this provides a broad measure of forest ecosystem and biodiversity maintenance. Changes in forest area and structure over time also provide an indicator for the impact of environmental disturbances and extreme events on forest ecosystems, such as bushfires.

Bioregions are the major geographic stratification unit for the VFMP. There are 11 in Victoria (Figure 8). Within each bioregion, further divisions are made based on public land tenure. State forests and parks and reserves are the two major tenures of interest for this report.[46] State forests are primarily managed for conservation and recreation, with small portions for native-timber harvesting. Parks and conservation reserves are managed for conservation outcomes as well as for recreation and tourism. Intensive recreation takes place in some areas, such as alpine parks.

This indicator provides information on the area of forest by broad forest type and tenure, as well as change in forest extent (forest cover) over time. Forest types, including height and canopy-cover classes, are defined according to Australia's National Forest Inventory (NFI) definitions.[47] Information about area of forest by forest type and tenure is reported for public forests and plantations on private land.

46. Department of State Development, Business and Innovation, 'Public land management (PLM25)', Melbourne, Victoria https://www.data.vic.gov.au/data/dataset/public-land-management-plm25 Accessed 3 December 2018.
47. Australian Department of Agriculture and Water Resources ABARES, 'Australia's forests', Canberra, Australia http://www.agriculture.gov.au/abares/forestsaustralia/australias-forests Accessed 3 December 2018.

	Status (UNKNOWN / POOR / FAIR / GOOD)	Trend	Data Quality
1.1a Area of forest by type and tenure - forest canopy cover and canopy height classes **Data Custodian** DELWP		?	DATA QUALITY Poor

Forest canopy cover is derived from the freely available Landsat archive, with a baseline year of 2013. (This is consistent with the five-year interval used in SoF 2013, which presented a 2008 baseline year.) A binary (forest/non-forest) classification is applied. The identified forest area is used as the extent for the direct expansion method, from which the aspatial forest type estimates described above are derived (Figure 9).

Comparison of this product to national and global forest-cover products[48] suggests this process is relatively accurate for state-level reporting, with a global error of +/– 15% variable across the state. It is even more accurate for public land, which provided the source of validated, ground-truthed data.

Analysis demonstrates that forest-cover confidence is lowest in the Mallee and some coastal regions, particularly in national and global forest-cover products. Although the 2008–13 data can provide the change in forest cover, the trends have not been analysed for this report due to time constraints, but will be included in future reports.

48. Soto-Berelov M, Jones SD, Haywood A 2018, 'Assessing large area forest cover products derived from the same imaging source across Victoria, Australia', Ecological Management & Restoration, 19(1), pp. 66-75.

Figure 9. Victorian forest cover, 2018 (Data source: DELWP 2018)

Criterion 1: Conservation of biological diversity

	Status				Trend	Data Quality
	UNKNOWN	POOR	FAIR	GOOD		
1.1a Area of forest by type and tenure - forest type **Data Custodian** DELWP	○	○	●	○	↗	DATA QUALITY Good

'Forest' is defined by Australia's National Forest Inventory as an area greater than 0.5 hectares of native forest, with a dominant vegetation height of greater than 2 m and canopy cover greater than 20%. Areas that meet this definition are assigned a land cover classification based on the species they are home to, dominant height and canopy cover, as well as the level of disturbance experienced. Forest types are based on the relative abundance of eucalypt species (eucalypt, mallee or mixed) and divided into height classes with low (2–10 m), medium (11–30 m) and tall (>30 m).

Forest-area estimates are derived from a network of 2 km x 2 km high-resolution aerial photographs taken above each VFMP plot. The photographs have been interpreted by trained practitioners and provide information describing the boundaries of different forest and land regions using the classifications of broad forest type, canopy cover and height, as described above.

A direct expansion method[49] was used to inform area and uncertainty estimates. This method has been found to be practical for land-cover-type mapping.[50] It incorporates digitised representative sample units through mathematical functions, enabling unbiased, landscape-scale land-cover interpretation of estimates with minimal sampling size.[51,52] Information about forest type on private land is not reported under this methodology; however, some estimates are provided in the section on indicator 1.1a (Area of forest by type and tenure - forest canopy cover and canopy height classes).

The VFMP estimates forest extent with the help of remote-sensing technology. In 2013, the forest-area estimates were derived from imagery from a five-year period (2003–07) and modelled to a baseline year of 2008.

The forest-area estimates in this report were derived from a 5-year period (2008–12) and modelled to 2013.

The forest-area estimates report the land-cover types of Victoria's major vegetation types based on predominant height.[53]

The area of most forest types has increased. A notable exception is the 'forest unclassified (burnt)' type. This increased dramatically after the February 2009 Black Saturday fires (Table 7 and Table 8), but has decreased as forest areas recover (Figure 10 and Figure 11).

Note that methodological uncertainty may contribute to observed variation. For example, the dataset from 2018 is more comprehensive, with 15 additional Aerial Photo Interpretation (API) plots. Another potential source of error is the improved resolution of DELWP's corporate public land management spatial layer, which has improved from 100 m resolution in 2008 to 25 m resolution in 2013. Manual interpreters, with the aid of higher-resolution images, may make different decisions about forest types

49. Deppe F 1998, 'Forest area estimation using sample surveys and Landsat MSS and TM data', Photogrammetric Engineering and Remote Sensing, 64(4), pp. 285-292.
50. Kamaruzaman JHj, Hasmadi IM 2008, 'Mapping and quantification of land area and cover types with Landsat TM in Carey Island, Selangor, Malaysia', Modern Applied Science, 3(1), p. 42.
51. Ibid
52. Farmer E, Jones S, Clarke C, Buxton L, Soto-Berelov M, Page S, Mellor A, Haywood A 2013, 'Creating a large area landcover dataset for public land monitoring and reporting', in Arrowsmith C, Bellman C, Cartwright W, Jones S, Shortis M (eds.), Progress in Geospatial Science Research, pp. 85–98, Publishing Solutions, Melbourne, Victoria.
53. Farmer E, Jones S, Clarke M, Soto-Berelov M, Mellor A, Haywood A 2011, 'Semi-Automated API for Large Area Public Land Monitoring and Reporting', Proceedings of the GSR_1 Research Symposium, Melbourne, Australia, 12–14 December 2011, pp. 1–12.

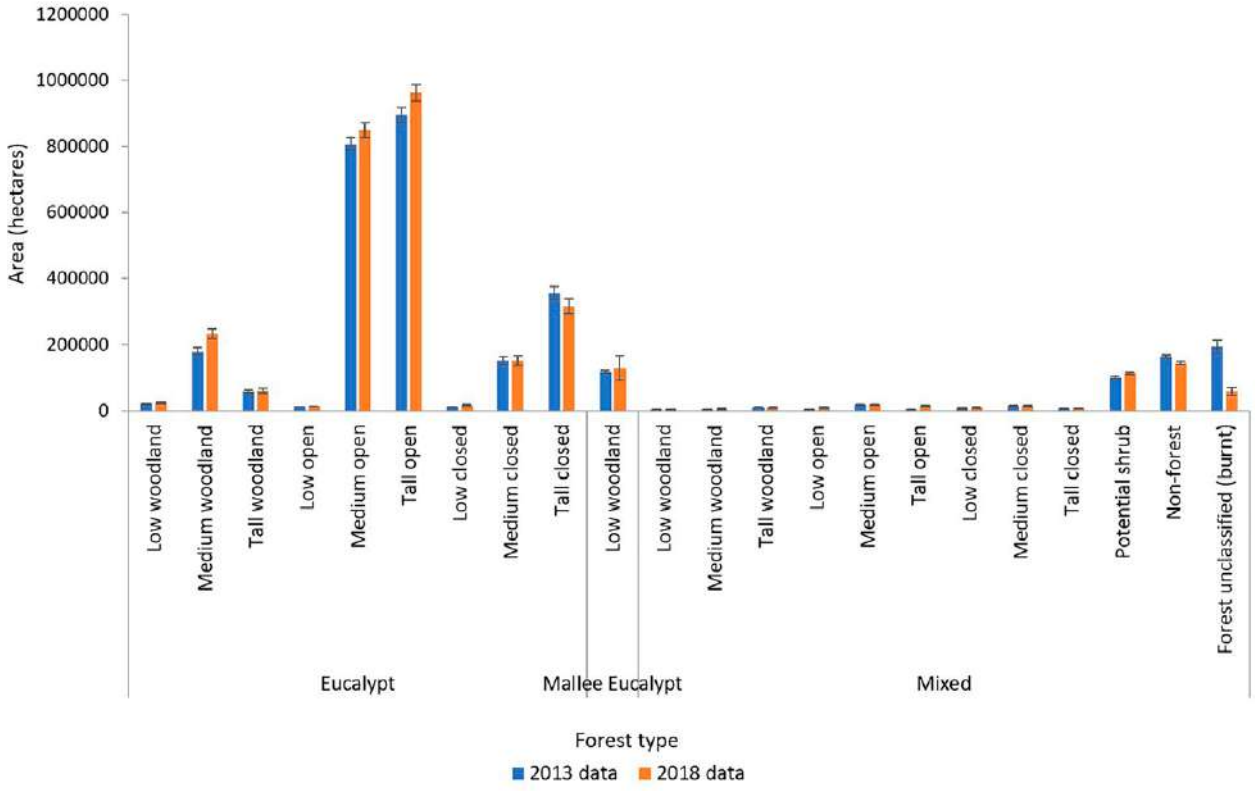


Figure 10. Area of forest by broad forest type, height and canopy cover in state forests (Data source: DELWP 2018)

Table 7. State forest area estimates

Forest type/ land cover	Cover	2013		2018	
		Area (ha)	C.I. (95%)	Area (ha)	C.I. (95%)
Eucalypt	Low woodland	19,895	8.3	23,313	12.5
	Medium woodland	179,929	6.5	233,037	6.2
	Tall woodland	58,281	7.9	60,647	10.6
	Low open	11,492	6.5	12,559	6.2
	Medium open	808,105	2.4	849,327	2.7
	Tall open	895,140	2.6	962,058	2.6
	Low closed	10,301	15.2	16,805	15.7
	Medium closed	151,501	8.2	152,784	9.7
	Tall closed	356,340	5.3	317,722	7.0
Mallee Eucalypt	Low woodland	117,872	2.8	128,802	28.5
Mixed	Low woodland	3,683	4.0	3,381	6.7
	Medium woodland	4,601	5.5	4,766	6.3
	Tall woodland	9,637	17	9,531	28.3
	Low open	3,582	13.7	8,504	19.9
	Medium open	17,859	7.4	17,592	9.4
	Tall open	3,750	30.5	13,802	18.7
	Low closed	6,266	29.5	7,756	28.6
	Medium closed	14,055	16.3	14,027	20.7
	Tall closed	6,533	10.6	6,429	15.3
Potential shrub		100,658	3.8	113,566	3.6
Non-forest		163,719	2.5	143,794	3.1
Forest unclassified (burnt)		194,257	10.1	57,935	21.5

Note: C.I. = confidence interval
(Data source: DELWP 2018)

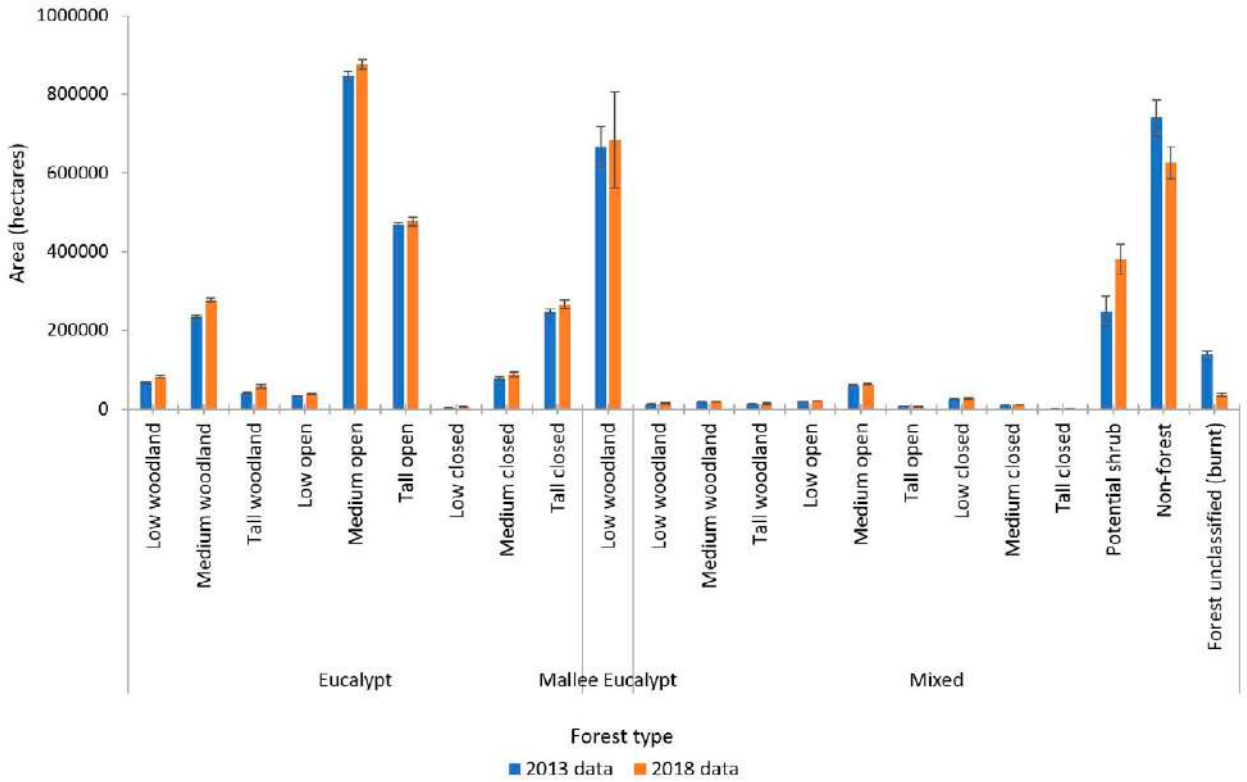


Figure 11. Area of forest by broad forest type, height and canopy cover in parks and reserves (Data source: DELWP 2018)

Table 8. Parks and reserves area estimates

Forest type/ land cover	Cover	2013		2018	
		Area (ha)	C.I. (95%)	Area (ha)	C.I. (95%)
Eucalypt	Low woodland	68,001	4.8	81,773	4.1
	Medium woodland	234,369	1.7	277,013	2.0
	Tall woodland	39,830	5.4	57,193	9.4
	Low open	33,105	5.4	38,337	5.2
	Medium open	846,636	1.4	875,429	1.4
	Tall open	467,166	1.4	476,742	2.2
	Low closed	2,877	8.5	5,933	9.1
	Medium closed	77,993	3.1	87,878	6.8
	Tall closed	246,887	2.4	265,896	3.7
Mallee Eucalypt	Low woodland	665,686	7.7	683,707	17.8
Mixed	Low woodland	12,399	4.9	13,734	7.3
	Medium woodland	18,410	5	18,711	7.6
	Tall woodland	13,131	5.8	13,165	16.1
	Low open	19,418	5.3	20,478	5.3
	Medium open	60,099	2.7	62,466	2.6
	Tall open	6,784	8.3	6,069	23.7
	Low closed	25,599	1.9	27,210	3.4
	Medium closed	10,520	2.2	10,336	5.1
	Tall closed	241	12.8	241	39.3
Potential shrub		247,927	15.3	379,715	9.9
Non-forest		739,807	6.3	625,948	6.6
Forest unclassified (burnt)		141,083	3.9	35,814	9.2

Note: C.I. = confidence interval
(Data source: DELWP 2018)

	Status				Trend	Data Quality
	UNKNOWN	POOR	FAIR	GOOD		
1.1a Area of forest by type and tenure - plantation forest in private land **Data Custodian** ABS	○	○	●	○	→	DATA QUALITY Good

Victoria's plantation forests provide export and domestic timber products, including both hardwood and softwood. Plantation forests are almost all privately owned (99%).

The most recent statistics, from 2015–16, show Victoria has the largest total area of plantations in Australia.[54] Victorian plantations account for approximately one-fifth of Australia's total plantation forest estate. Each year, plantation areas are harvested extensively: some are not replanted, and occasionally left fallow. (Note that in this report, 'plantation' describes land use: both planted and fallow land may be referred to as 'plantation')

In 2016–17, there were 421,700 hectares of industrial hardwood and softwood plantations in Victoria (Figure 12). Over the past 18 years, commercial softwood plantation areas have been stable at between 212,000 and 226,000 hectares. By contrast, commercial hardwood plantation areas doubled in the 10 years since the 1999–2000 financial year, from 101,500 to 203,000 hectares. (This increase was mainly due to managed investment schemes, popular in the early 2000s. Several high-profile agri-business managed investment schemes collapsed, resulting in substantial losses for many investors)

54. Australian Department of Agriculture and Water Resources ABARES, 'Australian plantation statistics 2017 update', Canberra, Australia https://data.gov.au/dataset/pb_aplnsd9abfe20170503/resource/477323a0-11dd-4276-a765-dc8e19fdeb49 Accessed 3 December 2018.

Since the 2010–11 financial year, plantation areas have gradually decreased by approximately 11,200 hectares (Figure 12). This is due to a decrease in the rate of new plantation establishments since 2000.

Newly established plantation areas in Victoria have decreased sharply from a peak of approximately 38,000 hectares in 1999–2000 (Figure 13). No new plantation areas have been established since the 2012–13 financial year.

Victoria pledged $110 million in the 2017–18 budget to assist plantation establishment in the Latrobe Valley, to support the long-term sustainability of Victoria's timber-harvesting industry.[55]

55. Victorian Department of Treasury and Finance 2017, 'Getting on with the job: Victorian Budget 17/18 overview', Melbourne, Victoria https://www.dtf.vic.gov.au/sites/default/files/2018-02/state-budget-overview-2017-18.pdf Accessed 4 December 2018.

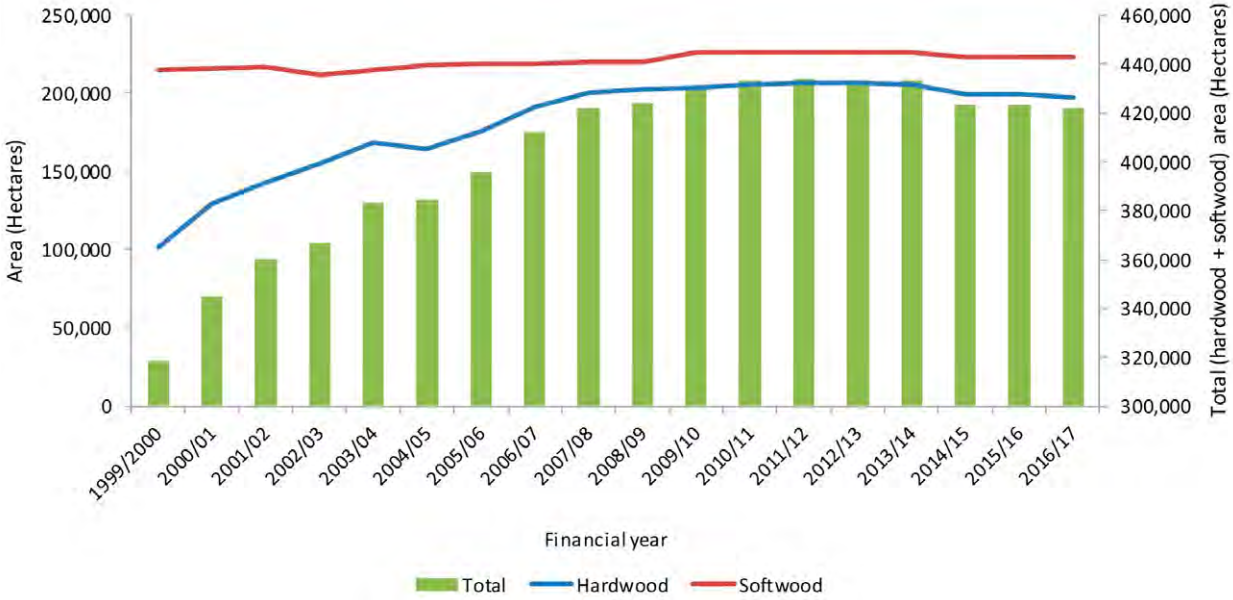


Figure 12. Plantation areas in Victoria, 1999–2000 to 2016–17 [56,57]

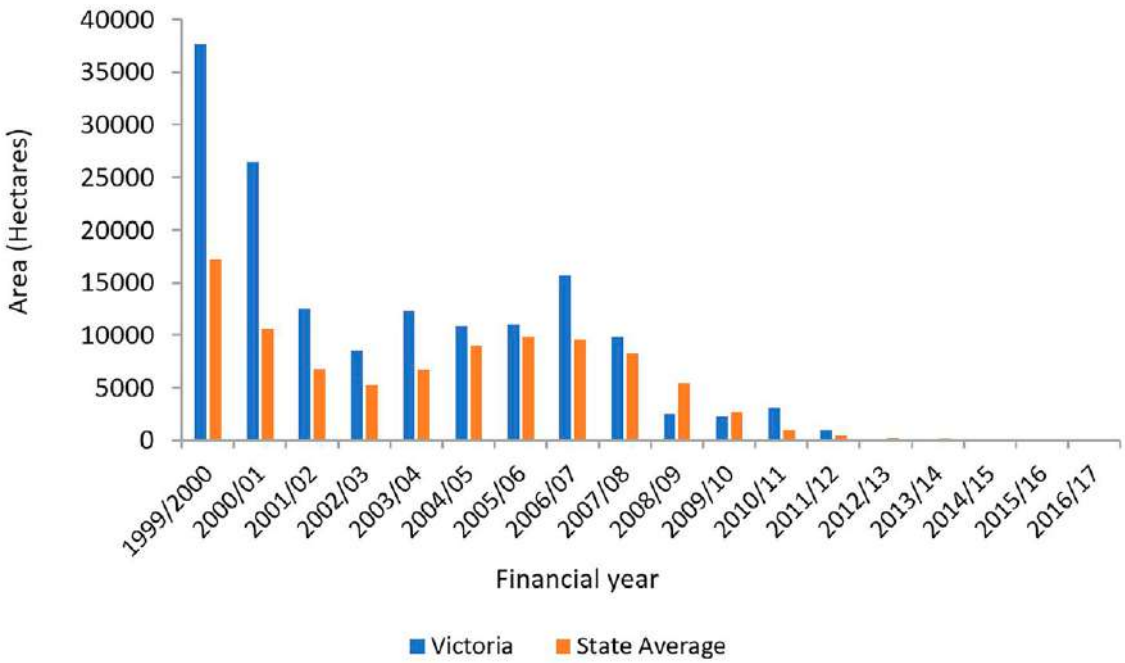


Figure 13. Area of new plantation establishment in Victoria, 1999–2000 to 2016–17[58]

56. Australian Department of Agriculture and Water Resources ABARES 2018, 'Australian forest and wood products statistics: September and December quarters 2017', Canberra, Australia http://data.daff.gov.au/data/warehouse/9aaf/afwpsd9abfe/afwpsd9abfe20180524/AFWPSOverview_Sep-Dec_2017_v1.0.0.pdf Accessed 4 December 2018.
57. Australian Department of Agriculture and Water Resources ABARES 2007, 'Australian forest and wood products statistics: September and December quarters 2006', Canberra, Australia http://data.daff.gov.au/data/warehouse/pe_abare99001363/afwps06.2_sept__dec06.pdf Accessed 4 December 2018.
58. Australian Department of Agriculture and Water Resources ABARES 2018, 'Australian forest and wood products statistics: September and December quarters 2017', Canberra, Australia http://data.daff.gov.au/data/warehouse/9aaf/afwpsd9abfe/afwpsd9abfe20180524/AFWPSOverview_Sep-Dec_2017_v1.0.0.pdf Accessed 4 December 2018.

	Status				Trend	Data Quality
	UNKNOWN	POOR	FAIR	GOOD		
1.1b Area of forest type by growth stage Data Custodian DELWP	○	○	●	○	↗	DATA QUALITY Good

Understanding the previous and current growth stages of forests in Victoria is important for sustainable forest management. Forest dynamics, and particularly species succession, can be drastically altered by natural and human-induced disturbances, which are increasing. Knowledge of growth stages, and subsequent forest-recovery conditions, is thus critical for decision-making by land managers to mitigate any ecological losses.[59]

This indicator provides information on the area and extent of forest ecosystem types, including successional stage, age class and the nature of tenure or ownership. Reporting the growth stage by broad forest type provides an indication of the diversity and balance of growth stages across Victoria's forest estate.

In this report, forest area is classified by height, which is considered a growth-stage indicator. Height is classified according to the NFI[60] forest definition into three types, depending on stand height:

- low: 2–10 m
- medium: 11–30 m
- tall: > 30 m.

The total area of all forest types, except 'non-forest' (describing a traditional forest area that currently has no trees due to disturbances including fire damage), increased between the two assessments.

Recovery of forests following the 2009 Black Saturday bushfires explains the large reduction in 'non-forest' areas compared with SoF 2013, which has a baseline year of 2008. Fire-affected areas that regrew post-2008 are likely to have been reclassified from 'non-forest' to 'forest' or 'forest potential shrub'.

Medium and tall eucalypt forests make up 63% of the native forests across Victoria's state forests, parks and conservation reserves, covering an area of 4.6 million hectares. While the total area of medium and tall forest has increased since 2013, the relative proportion of these types has declined by approximately 15% due to an increase in low eucalypt, low mixed/other forest and forest potential shrub with a decrease of non-forest area. This is predominately due to residual mallee regrowth from fires that occurred during the 2002-03 summer bushfire season. For a description of the method used to calculate areas and associated uncertainty estimates, see indicator 1.1a (i) (Area of forest by type and tenure: forest canopy cover and canopy height classes).

59. Franklin JF, Lindenmayer DB, MacMahon JA, McKee A, Magnusson J, Perry DA, Waide R, Foster DR 2000, 'Threads of continuity: ecosystem disturbances, biological legacies and ecosystem recovery', Conservation Biology in Practice, 1, pp. 8–16.
60. Australian Department of Agriculture and Water Resources ABARES, 'Australia's national forest inventory', Canberra, Australia http://www.agriculture.gov.au/abares/forestsaustralia/australias-national-forest-inventory Accessed 3 December 2018

Table 9. Broad forest types by estimated area in state forests, and parks and conservation reserves

Forest type and height class	State forests				Parks and conservation reserves			
	2013		2018		2013		2018	
	Area (ha)	C.I.	Area (ha)	C.I.	Area (ha)	C.I.	Area (ha)	C.I.
Low Eucalypt	41,688	6.1	52,677	7.4	103,983	3.6	126,042	3.1
Medium Eucalypt	1,139,535	1.8	1,235,148	1.9	1,158,997	1.1	1,240,319	1.1
Tall Eucalypt	1,309,761	1.8	1,340,426	1.8	753,883	1.0	799,832	1.7
Mallee Eucalypt	117,872	2.8	128,802	28.5	665,686	7.7	683,707	17.8
Low mixed/other* forest	13,530	15.6	19,641	15.7	57,416	2.6	61,421	2.5
Medium mixed/other forest	36,514	7.6	36,385	9.5	89,029	2.7	91,513	2.6
Tall mixed/other forest	19,920	11.9	29,762	11.6	20,156	6.1	19,475	15
Forest potential shrub†	100,658	3.8	113,566	3.6	247,927	15.3	379,715	9.9
Non-forest	359,003	5.5	203,421	5.6	881,388	5.4	662,277	6.2

C.I. = Confidence Interval (95%)

†Forest potential shrub: previously forested land cover which has undergone significant disturbance (such as short-interval bushfire) or clearance (such as by clearfell logging), but which is known to be regenerating as 'forest' (according to NFI definition).

** Mixed/other forest types include casuarina, callitris, acacia, melaleuca, rainforest and mangrove. Eucalypt forests comprise the vast majority of Victoria's public forests. As a result, other forest types are underrepresented in the land cover map sampling because obtaining reliable area estimates is difficult. For this analysis, these forest types are aggregated into a 'mixed and other forest types' class. Based on data presented in SoF 2008, other forest types make up less than 10% of Victoria's total native forest area.*

(Data source: DELWP 2018)

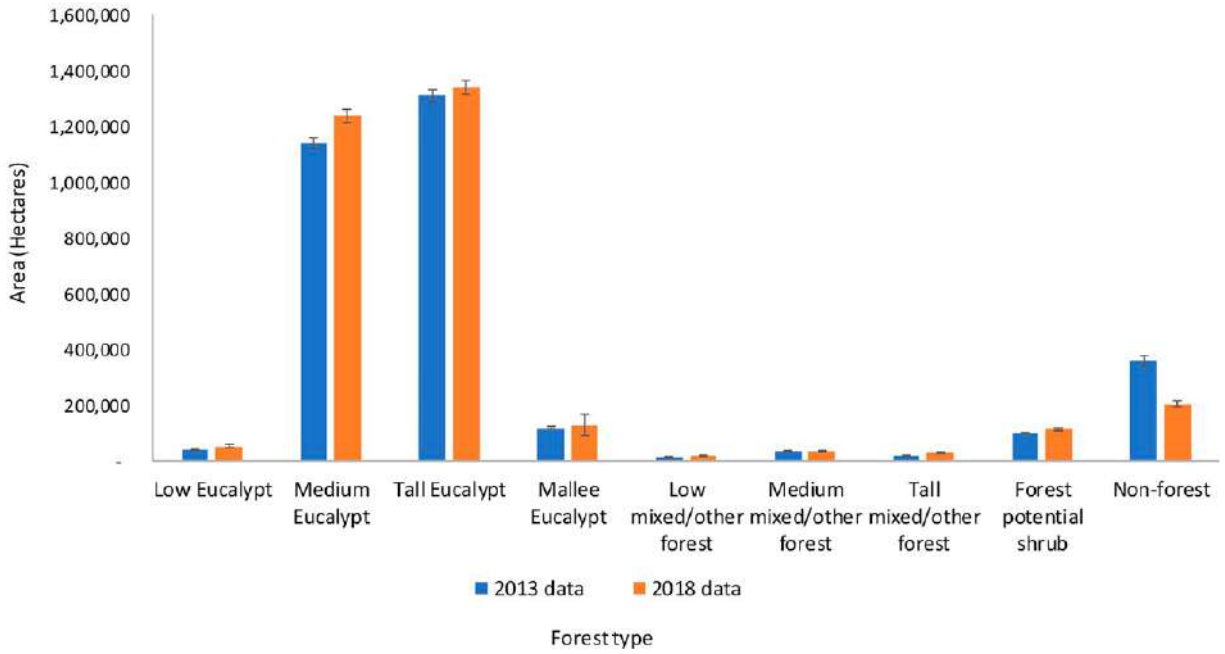


Figure 14. Area of state forest by forest type, 2013 and 2018
(Data source: DELWP 2018)

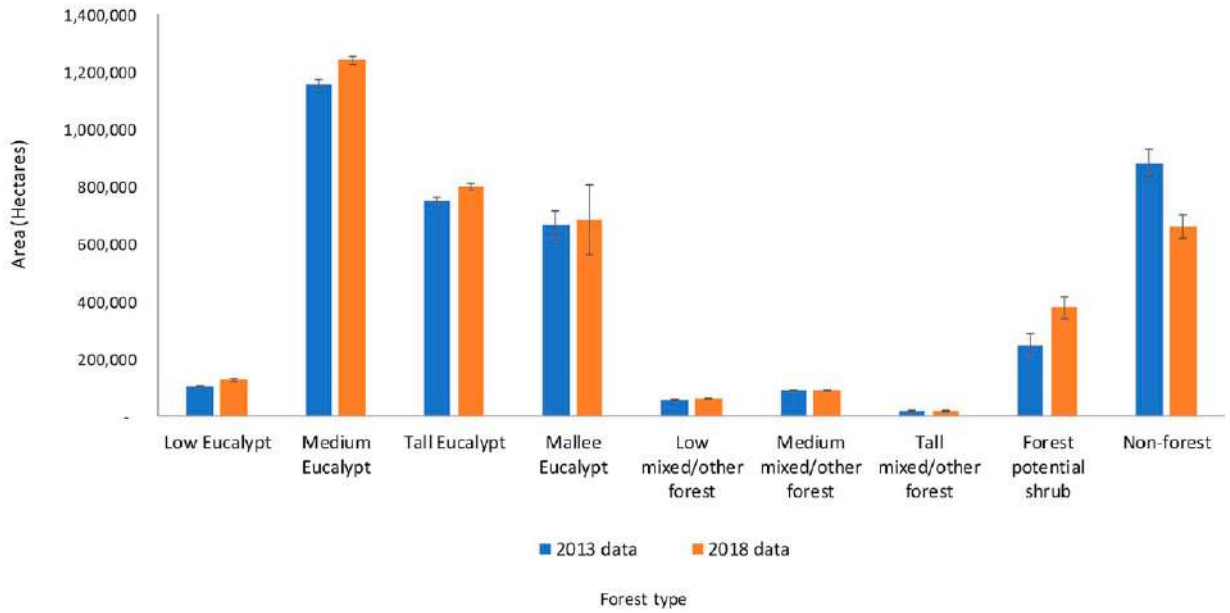


Figure 15. Area of parks and reserves by forest type, 2013 and 2018
(Data source: DELWP 2018)

Criterion 1: Conservation of biological diversity

	Status				Trend	Data Quality
	UNKNOWN	POOR	FAIR	GOOD		
1.1c Area of forest type by growth stage distribution in protected zones **Data Custodian** DELWP, Parks Victoria	○	○	●	○	↗	DATA QUALITY Fair

The protection of biodiversity to sustain forest ecosystems and the species that inhabit them is fundamental to Victoria's approach to forest conservation. It is also a key objective of sustainable forest management.

The management of forests in Australia is guided by the 1992 National Forest Policy Statement (NFPS): a set of broad goals agreed to by Commonwealth, state and territory governments. The goals undertake to embed the concept of ecologically sustainable development. The aim is to manage Australia's native forests to conserve biological diversity, heritage, and cultural values, while at the same time developing an internationally competitive forest products industry based on native forests that are managed sustainably.

Major elements of the NFPS include a commitment to the development of a comprehensive, adequate and representative (CAR) reserve system, and implementation of strategies to protect old-growth forests and wilderness as part of the reserve system. The CAR reserve system is based on three principles:

- including the full range of vegetation communities (comprehensive)
- ensuring the level of reservation is large enough to maintain species diversity (adequate)
- conserving the diversity within each vegetation community, including genetic diversity (representative).

The system identifies the forested areas based on 'JANIS'[61] criteria to protect nature conservation reserves.[62]

The CAR reserve system contains two categories, formal and informal reserves, defined as follows:

- formal reserve: including Crown land formally reserved where environmental protection that provides legislated prohibition on timber harvesting is required – such as forest parks, national parks, state parks, nature conservation reserve and other conservation reserve
- informal reserve: including public land where public authorities are assigned to achieve conservation values while excluding timber harvesting.

The proportion of Victorian land assigned formal protection status has risen from less than 1% in the 1950s to 17% in 2016 (Figure 16). Between the late 1970s and early 1990s, the addition of more than 3,000 protected areas significantly increased the total formal protected area. Much of this increase was due to changes to the *National Parks Act 1975* and *Crown Land (Reserves) Act 1978*.

Between 2000 and 2014, the total area of parks and conservation reserves increased by around 400,000 hectares. Since 2014, additional land parcels have been added as a result of improvements and clarifications to Crown land records, changes of the on-ground manager (for example, land has moved from Parks Victoria to Water Authority/VicTrack[63]) and the purchasing and reserving of land.

61. Australian Department of Agriculture and Water Resources, 'Protecting our forest environment', Canberra, Australia http://www.agriculture.gov.au/forestry/policies/rfa/about/protecting-environment Accessed 3 December 2018.
62. Australian Department of Agriculture and Water Resources, 'Conservation of Australia's forests', Canberra, Australia http://www.agriculture.gov.au/forestry/australias-forests/forest-mgnt/conservation Accessed 3 December 2018.
63. VicTrack is a state-owned enterprise which owns all railway and tram lines.

Details of significant additions to reserves are described in Table 10. (Note that the addition of land to Great Otway National Park was not captured in the 'land assigned formal protection status' prior to its surrender to the Crown. The assignment of 6,367 hectares in 2017 was not included in the Parks Victoria (PV) managed estate reported in annual reports and budget papers tabled in Victorian Parliament.)

There was a net addition of approximately 5,800 hectares to the area that PV manages between July 2014 and July 2017.

Table 10. Significant additions to formal protection area, July 2014 to July 2017

Significant additions	Area (ha)
Belfast Coastal Reserve – addition of tidal areas	34
Red Gum Swamp, Jallumba Wildlife Reserve – previously freehold	73
Great Otway NP – addition of Anglesea Heath (ALCOA lease)	6,367
Truganina South Nature Conservation Reserve – previously freehold	38
Western Grassland Nature Conservation Reserve – purchased freehold	1,200
Mount Ridley Nature Conservation Reserve – previously freehold	44
Plenty Gorge Parklands Park (addition) – purchased freehold	42
Woowookarung Regional Park – previously Reserved Forest (previously known as Canadian Regional Park)	640

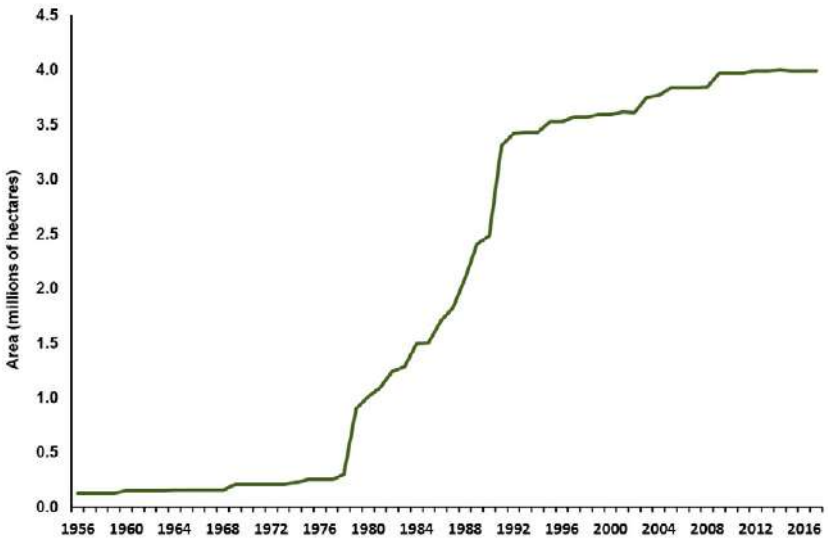


Figure 16. Change in Victoria's formal protected area (parks and conservation reserves), 1956–2016 (Data source: Parks Victoria 2018)

IUCN Protected Areas

The International Union for Conservation of Nature (IUCN) is the global authority on the status of the natural world. IUCN defines a protected area as 'a clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values'.[64]

Australia compares favourably against other countries with respect to forest conservation.[65] Under *Australia's Strategy for the National Reserves System 2009–2030*, all state and territory governments have agreed to adopt IUCN international standards for defining and reporting areas of protected area management.

All Victorian formal reserves are assigned an IUCN protected area category based on protection status and primary land management. Victorian terrestrial IUCN protected areas are described in Figure 17. The IUCN assigned area categories may be refined occasionally. Informal reserves are not assigned an IUCN protected area category.

There was an increase of about 13% in IUCN protected areas overall between 2004 and 2016 (Table 11), indicating better protection of Victoria's forests.

Type V (protected landscape/seascape) and Type VI (protected area with sustainable use of natural resources) areas increased most, by more than 200% each. Type Ia (strict nature reserve) and Type III (natural monument or feature) areas increased gradually. (Type Ia area is protected for biodiversity and strictly controlled to avoid any intervention. Type III area is to protect a specific natural monument such as a cave.)

Significant changes have been made to the network of protected areas, including the expansion of Great Otway National Park, and additions to conservation parks and reserves (Table 10), more accurate GIS mapping, and clarifications and changes from on-ground managers.

64. The International Union for Conservation of Nature, 'About protected areas', Suva, Fiji https://www.iucn.org/theme/protected-areas/about Accessed 11 January 2019.
65. The International Union for Conservation of Nature, 'Australia', Suva, Fiji https://www.iucn.org/regions/oceania/get-involved/members/australia Accessed 11 January 2019.

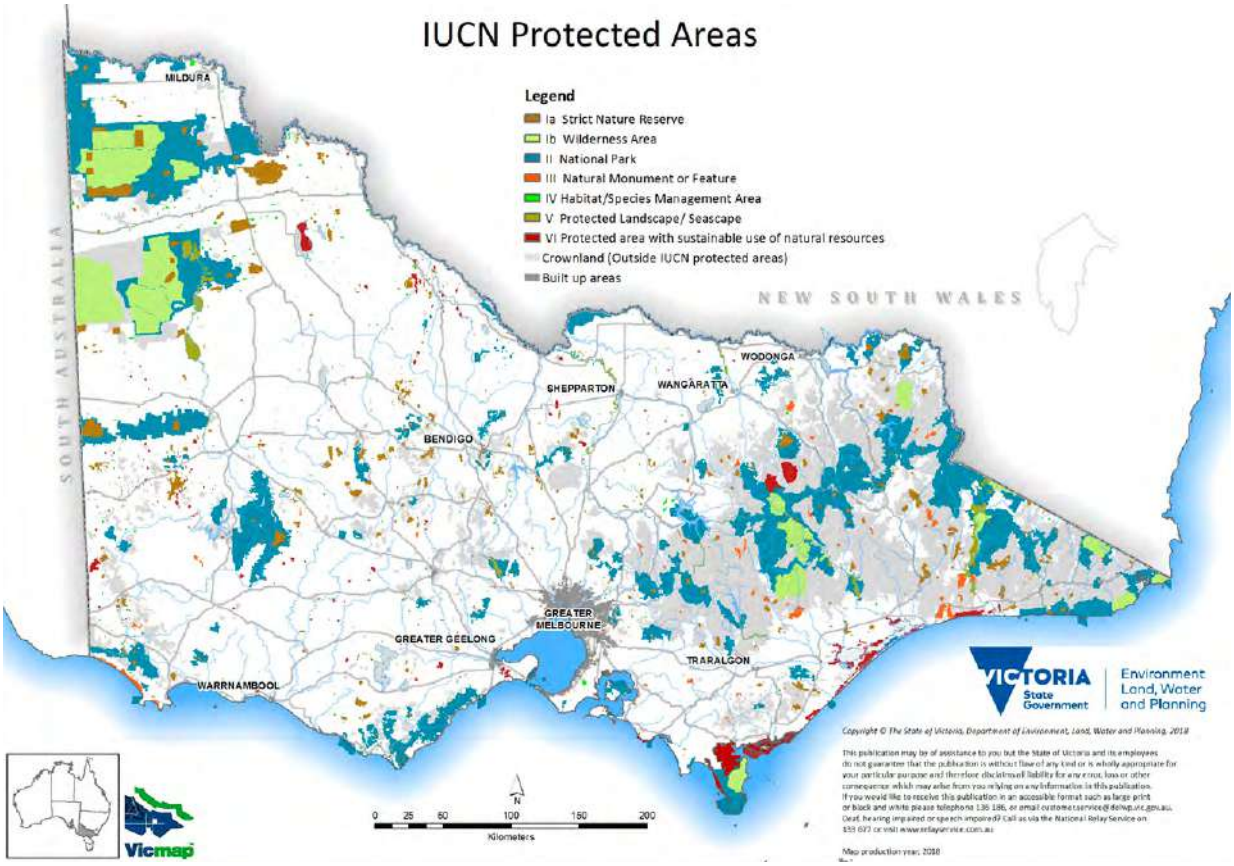


Figure 17. Victorian terrestrial IUCN protected areas, 2018
(Data source: DELWP 2018)

Table 11. Victorian protected areas by IUCN category and informal Special Protection Zone reserves, 2004–2016

Formal protection IUCN Category	Area (hectares)							Proportion of forest cover (%) (a)
	2004	2006	2008	2010	2012	2014	2016	
Ia	356,300	366,200	381,900	380,700	388,600	421,600	421,500	83.37
Ib	815,500	815,300	815,700	815,700	815,500	740,900	740,900	78.50
II	2,128,600	2,182,400	2,224,200	2,309,700	2,371,300	2,374,400	2,373,700	83.89
III	55,000	48,900	49,500	51,300	78,000	75,500	75,600	73.68
IV	48,000	44,900	43,800	43,700	47,400	47,500	47,500	54.74
V	58,500	57,800	56,600	49,200	26,800	135,200	135,200	58.58
VI	91,100	89,200	94,500	85,100	130,600	208,300	206,200	23.13
All IUCN Protected Area	3,553,000	3,604,700	3,666,200	3,735,400	3,858,200	4,003,400	4,000,600	
Informal protection area								
Special protection zone (SPZ)	828,100	828,100	783,100	783,100	753,100	747,300	761,100	97.19
Total	**4,381,100**	**4,432,800**	**4,449,300**	**4,518,500**	**4,611,300**	**4,750,700**	**4,761,700**	**81.44**

**Proportion of forest cover refers to the proportion of this reserve class under forest*
(Data source: DELWP 2018)

Currently, there is little evidence on how well these classifications protect species. Detailed research is necessary to identify the benefits of different IUCN protected areas for target species, such as those on the IUCN Red List of Threatened Species.

A viability analysis has been completed for the ash-type forests of the Central Highlands of Victoria for the threatened species, Leadbeater's possum *(Gymnobelideus leadbeateri)*. Leadbeater's possum is listed on the IUCN Red List, and listed as threatened in the FFG Act 1988. The viability analysis indicates that the entire mountain ash resource needs to be protected from timber harvesting to achieve sustainable populations of Leadbeater's possum, and other species of possums, gliders and large forest owls in the medium term.[66,67]

To reflect this, DELWP established a 200-metre-radius timber-harvesting exclusion zone (THEZ) to gauge the impact of exclusion zones on the conservation of Leadbeater's possum.[68] Two years of intensive surveying found that the addition of 4,046 hectares (through an increase of the special protection zone in the Central Highlands from 30,520 to 34,566 hectares) resulted in the protection of 436 additional Leadbeater's possum colonies.[69] Nonetheless, the population in the protected area will be at a high risk of extinction if a single bushfire event is factored into the analysis.[70]

66. Todd CR, Lindenmayer DB, Stamation K, Acevedo-Catteneo S, Smih S, Lumsden LF 2016, 'Assessing reserve effectiveness: application to a threatened species in a dynamic fire prone forest landscape', Ecological Modelling, 338, pp. 90-100.
67. Taylor C, Cadenhead N, Lindenmayer DB, Wintle BA 2017, 'Improving the design of a conservation reserve for a critically endangered species', PLOS One, 12, e0169629.
68. DELWP 2017 'A review of the effectiveness and impact of establishing timber harvesting exclusion zones around Leadbeater's Possum colonies', Melbourne, Victoria https://www.wildlife.vic.gov.au/__data/assets/pdf_file/0033/73869/eadbeaters-Possum-Review-Report-July-2017.pdf Accessed 4 December 2018.
69. Nelson JL, Durkin LK, Cripps JK, Scroggie MP, Bryant DB, Macak PV, Lumsden LF 2017, 'Targeted surveys to improve Leadbeater's Possum conservation', Arthur Rylah Institute for Environmental Research Technical Report Series No. 278, Department of Environment, Land, Water and Planning, Heidelberg, Victoria https://www.wildlife.vic.gov.au/__data/assets/pdf_file/0032/27896/Targeted-survey-report-2015_final-7Oct15r.pdf Accessed 4 December 2018.
70. Woinarski J 2017, 'Independent review report: assessment of the conservation benefit provided to Leadbeater's Possum by the establishment of timber harvesting exclusion zones', Charles Darwin University, Darwin, Northern Territory https://www.wildlife.vic.gov.au/__data/assets/pdf_file/0025/73870/Independent-Review-of-LBP-Review-Report-Conservation-Benefits-Analysis.pdf Accessed 4 December 2018.

	Status (UNKNOWN / POOR / FAIR / GOOD)	Trend	Data Quality
1.1d Fragmentation of native forest cover Data Custodian DELWP		?	DATA QUALITY Fair

Forest fragmentation is a metric to describe forest quality. It assumes that the highest-quality forests are at the centre, and that the larger the area, the more resilient the forest is to disturbances.[71,72,73] Forest loss and the deterioration of forest health via increasing fragmentation, pose significant threats to biodiversity, and endanger the sustainability of ecological goods and services from forested land.[74,75,76,77]

This indicator measures the loss of forest cover and the spatial configuration of that loss to show the level of fragmentation in Victoria's forests and the likely impacts on forest-dependent species.

Analysis of the satellite Landsat data captured in 2013 (Table 12 and Table 13) shows that on a state scale:

1. On average approximately 75% percent of Victoria's forest cover in each bioregion is classed as 'interior' (for example, core and non-fragmented forest) and around 13% as 'edge area', with boundaries between interior forest and non-forest landcover (Table 13). 25% of Victoria's total land area is interior forest, and about 4% is edge area (Table 12).
2. Bioregions with the highest proportion of interior forest are concentrated in Victoria's east. Main areas include the Australian Alps (91% interior forest), South East Corner (89% interior forest) and South Eastern Highlands (85% interior forest). Riverina is the most fragmented bioregion, and also has the highest proportion of forest patches (20%).
3. Except for the Riverina bioregion, the most fragmented areas are on private land within each bioregion (Figure 19). On average, about 85% of state forest (SF) and parks and reserves (PR) have interior areas. But on private land, the proportion of interior forest drops to one-third. Proportionally, the sum of 'edge', 'transitional' (deteriorating forest fragmentation from interior type to patch or edge) and 'patch' (small and isolated remnant vegetation) areas in private land was six times greater than in SF and PR.
4. In the South East Coastal Plain (SECP), PR appears more fragmented than SF; however, there is significantly more area of PR than SF. Moreover, a large area of SECP was transferred to PR when native-forest timber harvesting ceased in the Otway Ranges in the early 2000s.

A map of statewide forest fragmentation is provided in Figure 18. Due to differences in mapping methodology and improvements in satellite imaging resolution, it is not possible to compare this data with that of previous years. This makes it difficult to assess overall trends in forest fragmentation in different bioregions and for different forest types.

71. Forman RTT, Godron M 1986, 'Landscape ecology', John Wiley, New York, USA.
72. Turner MG 1989, 'Landscape ecology: the effect of pattern on process', Annual Review of Ecology and Systematics, 20, pp. 171-197.
73. Levin SA 1992, 'The problem of pattern and scale in ecology', Ecology, 73, pp. 1943-1967.Harris LD 1984, 'The fragmented forest. Island biogeography theory and the preservation of biotic diversity', University of Chicago Press, Chicago, Illinois, USA.
74. Lovejoy TE, Bierregaard RO, Rylands AB, Malcolm JR, Quintela CE, Harper LH, Brown KS, Powell AH, Powell GVN, Schubart HOR, Hays MB 1986, 'Edge and other effects of isolation on Amazon forest fragments' in ME Soulé, ed. Conservation biology: the science of scarcity and diversity, Sinauer Associates, Sunderland, Massachusetts, USA.
75. Bierregaard RO, Lovejoy TE, Kapos V, dos Santos AA, Hutchings RW 1992, 'The biological dynamics of tropical rainforest fragments', BioScience, 42, pp. 859-866.
76. Laurance WF, Laurance SG, Ferreira LV, Rankin-de Merona JM, Gascon C, Lovejoy TE 1997, 'Biomass collapse in Amazonian forest fragments', Science, 278, pp. 1117-1118.
77. Laurance WF, Laurance SG, Ferreira LV, Rankin-de Merona JM, Gascon C, Lovejoy TE 1997, 'Biomass collapse in Amazonian forest fragments', Science, 278, pp. 1117-1118.

Table 12. Victorian forest fragmentation, 2018

Fragmentation category	2018 (ha)	% of total state area
Non-forest	15,053,953	66.24
Patch	223,483	0.98
Transitional	273,889	1.21
Edge	979,423	4.31
Perforated	436,091	1.92
Interior	5,772,863	25.40
Undetermined	1,455	0.01
Total	**22,741,158**	**100**

(Data source: DELWP 2018)

Table 13. Victorian forest fragmentation, 2018, as % of total forest area by bioregion

Bioregion	Forest Cover Fragmentation category (% of bioregion total area)				
	Patch	Transitional	Edge	Perforated	Interior
Australian Alps	0.2	0.5	5.0	3.5	90.8
Flinders	1.5	3.6	15.0	6.4	73.5
Murray–Darling Depression	4.4	5.0	16.4	10.1	64.2
Naracoorte Coastal Plain	1.9	3.8	18.8	8.7	66.7
NSW South Western Slopes	5.4	6.7	22.4	6.8	58.7
Riverina	20.1	16.5	28.0	13.5	21.9
South East Coastal Plain	8.1	9.0	26.1	8.6	48.1
South East Corner	0.5	1.1	6.5	2.8	89.1
South Eastern Highlands	1.2	1.8	8.3	3.2	85.4
Victorian Midlands	5.2	6.5	21.6	7.8	58.8
Victorian Volcanic Plain	10.8	9.1	24.0	6.6	49.4
Total	**2.9**	**3.6**	**12.7**	**5.7**	**75.1**

(Data source: DELWP 2018)

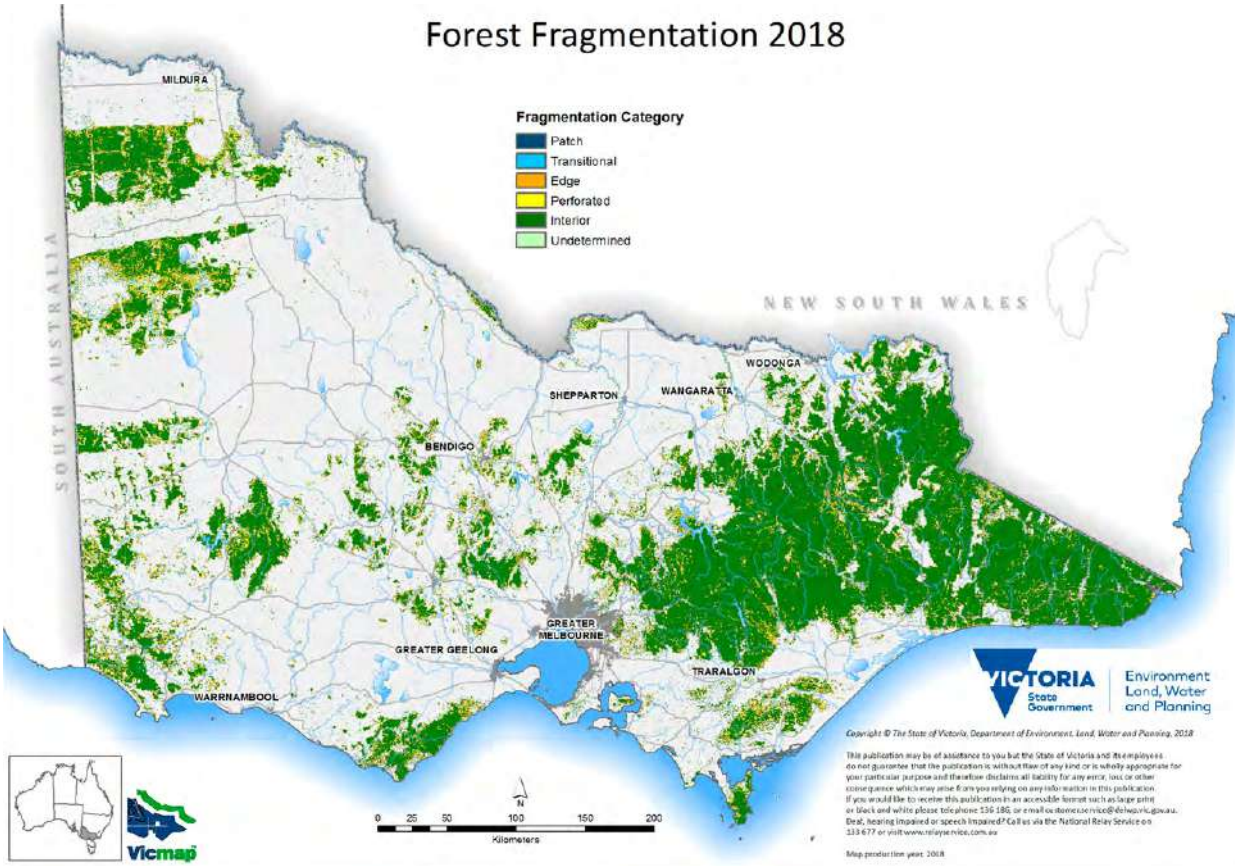


Figure 18. Forest fragmentation in Victoria, 2018
(Data source: DELWP 2018)

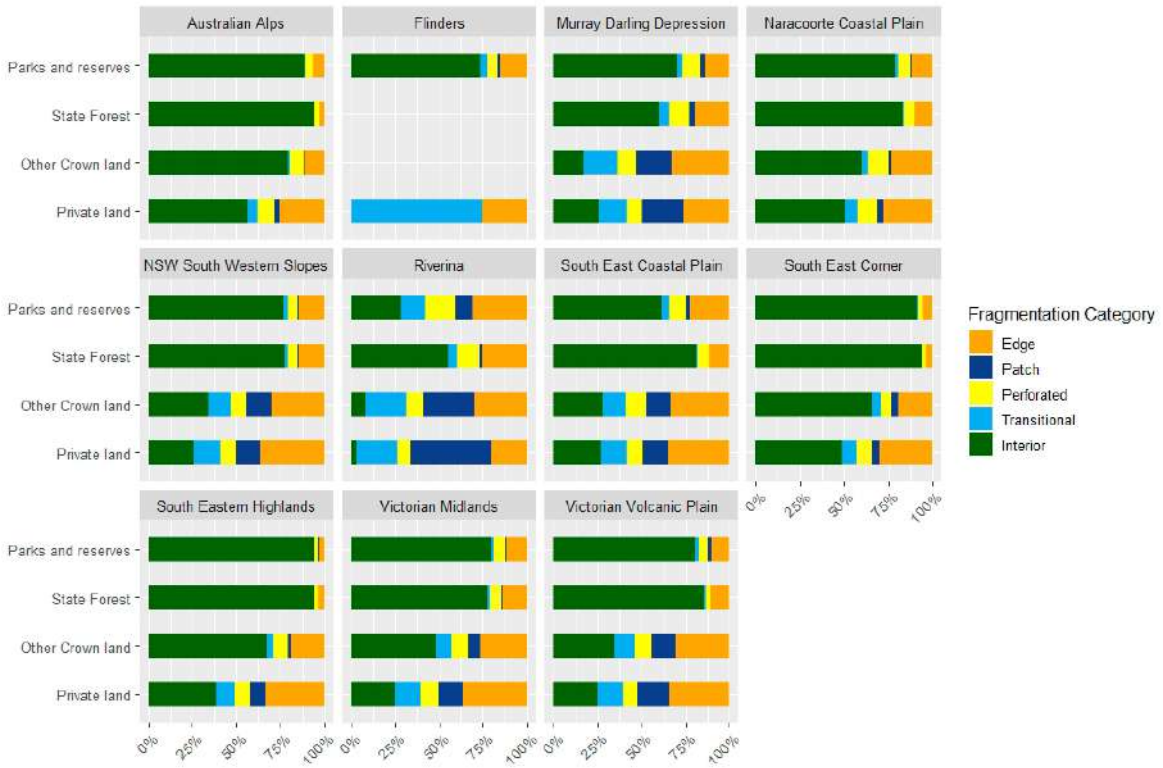


Figure 19. Relative proportion of forest fragmentation categories by region and land type, based on % of total cover, 2018
(Data source: DELWP 2018)

Long-term monitoring and detailed spatial research have been conducted at a regional scale to investigate the effects of fragmentation on native forests and biodiversity.

One example is the research conducted on mountain ash forests. These are fragmented by roads and logging coupes,[78] which work as barriers to the movement of animals such as Leadbeater's possum.[79,80]

It has also been found that these barriers promote the rate of collapse of large old trees, which are key habitats for cavity-dependent fauna.[81,82] This disturbance is intensifying with the addition of more logging coupes under the Timber Release Plan.[83,84,85]

To compensate for this, DELWP Arthur Rylah Institute (ARI) surveyed 176 sites between September 2015 and April 2016 for presence of Leadbeater's possum in the Central Highlands.[86] Fifty-four of those sites were in areas designated for timber harvesting under the 2013–16 Timber Release Plan; Leadbeater's possum was detected in 38 of the 54. THEZs were subsequently established in these areas to protect the species.

Intensification of forest fragmentation has been observed in other parts of Victoria, such as in the box-ironbark forests in Central Victoria, where greater abundance and widespread distribution of generalist egg predators of many bird species were observed, including the Regent honeyeater *(Anthochaera phrygia)*.[87] State-scale assessments of threatened species need to be conducted, and intense management should be taken in areas where mitigation actions are required.

78. Lindenmayer DB, Blair D, McBurney L, Banks S 2015, 'Mountain Ash: Fire, logging and the future of Victoria's giant forests', CSIRO Publishing, Melbourne, Victoria.
79. Blair D, McBurney L, Lindenmayer DB, Banks S, Blanchard W 2017, 'The Leadbeater's Possum review', The Australian National University, Canberra, Australia.
80. Blair D, McBurney L, Lindenmayer DB 2018, 'Failing to conserve Leadbeater's Possum and its Mountain Ash forest habitat', Australian Zoologist, 39(3), pp. 442-448.
81. Lindenmayer DB, Blanchard W, Blair D, McBurney L 2018, 'The road to oblivion – quantifying pathways in the decline of large old trees', Forest Ecology and Management, 430, pp. 259-264.
82. Lindenmayer DB, Blanchard W, Blair D, McBurney L, Stein J, Banks SC 2018, 'Empirical relationships between tree fall and landscape-level amounts of logging and fire', PLOS One, 13(2), e0193132.
83. VicForests, 'Timber release plan', Melbourne, Victoria http://www.vicforests.com.au/planning-1/timber-release-plan-1/timber-release-plan Accessed 4 December 2018.
84. Lindenmayer DB, Blanchard W, Blair D, McBurney L 2018, 'The road to oblivion – quantifying pathways in the decline of large old trees', Forest Ecology and Management, 430, pp. 259-264.
85. Lindenmayer DB, Blanchard W, Blair D, McBurney L, Stein J, Banks SC 2018, 'Empirical relationships between tree fall and landscape-level amounts of logging and fire', PLOS One, 13(2), e0193132.
86. Nelson JL, Durkin LK, Cripps JK, Scroggie MP, Bryant DB, Macak PV, Lumsden LF 2017, 'Targeted surveys to improve Leadbeater's Possum conservation', Arthur Rylah Institute for Environmental Research Technical Report Series No. 278, Department of Environment, Land, Water and Planning, Heidelberg, Victoria https://www.wildlife.vic.gov.au/__data/assets/pdf_file/0032/27896/Targeted-survey-report-2015_final-7Oct15r.pdf Accessed 4 December 2018.
87. Meney B, Cunningham S, Weston MA, Whisson DA 2018, 'Woodland birds and rural towns: artificial clutch survival in fragmented Box-Ironbark forests', The Royal Society of Victoria, 130, pp. 7-17.

	Status (UNKNOWN / POOR / FAIR / GOOD)	Trend	Data Quality
1.2a The status of forest-dependent species at risk of not maintaining viable breeding populations, as determined by legislation or scientific assessment. **Data Custodian** DELWP	○ ○ ● ○	↘	DATA QUALITY Good

Identifying the conservation status of forest-dependent species at risk is an important initial step to developing action plans for successful protection. Current conditions of rare and threatened species are useful indicators for recognising species particularly at risk and the state of the forest communities. Changes in conservation status can be used to assess the effectiveness of biodiversity management and species recovery programs.

This indicator is reported based on information from DELWP's Threatened Species Advisory List, and the threatened species and communities listed under the FFG Act.

In 2018, Victoria signed the Intergovernmental Memorandum of Understanding Agreement on a Common Assessment Method for Listing of Threatened Species and Threatened Ecological Communities (CAM MoU).[88] The CAM MoU requires signatories to adopt the IUCN Red List categories and criteria through legislative reform, to establish a single operational list of threatened species in each jurisdiction, and to collaborate in the assessment and periodic review of the conservation status of native species in Australia.

The IUCN Red List of Threatened Species provides taxonomic, conservation status and distribution information on plants, fungi and animals that have been globally evaluated using the IUCN Red List categories and criteria.[89] The system is designed to determine the relative risk of extinction, with the main purpose to catalogue and highlight those plants, fungi and animals that are facing higher risk of global extinction. Following assessment, plants, fungi and animals are listed as either: 'Critically Endangered', 'Endangered', 'Vulnerable', 'Near Threatened', 'Least Concern', 'Data Deficient', 'Not Evaluated', 'Extinct' or 'Extinct in the Wild'.[90]

DELWP is currently working on a project to reassess all listed Victorian rare and/or threatened species, according to the IUCN Red List categories and criteria, including species listed in the FFG Act Threatened List and the DELWP advisory list. In addition to yielding a single, comprehensive list of Victorian threatened species, this work will also provide the baseline for key targets in *Biodiversity 2037*. This new list will not be comparable to the current DELWP Advisory List, but will instead create a new baseline for trend reporting. An update on this new, comprehensive Victorian threatened species list will be made available in 2019.

At the time of writing, DELWP was also leading a review process for the FFG Act. This review process included public consultation to inform the development of reforms to the FFG Act. The Flora and Fauna Guarantee Amendment Bill was introduced into Victorian Parliament on 23 May 2018. The Bill was debated in the Legislative Assembly and passed without amendment. It was subsequently introduced into the Legislative Council, but was not debated before the final scheduled parliamentary sitting day of the 58th Parliament of Victoria.

88. Australian Department of the Environment and Energy 2015, 'Intergovernmental Memorandum of Understanding. Agreement on a common assessment method for listing of threatened species and threatened ecological communities', Canberra, Australia https://www.environment.gov.au/system/files/resources/36ece4ab-82dc-4de9-aac6-9cc54bd7a820/files/mou-cam.docx Accessed 4 December 2018.
89. International Union for Conservation of Nature 2000, 'IUCN Red List categories and criteria', Gland, Switzerland https://www.iucnredlist.org/resources/categories-and-criteria Accessed 4 December 2018.
90. International Union for Conservation of Nature Standards and Petitions Subcommittee 2014, 'Guidelines for using the IUCN Red List categories and criteria. Version 11', Gland, Switzerland https://cmsdata.iucn.org/downloads/redlistguidelines.pdf Accessed 4 December 2018.

Since 2013, the only species group to be updated is vascular plants, which occurred in 2014.[91] (However, assessing changes in plant species on DELWP's advisory list can be difficult. Frequent changes in botanical nomenclature means that apparently new plants may simply have been renamed.) The status of the 461 species listed in 2013 has not changed. Vascular plants represent by far the greatest proportion of these species (Figure 20 and Table 14). This might be due to greater knowledge and awareness of vascular plants within the scientific community, and their relative ease of detection.

Since 2007–08, no changes have been observed in the number of rare or threatened amphibians. Conservation status of mammals is a concern, with approximately 40% of the species on the list close to extinct or already extinct in the wild. This suggests a deteriorating trend in some forest species groups at risk, though fair strategies are in place to monitor the current status.

Deterioration in the overall status of species has been observed in the Central Highlands. Between 1990 and 2015, the numbers of species listed under the IUCN Red List categories in the Central Highlands increased from 16 to 44. The increasing number of listed species in threatened species categories is also described in other studies.[92,93]

As recommended in 1.1c Area of forest type by growth stage distribution in protected zones, results from viability analyses for key threatened forest-dependent taxa are important to adjust current management strategies to mitigate the risks of not being able to maintain viable breeding populations.

91. Department of Environment and Primary Industries 2014, 'Advisory list of rare or threatened plants in Victoria', Melbourne, Victoria. https://www.environment.vic.gov.au/__data/assets/pdf_file/0021/50448/Advisory-List-of-Rare-or-Threatened-Plants-in-Victoria-2014.pdf Accessed 11 January 2019.
92. Keith H, Vardon M, Stein JA, Stein JL, Lindenmayer DB 2017, 'Ecosystem accounts define explicit and spatial trade-offs for managing natural resources', Nature Ecology and Evolution, 1, pp. 1683-1692.
93. Keith H, Vardon M, Stein JA, Stein JL, Lindenmayer DB 2017, 'Experimental ecosystem accounts for the Central Highlands of Victoria: Summary Report', The Australian National University and the Threatened Species Recovery Hub, Canberra, Australia.

Table 14. Number of forest-dependent species by conservation status, 2018

Species group	Extinct in the wild	Extinct	Regionally extinct	Critically endangered	Endangered	Vulnerable	Near threatened	Data deficient	Total
Amphibians				7	3	2		3	15
Birds				4	15	17	15		51
Fish				2		3	1		6
Invertebrates				5	7	12	1	9	34
Mammals	1	8	9	2	7	6	14	2	49
Reptiles				5	7	8	7		27
Vascular plants					4	10			14
Other flora					92	165	6	1	264
Total	**1**	**8**	**9**	**25**	**135**	**223**	**44**	**15**	**460**

(Data source: DELWP 2018)

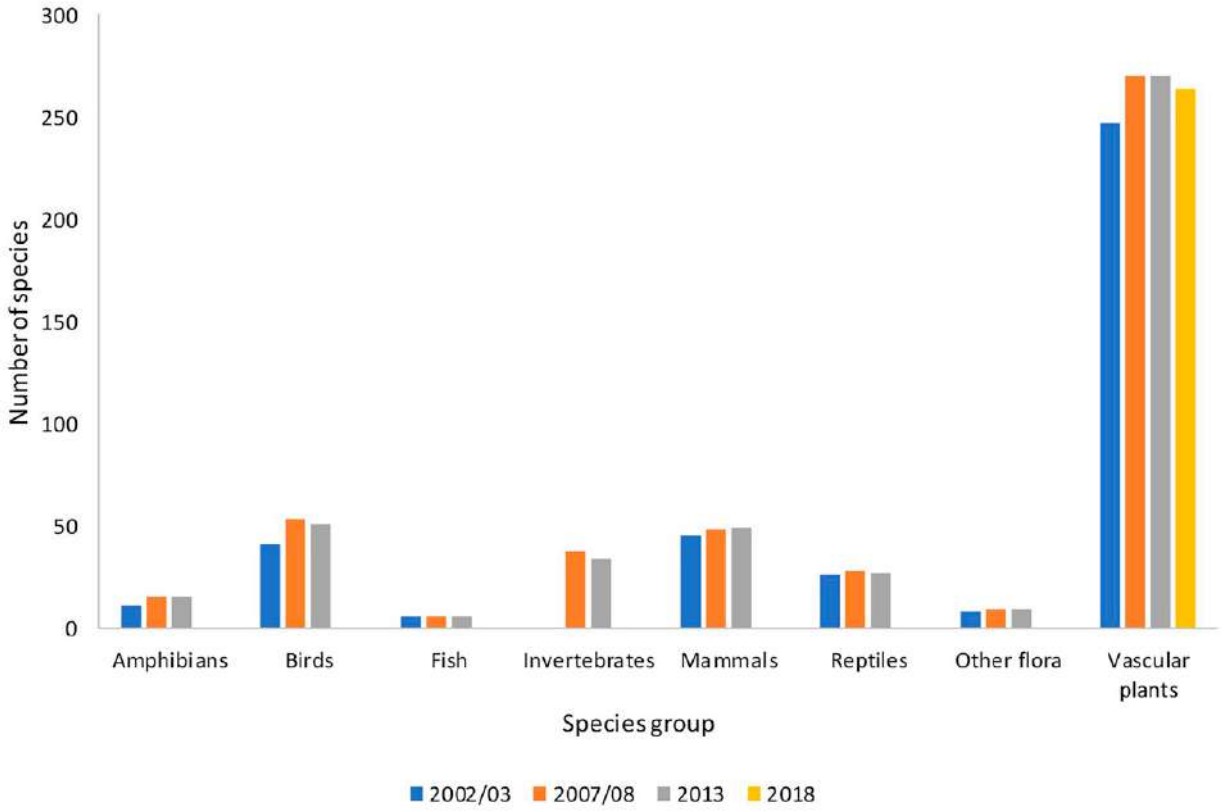


Figure 20. Change in numbers of rare or threatened species on the advisory list, by reporting period (Data source: DELWP 2018)

The Victorian Environmental Assessment Council (VEAC) is responsible for conducting investigations that are requested by the Victorian Government relating to the protection and ecologically sustainable management of the environment and natural resources of public land.

VEAC's 2017 'Conservation values of state forests: assessment report' focuses on the state forests in the Central Highlands, North East Gippsland and East Gippsland regions, where most commercial native-timber harvesting is in place, to identify forest-dependent species.[94] An identification process was conducted by a group of expert biologists convened by DELWP. Of 79 forest-dependent species identified, 35 were selected that could be adversely affected by native-timber harvesting. Of the 79 species, 28 are listed as critically endangered, endangered, or vulnerable in the *Environment Protection and Biodiversity Conservation Act 1999*, 54 are listed as a threatened tax on under the FFG Act (see Appendix 2 in the VEAC report). Although a time-series trend analysis and status assessment were not conducted, this information is useful, as it provides a specific list of forest-dependent species in areas where most commercial native-timber harvesting has taken place.

The list of forest-dependent species used for this analysis was developed with DELWP expert opinion and is consistent with previous SoF reports. However, as the list in Table 14 has not been published and differs from other lists (such as that published in the VEAC report), there may be some ambiguities in future analyses. Care should be taken to avoid the inadvertent omission of species that require critical attention. A formal and agreed list of forest-dependent species would assist the consistency and transparency of this analysis.

94. VEAC 2017, 'Conservation values of state forests: assessment report', Melbourne, Victoria http://www.veac.vic.gov.au/documents/Complete%20report%20for%20web%20page.pdf Accessed 3 December 2018.

Criterion 1: Conservation of biological diversity

	Status UNKNOWN	POOR	FAIR	GOOD	Trend	Data Quality
1.2b Area of habitat available for forest-dependent indicator species **Data Custodian** DELWP	○	○	●	○	?	DATA QUALITY Poor

This indicator aims to provide information on the availability of habitats for indicator species. While the presence of a compatible habitat is not necessarily an indicator for the subsistence of a species, habitat information can inform decision-making for forest management and protection.

A broad-scale (statewide) assessment of a habitat relies on surrogate indicators to show habitat potential. Examples of indicators are deadwood volumes – both standing and on-ground debris – and the presence of large trees that have a high potential of bearing hollows. This data is of greatest use when trends can be observed through systematic and on-going assessment. The VFMP is set up to monitor such trends, but trend data will only be available from 2020, by which time an appropriate sample of plots will have been remeasured.

The data presented here represents a complete, single assessment of the VFMP plot network collected over five years. This builds on the 2013 data, which only represented two years of data. Consequently, the results presented here vary greatly from those in 2013. Confidence in the new dataset is higher, as it is more comprehensive and complete.

Dead standing trees and coarse woody debris (CWD) are important ecological features. They provide shelter and protection for birds and arboreal mammals. They also provide habitat and a microclimate for insects and lizards, which are critical components of the food chain.

The volume of CWD is generally proportional to the biomass production potential of a bioregion. That is, the relationship of CWD to biomass should be linear. In addition, fire and fuel reduction burns reduce debris loads, which may have implications for habitat and ecosystem resilience. The health of ecosystems in relation to fire is monitored through DELWP's Ecosystem Resilience project. Please see the case study section of webpage of the Commissioner of the Environmental Sustainability (www.ces.vic.gov.au).

The volume of CWD and dead tree per bioregion in Figure 21 demonstrates that Australian Alps bioregion has the highest volume and Murray Darling Depression bioregion had the lowest volume.

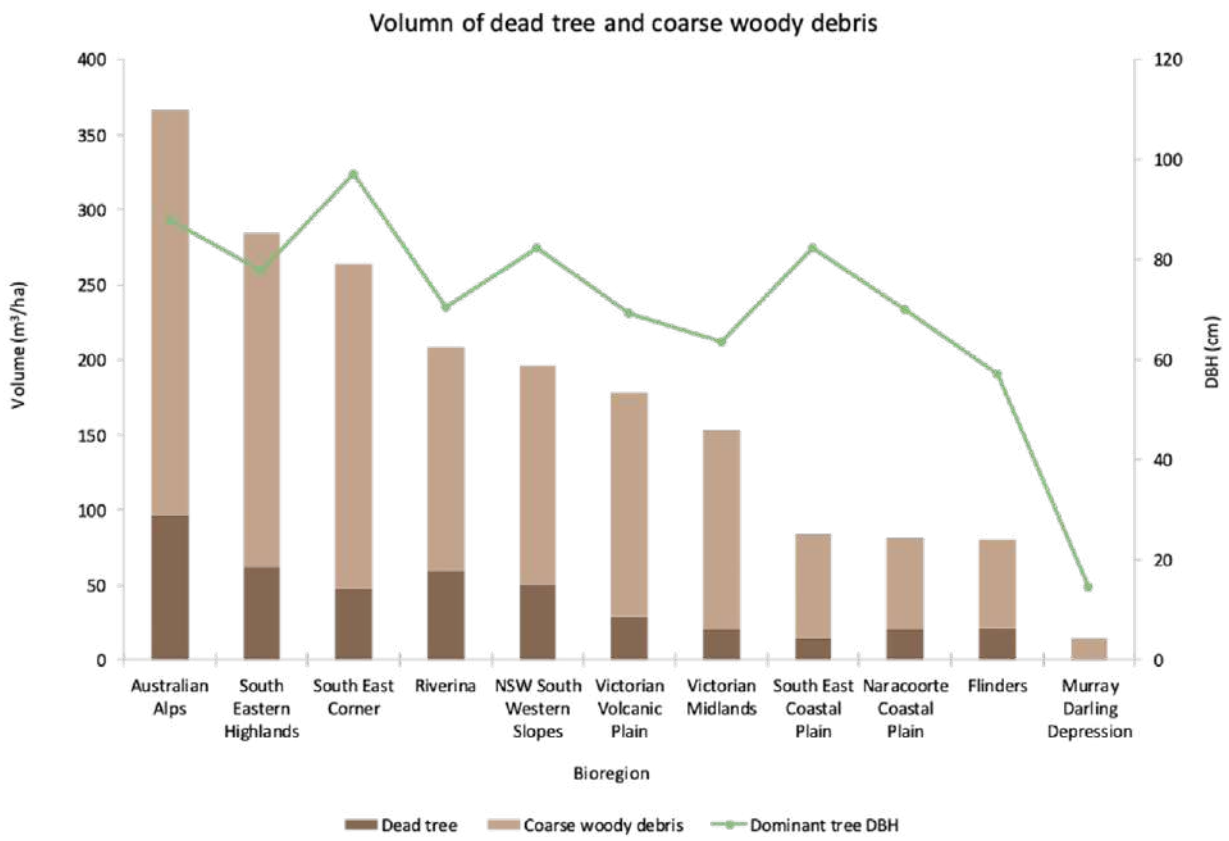


Figure 21. Volume of dead tree and coarse woody debris (left y-axis) and dominant tree's diameter at breast height (DBH: 1.5m) at (right y-axis), by bioregion.
(Data source: DELWP 2018)

Habitats can also be classified based on the relative abundance of plant functional types. Figure 22 shows the proportion of plant growth forms per bioregion. 'Tree' indicates large tree species capable of growing over 30m tall. Tall eucalypt forests of the Australian Alps, Southeast Highlands and Southeast Corner all have a similar proportion of tall tree, shrub and herb layers, and are the most complex Victorian ecosystems.

The Murray–Darling Depression, and to a lesser extent the Victorian Midlands, are the dryer areas of the state, dominated by mallee-type vegetation, which is characterised by smaller trees and shrubs that produce proportionally less deadwood/CWD volumes.

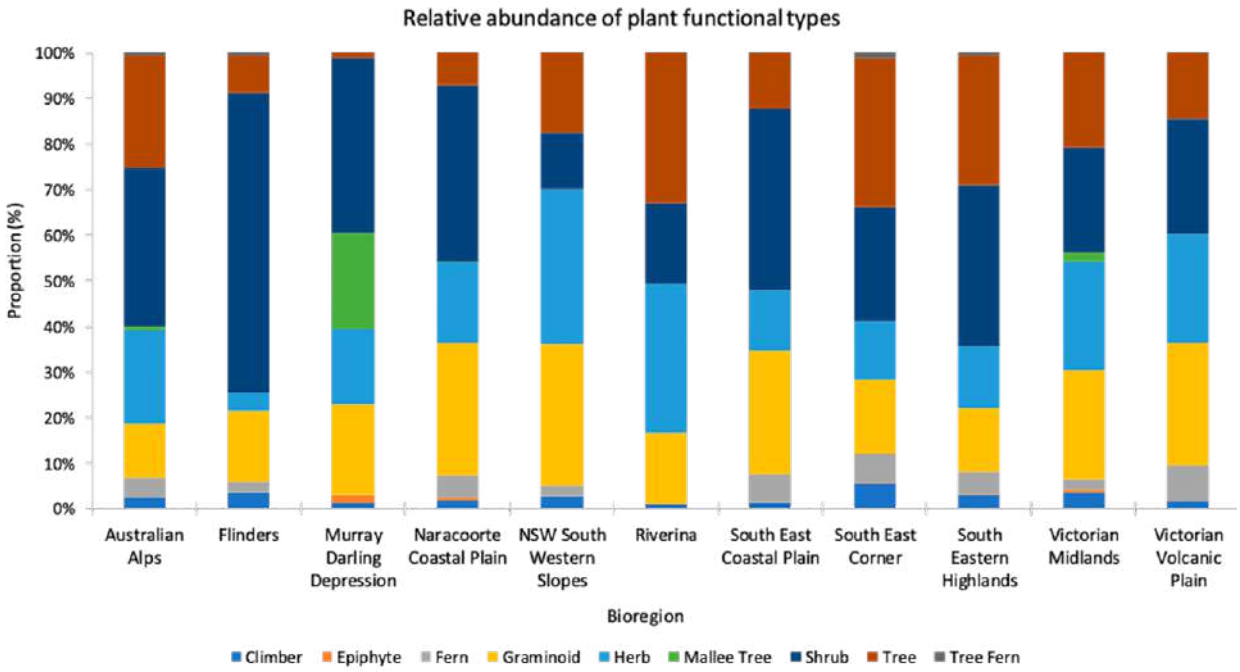


Figure 22. Relative abundance of plant functional types by bioregion (Data source: DELWP 2018)

Vascular plant species richness

To quantify species richness (diversity), the represented area must be defined. Using this approach, the diversity of species may be assessed on a per unit area basis. The VFMP measures plant species richness at three scales: at local site (plot) scale, between sites or habitats and at total landscape (bioregional) scale.

The Victorian Midlands, with relatively high fragmentation (see indicator 1.1d (Fragmentation of native forest cover)), has high overall values for both habitat and landscape-level richness (Figure 23). This is influenced by broad longitudinal extent, and the presence of the Grampians National Park, home to one-third of Victoria's flora.[95] Flinders (Wilsons Promontory), the smallest bioregion by area, has the lowest habitat and landscape-level richness. It is, however, the sixth-most diverse bioregion at site level.

95. Visit Victoria, 'Things to do: nature and wildlife', Melbourne, Victoria http://www.visitvictoria.com/Regions/Grampians/Things-to-do/Nature-and-wildlife Accessed 9 January 2019.

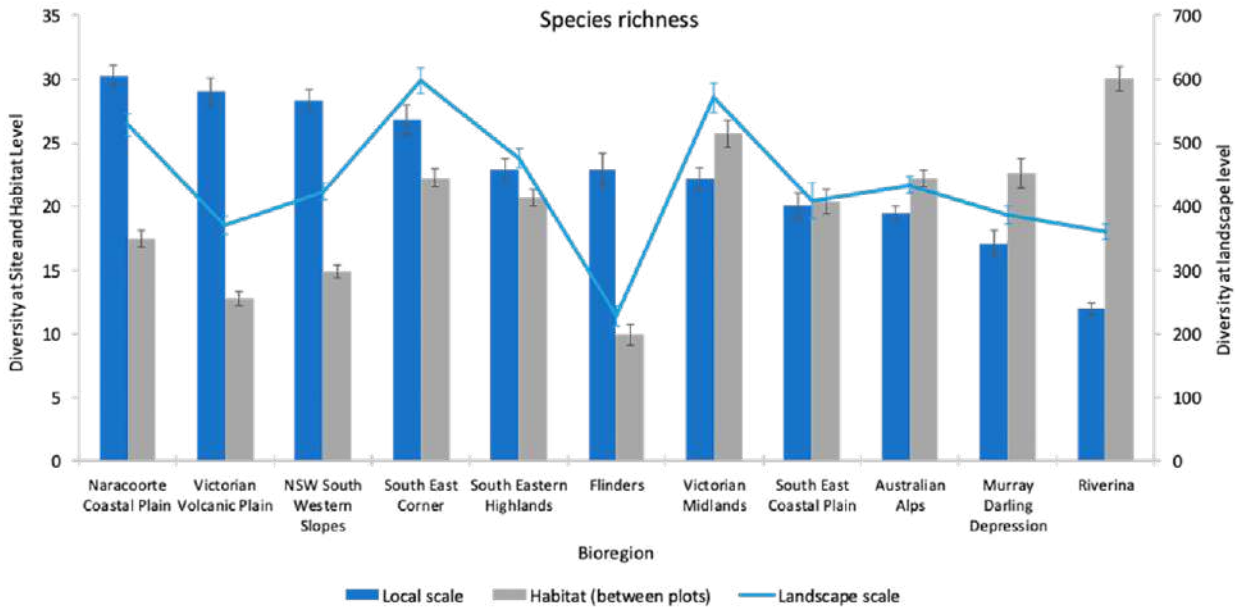


Figure 23. Species richness at local, habitat and landscape scales, by bioregion
Note: These metrics area defined as alpha, beta and gamma diversity, respectively. Local scale is calculated in each sample plot and habitat scale is calculated by comparing plots. Landscape scale diversity is calculated by comparing between bioregions.
(Data source: DELWP 2018)

The availability of a suitable habitat is fundamental to the survival of species and the maintenance of species diversity. The datasets presented provide some useful information in understanding the status of forests. However, some information is lacking to evaluate the status and estimate future conditions of available habitats for forest-dependent indicator species.

First, sufficient time-series data is not available. SoF 2003 and 2008 presented no data against this indicator, while the data in SoF 2013 is not comparable with the current dataset (as explained above). Therefore, the current dataset does not indicate whether species diversity has been maintained previously, or the likelihood of its future maintenance.

It is difficult to evaluate current status of this indicator, as there are no thresholds for habitat requirements at landscape-scale. This means that land managers are currently unable to determine relevant management actions based on this data alone. More targeted studies are required in some areas.

Although it is generally accepted that species diversity will increase with habitat availability, other pertinent factors for diversity are habitat connectivity, disease, disturbance, and competition and predation from other species.[96]

96. Department of Sustainability and Environment 2007, 'Criteria and indicators for sustainable forest management in Victoria: guidance document', Melbourne, Victoria https://www.forestsandreserves.vic.gov.au/__data/assets/pdf_file/0022/30865/Vic_Indicators_for_SFM_Guidance.pdf Accessed 15 January 2019.

Criterion 1: Conservation of biological diversity

	Status				Trend	Data Quality
	UNKNOWN	POOR	FAIR	GOOD		
1.2c Representative indicator species from a range of habitats monitored at scales relevant to regional forest management **Data Custodian** DELWP	○	○	○	●	?	DATA QUALITY Fair

The Victorian Biodiversity Atlas (VBA) is a repository for information on flora and fauna sightings across Victoria. The VBA database includes observations from dedicated monitoring programs implemented by government and non-government entities, as well as sightings from 'citizen scientists' (non-professionals who volunteer time and effort for scientific research). The VBA database helps managers understand where wildlife is now – and where it used to be. It is a key tool for the government's processes and programs that manage native species.

Specifically, it is used in conservation status assessments, and for the development of Habitat Distribution Models (HDMs) that inform strategic decision-making process, including Native Vegetation Removal Regulations.

During the reporting period for this document (2013–17), 813 fauna species were observed under 361 different projects or events (Table 16), distributed throughout the state (Figure 24). Most of the data (88%) comes from the South East Coastal Plain, South Eastern Highlands and Victorian Volcanic Plain bioregions.

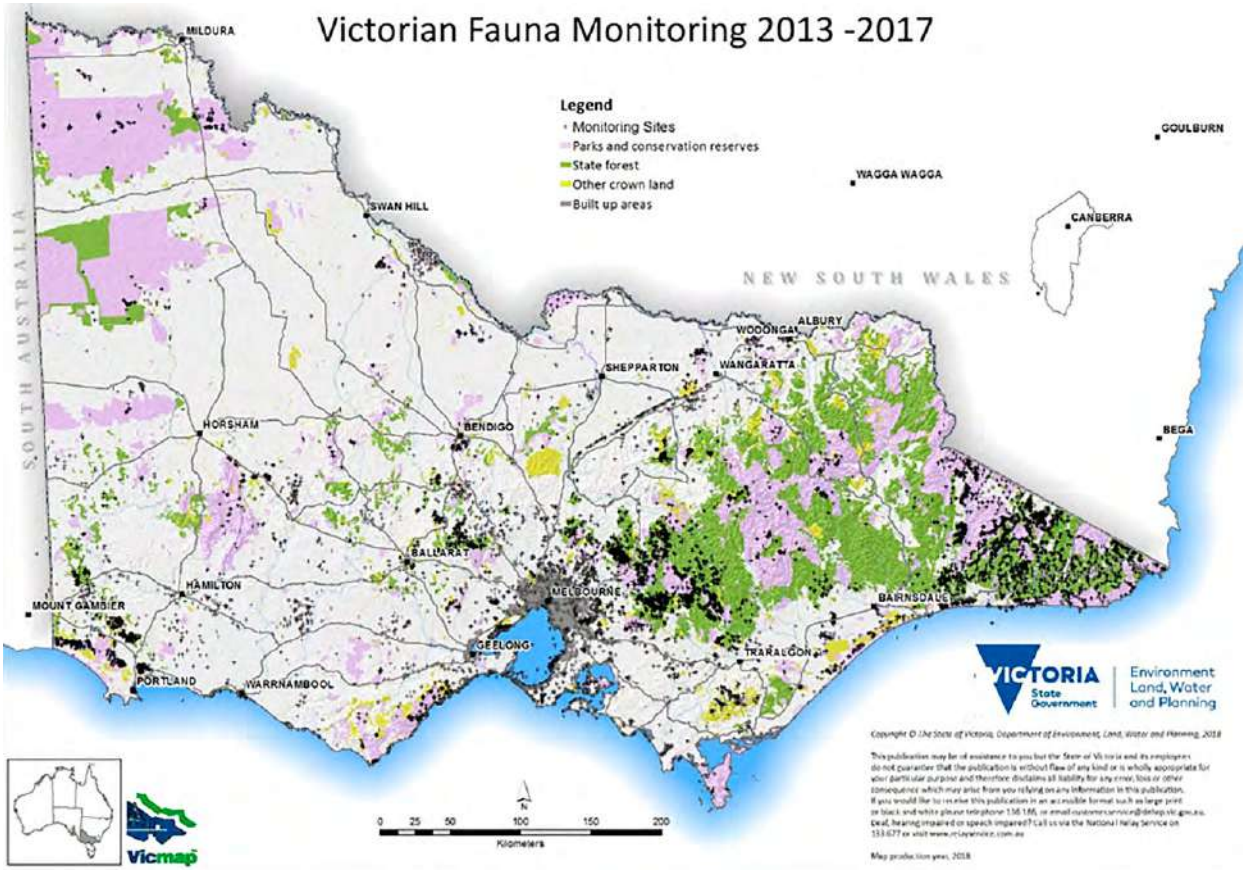


Figure 24. Victorian fauna monitoring sites, 2013–17 (Data source: DELWP 2018)

Of the 361 monitoring projects/events, 149 were conducted in national parks and conservation reserves, 81 in state forests, 143 in other Crown lands, and 240 in private land. Many projects/events crossed tenures, hence a total greater than 361. As each project had different timelines, it is difficult to compare with the data from previous reporting periods.

*Table 15. Species monitored, by taxonomy types (2013–17)**

Taxonomy Type	Number of species
Amphibians	113
Aquatic invertebrates	3
Fish	41
Invertebrates	35
Mammals	223
Mussels, decapod crustacea	4
Non-passerine birds	32
Passerine birds	190
Reptiles	158
Waders	133
Not-listed	57
Others	35

**'Total' column not included, as many monitoring projects last more than a year, meaning a duplication in counts each year.*
(Data source: DELWP 2018)

Credit: Faye Bedford

The most popular survey (project) type is infrared-sensor-triggered remote-camera surveillance. About 34% (n= 36,535 observations) of fauna monitoring data was collected using this technique. Other popular survey types include 'incidental', 'general observations', 'bat trap', and 'electrofishing (backpack) spotlighting on foot'.

Other recording types are 'identified from bat detector recording', 'museum specimen', and 'identified from hair or scats'. Observations are recorded with categories including 'seen', 'observation with supporting evidence', 'observation' and 'heard'. The most common observations recorded by the fauna monitoring program were Australian magpie *(Cracticus tibicen)*, superb fairy-wren *(Malurus cyaneus)*, red fox *(Vulpes vulpes)*, eastern grey kangaroo *(Macropus giganteus)*, black-tailed wallaby *(Wallabia bicolor)*, common brush-tailed possum *(Trichosurus vulpecula)*, European rabbit *(Oryctolagus cuniculus)*, eastern ring-tailed possum *(Pseudocheirus peregrinus)*, grey shrike-thrush *(Colluricincla harmonica)* and common froglet *(Crinia signifera)*.

*Table 16. Fauna monitoring projects by year (2013–17)**

Year	No. of projects
2013	138
2014	158
2015	125
2016	131
2017	88

**'Total' column not included, as many monitoring projects last more than a year, meaning a duplication in counts each year.*
(Data source: DELWP 2018)

Criterion 1: Conservation of biological diversity

	Status UNKNOWN	POOR	FAIR	GOOD	Trend	Data Quality
1.2d Degree of disturbance to native-forest species caused by invasive species **Data Custodian** DELWP	○	○	●	○	↘	DATA QUALITY Good

Invasive species are defined here as any species that are non-native to a particular Victorian ecosystem, and whose introduction and spread causes adverse sociocultural, economic and/or environmental impact. As invasive species often do not have natural predators in Victoria's ecosystems (outside of their native range), they can spread, reproduce and compete for habitat, causing severe ecological degradation. Understanding the degree of disturbance caused by invasive species can provide an indication of the effectiveness of management/control actions, and assist with evaluation of policy responses.

Invasive species on public land in Victoria are managed by a biosecurity approach.[97] This approach focuses on asset-based protection measures that aim to minimise the impact of invasive species on the environment, economy and society. The Invasive Plants and Animals Policy Framework aims to protect Victoria's native flora, fauna and primary producers from harm caused by invasive species. The VFMP collects data on the presence and abundance of weed species across the state, including monitoring the impacts of weeds on native-forest species for the Victorian public forest estate. This data was collected for the first time between 2011 and 2012, and reported in SoF 2013. However, as the 2013 report was based on only 50% of the total plots measured, the information available for this report cannot be compared with previous data. The data in this indicator could be significantly different from that of the previous report.

The data shows that the proportion of weed species to total species is highest in the New South Wales Southwestern Slopes bioregion (24%) and the Riverina bioregion (20%). As shown in 1.1d Fragmentation of native forest cover, the Riverina bioregion is the most highly fragmented bioregion and has the largest proportion of edge and patch areas.

Considering the cumulative effects of a high number of invasive weed species and fragmentation, the Riverina bioregion's capability to deliver long-term sustainable forest management is under threat. The edges of forest patches, such as roadsides, are highly susceptible to invasion by exotic species. In addition, forests in the Riverina bioregion have developed on active floodplains, and flooding could promote the abundance, proliferation and spread of weeds.

97. Victorian Department of Economic Development, Jobs, Transport and Resources, 'Protecting Victoria from pest animals and weeds', Bacchus Marsh, Victoria http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/protecting-victoria-from-pest-animals-and-weeds Accessed 4 December 2018.

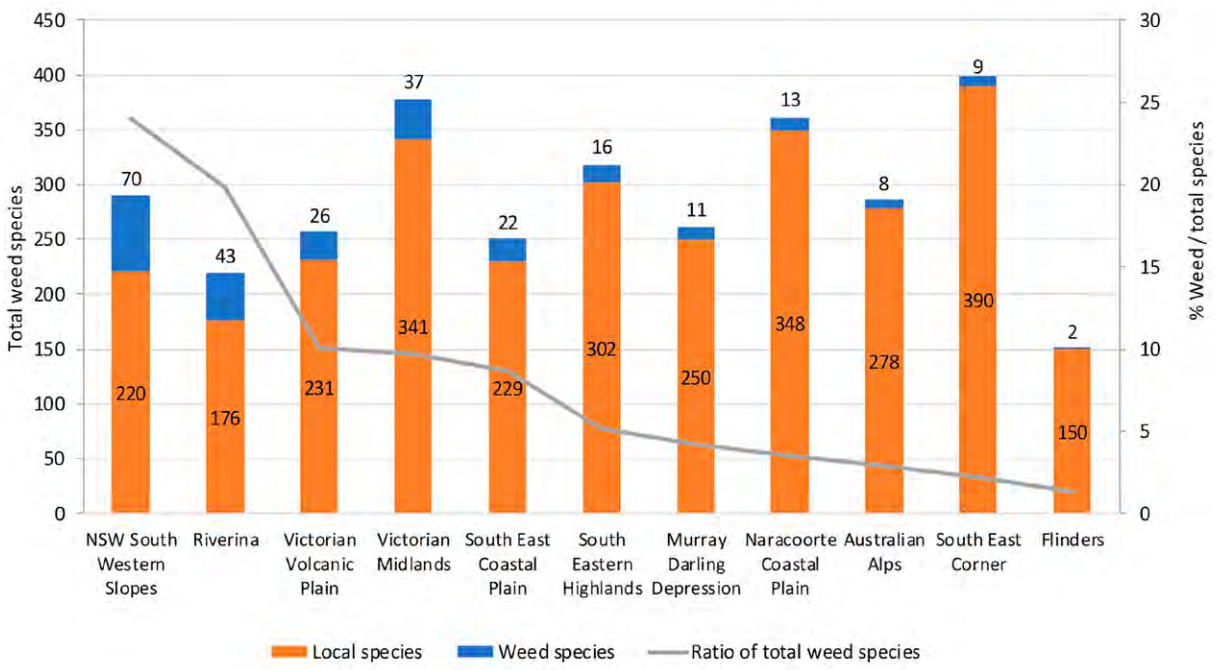


Figure 25. Proportional distribution of weed species in bioregions, 2018 (Data source: DELWP 2018)

The major insects and pathogenic agents, and their status/severity and scale of distribution, are listed in Table 18. A few notable changes were identified during the reporting period. These include a reduction in cup moth to 'minimal' since 2016–17 *(Deratifera spp.)*. By contrast, the effects of red gum basket lerp *(Cardiaspina retator)* have continued to proliferate, with heavy infestations affecting the north and north-eastern areas of the state, especially around Shepparton and Wodonga. These outbreaks have been exacerbated by dry periods, with the worst effects seen during autumn in monoculture stands, in both natural *Eucalyptus camaldulensis* stands and in plantation situations. (While lerp insects rarely cause the death of trees such as *E. camadulensis*, defoliation can be so severe that it results in dieback.)

To minimise and reduce the effects of dothistroma needle blight *(Dothistroma septosporum)* on pines such as *Pinus radiata*, up to 3,000 hectares of plantation areas in north-east Victoria have been treated. Increases in the incidence and severity of this disease have recently been observed, both where the disease has been established, and in notable range expansions.[98] Generally, the disease in *P. radiata* has been maintained at low levels, but local outbreaks in Noojee areas in Victoria required chemical control activity.

Psyllids of the genus *Cardiaspina* have been observed causing increasing moderate to severe levels of defoliation to predominantly *E. camaldulensis* and E. regnans across Victoria between 2013–18. The damage caused to *E. camaldulensis* is widespread, with severe localised areas observed along roadsides and within farm paddocks. Defoliation occurred predominantly in the lower crown of trees, with damage levels of up to 80% in the lower crown of some stands, compared to levels of up to 50% in the upper crowns. These outbreaks are exacerbated by dry periods, with the worst effects seen in autumn in farm monoculture stands and in natural E. camaldulensis stands. Control programs have been undertaken on high-value urban tree landscapes, but are not economically feasible for larger native stands.

98. Woods AJ, Martin-Garcia J, Bulman L, Vasconcelos MW, Boberg J, La Porta N, Peredo H, Vergara G, Ahumada R, Brown A, Diez JJ 2016, 'Dothistroma needle blight, weather and possible climatic triggers for the disease's recent emergence', Forest Pathology, 46(5), pp. 443-452.

The damage observed on *E. regnans* is localised yet severe within the Central Highlands and West Gippsland forests. No control program is possible within these natural ecosystems.

Mycosphaerella leaf disease is affecting *E. globulus* plantations in the Green Triangle region.[99] Variation in the susceptibility of E. globulus provenances to the disease, through successful breeding programs, may improve performance of future plantations.

Cypress canker *(Seridium spp.)* has become a significant pest in urban/farm forests since 2010–11, affecting exotic conifers in Victoria. The pathogen causes serious damage and economic loss, targeting many Cupressaceae species in forests, windbreaks and ornamental plantings.[100,101] There is no cure at present for the disease, and replacement with known tolerant species is the only means of avoidance. Significant issues remain regarding the removal of thousands of trees killed by cypress canker.

Since 2011–12, the distribution of *Phytophthora cinnamomi* has increased in native forests. This pathogen is listed as one of the 100-worst invasive alien species. Active land management activities and strategies are key to minimising its spread in Victoria to protect native species.[102] A 2014 estimation of the distribution of the pathogen shows that *P. cinnamomi* is more widespread in southern Australia than indicated by past records.[103] The pathogen is most destructive where there is a combination of conductive soils, susceptible hosts and a climate with a warm, wet winter/spring and dry summer. Victoria has all three conditions, including a climate increasingly favourable to the pathogen, making its further spread likely. Based on scenarios for continuous global warming,[104] Victoria's subalpine regions will eventually have a climate favourable to the pathogen, although it may have less impact due to the absence of known susceptible hosts, and younger and more fertile soils.

Deer has been a growing issue recently, causing problems for both biodiversity and commercial forest operations. An advisory group was established in March 2018 to inform the development of a draft deer management strategy for public consultation.[105] The final deer management strategy will be published in February 2019.

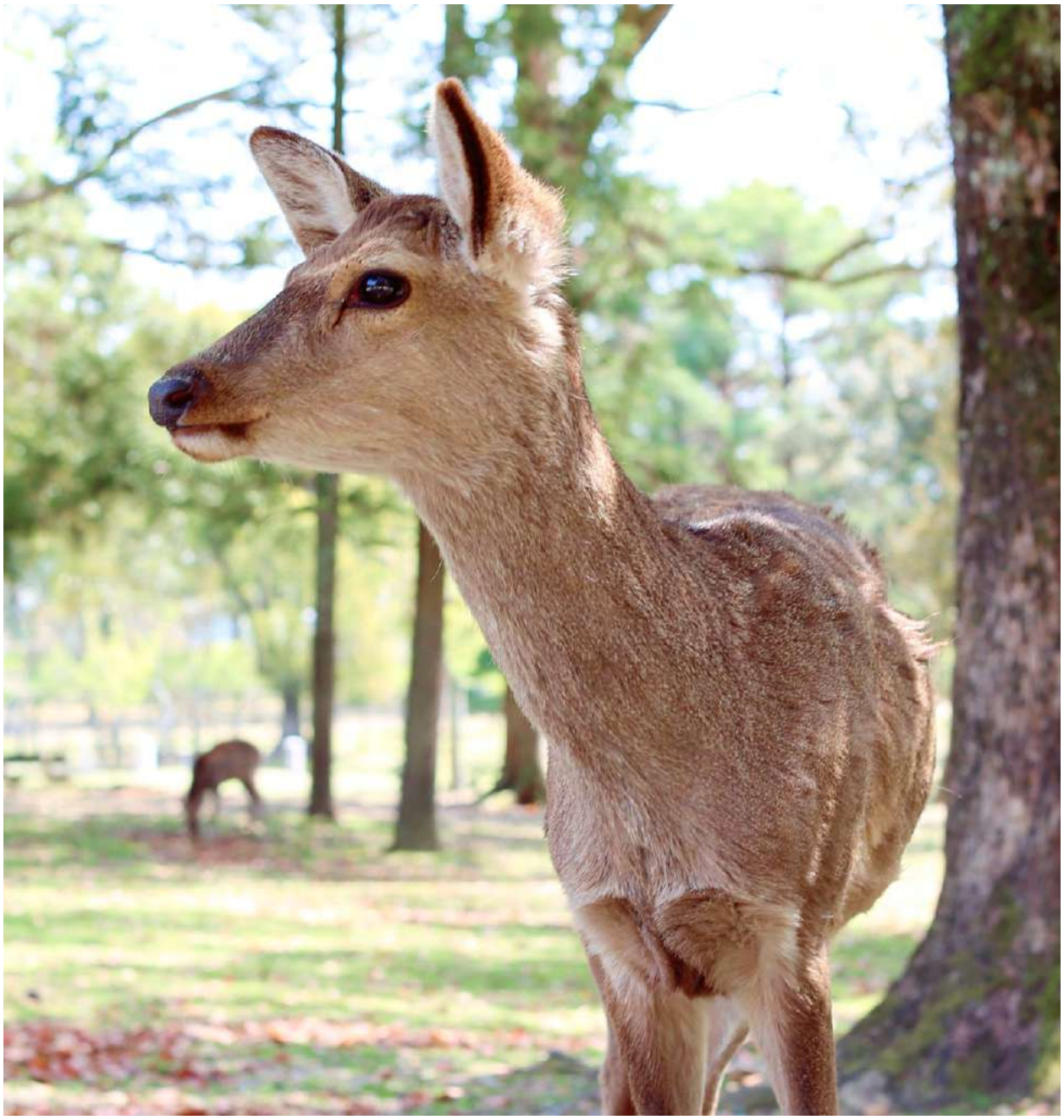
Finally, an increase in damage by sirex wood wasp (Sirex noctilio) was observed across the state. The severity of infestation varied, and several locations had greater than 3% (and up to 15%) damage. DELWP has been implementing management activities to control the outbreaks.

Overall, damage by most identified pathogens and insect agents in Victoria during the reporting period stabilised or decreased. However, the distribution and destruction of a few species on native forests, plantations and urban/farm forests has increased. It is crucial to continue monitoring the impacts of insect and pathogen species, and also consider climate change impacts on these identified species and the potential introduction of new insect and pathogenic agents in Victoria.

99. Australian Department of Agriculture, Fisheries and Forestry, 'Australia's Green Triangle: a growing region with significant opportunities for forest sector investment', Canberra, Australia http://www.agriculture.gov.au/SiteCollectionDocuments/forestry/green_triangle_investment_ver8.pdf Accessed 11 January 2019.
100. Danti R, Della Rocca G, Ranconesi A 2013, '17. Cypress Canker In: Infectious Forest Diseases' pp.359-375, In Gonthier P, Nicolotti G 2013, 'Infectious forest diseases', CAB International 2013, Croydon, UK.
101. Smith D, Smith I 2014, 'Endemic pests, current threats and future risks to Australian urban forests', Treenet, Glen Osmond, South Australia https://treenet.org/resources/endemic-pests-current-threats-and-future-risks-to-australian-urban-forests/ Accessed 11 January 2019.
102. Burgess TI, Scott JK, Mcdougall KL, Stukely MJ, Crane C, Dunstan WA, Brigg F, Andjic V, White D, Rudman T, Arentz F 2017, 'Current and projected global distribution of Phytophthora cinnamomi, one of the world's worst plant pathogens', Global Change Biology, 23(4), pp. 1661-74.
103. Australian Department of Agriculture, Fisheries and Forestry, 'Australia's Green Triangle: a growing region with significant opportunities for forest sector investment', Canberra, Australia http://www.agriculture.gov.au/SiteCollectionDocuments/forestry/green_triangle_investment_ver8.pdf Accessed 11 January 2019.
104. Ibid
105. Department of Premier and Cabinet 2018, 'Draft deer management strategy: for public consultation', Melbourne, Victoria https://s3.ap-southeast-2.amazonaws.com/hdp.au.prod.app.vic-engage.files/8815/3837/3085/DEDJTR_DeerManagmentStrategy_final_v2_003.pdf Accessed 13 January 2019.

Table 17. Colour code for Table 18, indicating scale of distribution and impact of insects and pathogenic agents on native forests, plantation and urban/farm forest

Code	Scale of distribution	Impact
0	Does not occur, or not observed in assessment period	No impact
1	Restricted (<25%)	Minimal
2	Restricted (<25%)	Adverse
3	Widespread (>25%)	Minimal
4	Widespread (>25%)	Localised adverse
5	Widespread (>25%)	Widespread adverse



Credit: Leo Bi

Table 18. Common insect and pathogen agent, distribution and impact, 2007–08 to 2017–18

		Native forests										
Agent common	**Agent scientific**	**2007-08**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**
Insects												
Autumn gum moth	Mnesampela privata											
Christmas beetle	Anoplognathus spp											
Chrysomelid leaf beetles	Chrysophtharta agricola											
Cup moth	Doratifera spp											
Five-spined bark beetle	Ips grandicollis											
Goldern-haired beetle	Hylurgus ligniperda											
Gum leaf skeletoniser	Uraba lugens											
Leaf blister sawfly	Phylacteophaga froggatti											
Longicorn borers	Phorocantha spp											
Monterey pine aphid	Essigella californica											
Mountain ash psyllid	Cardiaspina bilobata											
Red gum basket lerp	Cardiaspina retator Taylor											
Sawflies	Perga spp											
Sirex	Sirex noctilio											
Spurlegged phasmatid	Didymuria violescens											
Sycamore lace bug	Corythucha ciliata											
Pathogens												
Armillaria	Armillaria luteobubalina											
Corky leaf spot	Aulographina eucalypti											
	eucalypti											
Cyclaneusma needle cast	Cyclaneusma minus											
Cypress canker	Seridium sp											
Diplodia	Diplodia pinea											
Dothistroma needle blight	Dothistroma septosporum											
Eucalyptus canker	Holocryphia eucalypti											
Lophodermium	Lophodermium pinastri											
Mycosphaerella leaf disease	Mycosphaerella spp											
Myrtle rust	Uredo rangelii											
Myrtle wilt	Chalara australis											
Phytophthora	Phytophthora cinnamomi											
Septoria leaf blight	Kirramyces eucalpti											

Table 18. Common insect and pathogen agent, distribution and impact, 2007–08 to 2017–18 Cont'd

		Plantations										
Agent common	**Agent scientific**	**2007-08**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**
Insects												
Autumn gum moth	Mnesampela privata											
Christmas beetle	Anoplognathus spp											
Chrysomelid leaf beetles	Chrysophtharta agricola											
Cup moth	Doratifera spp											
Five-spined bark beetle	Ips grandicollis											
Goldern-haired beetle	Hylurgus ligniperda											
Gum leaf skeletoniser	Uraba lugens											
Leaf blister sawfly	Phylacteophaga froggatti											
Longicorn borers	Phorocantha spp											
Monterey pine aphid	Essigella californica											
Mountain ash psyllid	Cardiaspina bilobata											
Red gum basket lerp	Cardiaspina retator Taylor											
Sawflies	Perga spp											
Sirex	Sirex noctilio											
Spurlegged phasmatid	Didymuria violescens											
Sycamore lace bug	Corythucha ciliata											
Pathogens												
Armillaria	Armillaria luteobubalina											
Corky leaf spot	Aulographina eucalypti											
	eucalypti											
Cyclaneusma needle cast	Cyclaneusma minus											
Cypress canker	Seridium sp											
Diplodia	Diplodia pinea											
Dothistroma needle blight	Dothistroma septosporum											
Eucalyptus canker	Holocryphia eucalypti											
Lophodermium	Lophodermium pinastri											
Mycosphaerella leaf disease	Mycosphaerella spp											
Myrtle rust	Uredo rangelii											
Myrtle wilt	Chalara australis											
Phytophthora	Phytophthora cinnamomi											
Septoria leaf blight	Kirramyces eucalpti											

Table 18. Common insect and pathogen agent, distribution and impact, 2007–08 to 2017–18 Cont'd

		Urban/Farm Forests										
Agent common	**Agent scientific**	**2007-08**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**
Insects												
Autumn gum moth	Mnesampela privata											
Christmas beetle	Anoplognathus spp											
Chrysomelid leaf beetles	Chrysophtharta agricola											
Cup moth	Doratifera spp											
Five-spined bark beetle	Ips grandicollis											
Goldern-haired beetle	Hylurgus ligniperda											
Gum leaf skeletoniser	Uraba lugens											
Leaf blister sawfly	Phylacteophaga froggatti											
Longicorn borers	Phorocantha spp											
Monterey pine aphid	Essigella californica											
Mountain ash psyllid	Cardiaspina bilobata											
Red gum basket lerp	Cardiaspina retator Taylor											
Sawflies	Perga spp											
Sirex	Sirex noctilio											
Spurlegged phasmatid	Didymuria violescens											
Sycamore lace bug	Corythucha ciliata											
Pathogens												
Armillaria	Armillaria luteobubalina											
Corky leaf spot	Aulographina eucalypti											
	eucalypti											
Cyclaneusma needle cast	Cyclaneusma minus											
Cypress canker	Seridium sp											
Diplodia	Diplodia pinea											
Dothistroma needle blight	Dothistroma septosporum											
Eucalyptus canker	Holocryphia eucalypti											
Lophodermium	Lophodermium pinastri											
Mycosphaerella leaf disease	Mycosphaerella spp											
Myrtle rust	Uredo rangelii											
Myrtle wilt	Chalara australis											
Phytophthora	Phytophthora cinnamomi											
Septoria leaf blight	Kirramyces eucalpti											

Public land management programs across Victoria are helping to reduce the impact of invasive species. Some of the key programs are:

- Weeds and Pests on Public Land Program – an ongoing program investing in weed, predator and herbivore control to protect Victoria's key biodiversity assets
- Peri-Urban Weed Management Partnership Initiative – a project to protect key biodiversity assets on public land in Melbourne's peri-urban areas from high-threat weeds
- Good Neighbour Program – a program to support public land managers to control weeds and pests at the interface of public and private land for the protection of private land values.

Table 19 shows the area of invasive species control by actions in Victoria since SoF 2013. The analysis excludes private land programs coordinated through the Department of Economic Development, Jobs, Transport and Resources (DEDJTR).

The Biodiversity chapter in the State of the Environment 2018 report presents further assessments related to the management of invasive species, specifically indicators B:20 (Change in suitable habitat) and B:21 (Area of management in priority locations).

Table 19. Area of invasive species control, by action, in public and private land between 2013–14 and 2017–18 financial year

Action	Treated area (ha)
Feral cat control	66,054
Deer control	153,219
Fox control	2,409,659
Feral goat control	1,085,221
Feral pig control	91,576
Rabbit control	5,649,919
Weed control	4,223,328
Fencing	300,055
Total	13,979,031

Note: Excludes private land programs coordinated through DEDJTR
(Data source: DELWP 2018)

Criterion 1: Conservation of biological diversity

	Status				Trend	Data Quality
	UNKNOWN	POOR	FAIR	GOOD		
1.3a The number of forest dependent species at risk from isolation that may lead to loss of genetic variation	●	○	○	○	?	DATA QUALITY Poor

Data Custodian
Deakin University,
Australian National University

Isolation has significant implications for the genetic variation and long-term survival of forest-dependent species. This indicator provides information on forest-dependent species at risk of isolation, which may lead to loss of genetic variation. This information can be used to inform biodiversity management and threatened species recovery programs.

Isolation can result from various factors, including changes to fire regimes (indicator 3.1 (Scale and impact of agents and processes affecting forest health and vitality)), forest fragmentation (indicator 1.1d (Fragmentation of native forest cover)), pests and disease (indicator 3.1 (Scale and impact of agents and processes affecting forest health and vitality)) and introduced species (indicator 1.2d (Degree of disturbance to native forest species caused by invasive species)).

Prevention of movement or interaction of flora and fauna species in forests can produce geographically isolated populations. This interferes with various activities of forest-dependent species such as breeding, seed dispersal, pollination and habitat migration, which can cause loss of genetic variation. Isolation can make species less resilient to severe environmental changes and unexpected threats.

There is no comprehensive information on the number of forest-dependent species at risk from isolation at the state-scale to evaluate this indicator. Therefore, this indicator will present scientific evidence that particularly focuses on monitoring several threatened forest-dependent species in Victoria.

Victoria is the most heavily cleared state in Australia: more than 90% of forest and woodland cover prior to European settlement has been cleared.[106] Anthropogenic landscape change and habitat fragmentation have become pervasive and may threaten the genetic connectivity of flora species.[107] The decrease of forest cover and connectivity means the survival of many forest-dependent fauna species is also at risk.

One example is Leadbeater's possum in mountain ash forests. Habitat for this species can be fragmented by roads and logging coupes,[35] which impede movement [108,109] This can lead to the local isolation of species if appropriate habitat corridors are not provided. The addition of new logging coupes under the Timber Release Plan may also intensify disturbance. [110,111,112]

In Yellingbo, home to an isolated population of Leadbeater's possum (<45)[113] in lowland floodplain forest, DNA sampling analysis has shown a highly localised resident population.[114] The area has subsequently been included in the Leadbeater's Possum Action Statement to provide a clear management strategy and to preserve the area's high conservation value. To mitigate risks, DELWP has developed recovery plans that support various activities, including the introduction of a 200-metre-radius timber-harvest exclusion zone near Leadbeater's possum colonies, and the installation of nest boxes.[115]

Assessment of this indicator is incomplete due to extremely insufficient information.

106. Bradshaw CJA 2012, 'Little left to lose: deforestation and forest degradation in Australia since European colonization', Journal of Plant Ecology, 5(1) pp. 109-120.
107. Sork VL, Smouse PE 2006, 'Genetic analysis of landscape connectivity in tree populations', Landscape Ecology, 21(6) pp. 821-836.
108. Blair D, McBurney L, Lindenmayer DB, Banks S, Blanchard W 2017, 'The Leadbeater's Possum Review', Australian National University, Canberra, Australia.
109. Blair D, McBurney L, Lindenmayer DB 2018, 'Failing to conserve Leadbeater's Possum and its Mountain Ash forest habitat', Australian Zoologist, 39(3), pp. 443-448.
110. VicForests, 'Timber release plan', Melbourne, Victoria http://www.vicforests.com.au/planning-1/timber-release-plan-1/timber-release-plan Accessed 9 January 2019.
111. Lindenmayer DB, Blanchard W, Blair D, McBurney L 2018, 'The road to oblivion – quantifying pathways in the decline of large old trees', Forest Ecology and Management, 430, pp. 259-264.
112. Lindenmayer DB, Blanchard W, Blair D, McBurney L, Stein J, Banks SC 2018, 'Empirical relationships between tree fall and landscape-level amounts of logging and fire', PLOS One, 13(2), e0193132.
113. Department of Environment and Primary In dustries 2014, 'Action statement No.62: Leadbeater's possum Gymnobelideus leadbeateri', Melbourne, Victoria https://www.environment.vic.gov.au/__data/assets/pdf_file/0009/33003/Leadbeaters_Possum_Gymnobelideus_leadbeateri.pdf Accessed 9 January 2019.
114. Hansen BD 2008, 'Population genetic structure of Leadbeater's Possum Gymnobelideus leadbeateri, and its implications for species conservation', PhD Thesis, Monash University, Clayton, Victoria.
115. DELWP 2015, 'Supporting the recovery of the Leadbeater's Possum: progress report October 2015', Melbourne Victoria https://www.wildlife.vic.gov.au/__data/assets/pdf_file/0020/27911/DELWP0014_LeadbeaterPossum_Report2015_v9.pdf Accessed 5 December 2018.

	Status (UNKNOWN / POOR / FAIR / GOOD)	Trend	Data Quality
1.3b Number of in-situ and ex-situ conservation efforts for forest-dependent species **Data Custodian** DELWP		?	DATA QUALITY Poor

Several conservation measures are being applied for sustainable forest management of locally and regionally adapted native species. These measures require a combination of in-situ and ex-situ approaches. In-situ conservation is conducted by declaring, as protected, areas such as parks, genetic and ecological conservation areas, and reserved stands. Ex-situ conservation measures include seed banks, long-term captive breeding, animal translocation and gene banks for the preservation of components of biological diversity outside of natural habitats.

Previous SoF reports used the Actions for Biodiversity Conservation (ABC) system to describe the extent of conservation efforts for native species.[116] However, the system was decommissioned in 2013, making comparisons with past data difficult. The data provided here has been collated by DELWP's regional implementation teams.

Table 20 shows the level of management activity for each forest-dependent threatened species for eight action categories, as provided by DELWP's regional implementation teams.

The categories are:

1. community engagement
2. policy and planning
3. survey and monitoring
4. habitat protection and restoration
5. pest and weed control
6. population manipulation
7. captive management
8. research.

The two levels of management activity provide a qualitative measure of conservation efforts in Victoria; however, it is difficult to evaluate whether the current approach has a strong impact on achieving positive species conservation status. The management activities need to be linked with state-scale monitoring programs to evaluate the effectiveness of in-situ and ex-situ conservation efforts.

116. DELWP, 'Actions for biodiversity conservation', Melbourne, Victoria https://www.environment.vic.gov.au/conserving-threatened-species/actions-for-biodiversity-conservation Accessed 11 January 2019.

Credit: Faye Bedford

Table 20. Management activity for each forest-dependent threatened species, 2013–2017

Common name	Community engagement	Policy and planning	Survey and monitoring	Habitat protection and restoration	Pest and weed control	Population manipulation	Captive management	Research
Mammals								
Broad-toothed rat								
Brush-tailed phascogale								
Brush-tailed rock wallaby								
Eastern horseshoe bat								
Greater glider								
Grey-headed flying-fox								
Leadbeater's possum								
Long-footed potoroo								
Long-nosed potoroo								
Smoky mouse								
Spot-tailed quoll								
Squirrel glider								
Swamp antechinus								
White-footed dunnart								
Yellow-bellied glider								
Yellow-bellied sheathtail bat								
Birds								
Barking owl								
Brown treecreeper								
Chestnut-rumped heathwren								
Glossy black-cockatoo								
Grey goshawk								
Helmeted honeyeater								
Hooded robin								
Masked owl								
Powerful owl								
Regent honeyeater								
Sooty owl								
Speckled warbler								
Spotted quail-thrush								
Square-tailed kite								
Swift parrot								
Turquoise parrot								
White-bellied sea-eagle								

Note: Yellow cells denote minor activity – routine or ad hoc.
Green cells denote substantial activity – targeted or sustained.
Blank cells denote no activity.

Table 20. Management activity for each forest-dependent threatened species, 2013–2017 Cont'd

Common name	Community engagement	Policy and planning	Survey and monitoring	Habitat protection and restoration	Pest and weed control	Population manipulation	Captive management	Research
Reptiles								
Alpine bog skink								
Eastern she-oak skink								
Lace monitor								
Rosenberg's goanna								
Swamp skink								
Amphibians								
Baw baw frog								
Booroolong tree frog								
Brown toadlet								
Giant burrowing frog								
Green and golden bell frog								
Large brown tree frog								
Martin's toadlet								
Southern toadlet								
Spotted tree frog								
Fish								
Australian grayling								
Barred galaxias								
Cox's gudgeon								
Dwarf galaxias								
Empire gudgeon								
Flat-headed galaxias								
Macquarie perch								
Murray cod								
Trout cod								
Invertebrates								
Orbost spiny cray								

Table 20. Management activity for each forest-dependent threatened species, 2013–2017 Cont'd

Common name	Community engagement	Policy and planning	Survey and monitoring	Habitat protection and restoration	Pest and weed control	Population manipulation	Captive management	Research
Plants								
Baw baw berry								
Blackfellow's hemp								
Brown guinea-flower								
Colquhoun grevillea								
Eastern pomaderris								
Elegant daisy								
Forest geebung								
Forest phebalium								
Forest sedge								
Gippsland stringybark								
Gully grevillea								
Leafless pink-bells								
Outcrop guinea-flower								
Oval fork-fern								
Oval-leaf grevillea								
Sandfly zieria								
Serpent heath								
Slender fork-fern								
Small fork-fern								
Smooth geebung								
Tall astelia								
Tasmanian wax-flower								
Toothed leionema								
Tree geebung								
Upright pomaderris								
Veined pomaderris								
Velvety geebung								

Criterion 2: Maintenance of productive capacity of forest ecosystems

Commissioner *for* Environmental Sustainability Victoria

Credit: Wally Notman

Criterion 2:
Maintenance of productive capacity of forest ecosystems

	Status				Trend	Data Quality
	UNKNOWN	POOR	FAIR	GOOD		
2.1 Area and percentage of forest and net area of forest available and suitable for wood production	○	●	○	○	↘	DATA QUALITY Good

Data Custodian
VicForests, DELWP

The area of forest available for timber production, and forest types and age classes, is a key planning input for determining long-term sustainable timber production rates. Monitoring trends in available forest area assists the forest sector in managing any change that will affect resource availability. It also provides insight into the changing balance of management objectives across the forested landscape.

Not all public forests are available for commercial native timber harvesting. Commercial trees are those large enough and close enough to a market to allow them to be harvested. In Victoria, most commercially viable native forests are in the east, including the Central Highlands. Data from VicForests (the Victorian government business responsible for the harvest, commercial sale and regrowing of native timber from state forests) shows that approximately 0.04% of native forests are harvested each year.

Table 21 summarises the total available and unavailable area for timber production, in both state forests and parks and conservation reserves. It shows that unavailable area for timber production has increased by more than 200,000 hectares. This is because the area zoned for the protection of threatened species, such as Leadbeater's possum, has increased.

VicForests's Resource Outlook has also reduced the available timber production area in state forests. The Resource Outlook defines the volume of hardwood timber products from native forests to be made available to the market. It separates the species groups of timber supply, as either ash or mixed-species.[117]

Meanwhile, reduced availability of sawlog resource in areas such as the Central Highlands can be attributed to the effects of fire in estimates of sustained yield.[118,119]

Overall, the trend indicates less timber production in state forests in the future. It is likely that more emphasis will be placed on activities associated with species conservation and carbon sequestration.

117. VicForests 2016, '2016-2017 Resource Outlook', Melbourne, Victoria http://www.vicforests.com.au/static/uploads/files/vicforests-resource-outlook-2016-17-wfasdtpknkdp.pdf Accessed 4 December 2018.
118. Lindenmayer DB 2017, 'Halting natural resource depletion: engaging with economic and political power', The Economic and Labour Relations Review, 28, pp. 41-56.
119. Lindenmayer DB 2018, 'Flawed forest policy: flawed Regional Forest Agreements', Australasian Journal of Environmental Management, 25, pp. 258-266.

Credit: Braden Jenkin

Table 21. Area available for harvest in native forest, 2006, 2008, 2012, 2016

Tenure	Forest management zone	Year and Area ('000 ha)				
		2006	**2008**	**2012**	**2014**	**2016**
Available						
State forest	General management zone	2,403	2,318	2,110	2026	2,112
	Special management zone	182	172	275	263	159
Parks and conservation reserves	Limited timber production	12	12	18	14	19
Total available		*2,597*	*2,502*	*2,403*	*2,302*	*2,290*
Not available						
State forest	Special Protection Zone	828	783	753	747	761
Parks and conservation reserves	No timber production	3,820	3,825	3,982	4,117	4,106
Total not available		*4,648*	*4,608*	*4,735*	*4,864*	*4,862*
Grand total		**7,245**	**7,110**	**7,138**	**7,166**	**7,153**

(Data source: DELWP 2018)

Criterion 2:
Maintenance of productive capacity of forest ecosystems

	Status				Trend	Data Quality
	UNKNOWN	POOR	FAIR	GOOD		
2.2 Volume of wood by forest type in State forest that is available and suitable for timber production	○	○	●	○	→	DATA QUALITY Good

Data Custodian
DELWP, DEDJTR, VicForests

Monitoring and assessing levels of timber harvest from native forest is an essential part of sustainable forest management. Tracking annual harvest rates in native forests against the available level of harvest rate is important for evaluating whether the current approach is sustainable.

The native-timber industry in Victoria produces a variety of wood products. These include the sawlogs that are used in furniture, construction and flooring, as well as logs of lower quality, used for firewood and pulp or paper production. Sawlogs are mostly sourced from the ash forests of north-eastern Victoria and Gippsland, but can also be derived from mixed-species forests with comparatively lower-quality timber. Mixed-species forests, which have two or more eucalypt species, are widespread among native Victorian forests.

During the harvest process, not all trees or tree elements are deemed sawlog-quality. Some trees are too young or knotty, and tree components such as branches of the upper trunk are considered unsuitable for sawlog production. This 'residual timber' constitutes approximately two-thirds of the harvested volume and is primarily used for pulp or paper production with a smaller quantity sold as firewood. VicForests supplies timber harvested from operations in eastern and western Victoria to roughly 20 mills for sawlog processing.[120] Around 90% of this timber is processed by the largest 10 mills.[121]

The mechanism used to determine the sustainable harvest level for native forests in Victoria is the Allocation Order 2013 (AO). The AO was created under Section 13 of the *Sustainable Forests (Timber) Act 2004*. The AO describes the location and extent of timber resources allocated to VicForests for harvest and sale. Timber-harvesting activity beyond the designated locations is not allowed.

The AO[122] has been reviewed three times since its introduction. The first review was of the 'Allocation to VicForests Order 2004' (the predecessor to the AO) to account for the impact of the major bushfires in 2006–07 and 2009.

Following a second review in 2010, the ash forest five-year harvest area limit was increased to allow VicForests to undertake salvage harvesting of the burnt forests following the 2009 bushfires. After another review in 2010, the accounting process used to monitor harvesting compliance with the AO changed from a net area tally to a gross coupe area tally. (Net area is the extent of timber harvesting: the actual area, or 'footprint' of tree felling. Gross coupe area is the area of state forest where timber resources are potentially available to VicForests for harvest and sale. It includes areas that can be harvested and areas that will not be harvested, including those protected under the *Code of Practice for Timber Production 2014*; areas where the timber available is not commercially suitable or commercially viable.)

120. VAGO 2013 'Managing Victoria's native forest timber resources', Melbourne, Victoria http://www.vicforests.com.au/static/uploads/files/20131211-timber-resources-wfsdlrklejjj.pdf Accessed 4 December 2018.
121. Ibid
122. Victorian Department Economic Development, Jobs, Transport and Resources, 'Timber Allocation Order', Victoria http://agriculture.vic.gov.au/agriculture/forestry/timber-allocation-order Accessed 4 December 2018

Since August 2004, the AO has specified the maximum area that may be harvested, setting five-year harvest area limits. The AO currently specifies a five-year harvest-area limit of 14,200 hectares (gross) for ash forest type, and 70,000 hectares (gross) for mixed-species forest type (Table 24). The five-year harvest limit sets a harvest-area 'ceiling'. Assuming a commercial forest life of about 100 years, the five-year harvest-area limit is a maximum of around 5% of the total area in any five-year period.

The area of harvesting has not reached the five-year harvest area levels. The following comments apply when comparing the area of harvest with the AO:

- In the five years up to June 2009, VicForests harvested 66% of the ash forest and 57% of the mixed-species forest allocated for that five-year period for non-fire affected forest. In this period VicForests also undertook salvage harvesting of fire-affected forests (Table 22).
- In the period before the current AO from 2009 to 2013 (four years), VicForests harvested 71% of the ash forest five-year harvest area limit and 24% of the mixed-species forest five-year harvest area limit. VicForests undertook salvage harvesting of fire-affected forests (Table 23 and Table 25) in this period.
- In the period 2013 to 2017 (four years), VicForests harvested 66% of the ash forest five-year harvest area limit and 15% of the mixed-species forest five-year harvest area limit (Table 24).

Table 25 indicates that the area of state forest harvested between 2011–12 and 2016–17 was between 4,400 and 5,600 hectares per year. The average area harvested is less than 1% of the total area available for timber harvesting. (see indicator 2.1 (Area and percentage of forest and net area of forest available and suitable for wood production)). Note that Table 25 presents net area data – not gross area data – and so does not correlate with Table 22, Table 23 and Table 24.

The data for this report was finalised before 21 November 2018, when ABC News published an online article and broadcast a story on its 7.30 program speculating about potential timber-harvesting activity by VicForests outside its allocation boundary.[123,124] However, on 17 November 2018, a joint statement provide to the ABC from the Minister for Energy, Environment and Climate Change, and the Minister for Agriculture stated that DELWP confirmed that no harvesting occurred in protected areas,[125] and that the apparent discrepancy ABC News identified was due to differences between the legally enforceable map (see appendix 1 of the AO) and a spatial data file provided to the ABC.[126]

The re-elected Andrews Labor Government has committed to providing more detailed spatial data maps for any future AOs.[127] DEDJTR,[128] VicForests[129] and DELWP[130] have also responded to this issue. In addition, the Victorian Government ordered an independent review of timber-harvesting regulations.[131] The recommendations of the independent review will be released publicly. The Office of the Commissioner for Environmental Sustainability will consider this issue in the next reporting cycle, potentially developing a new indicator to address the specific issue of allocation boundaries.

123. ABC NEWS, 'Australia's endangered forests are being 'stolen' and sold in hardware and office stores' https://www.abc.net.au/news/2018-11-21/victorian-forests-appear-to-have-been-logged-illegally/10496424#statements Accessed 4 December 2018.
124. ABC 7.30 Report, 'Government-owned logging company accused of illegally logging state forest' https://www.abc.net.au/7.30/government-owned-logging-company-accused-of/10520270 Accessed 4 December 2018.
125. Joint statement from the Minister for Environment Lily D'Ambrosio and Minister for Agriculture Jaala Pulford, November 17: https://www.documentcloud.org/documents/5194121-Joint-Ministerial-Response.html Accessed 4 December 2018.
126. Response from DELWP spokesperson, November 16 and 18: https://www.documentcloud.org/documents/5194115-DELWP-Response.html Accessed 4 December 2018.
127. Joint statement from the Minister for Environment Lily D'Ambrosio and Minister for Agriculture Jaala Pulford, November 17: https://www.documentcloud.org/documents/5194121-Joint-Ministerial-Response.html Accessed 4 December 2018.
128. Response from the Department of Economic Development, Jobs, Transport and Resources (DEDJTR), November 16: https://www.documentcloud.org/documents/5194120-DEDJTR-Response.html Accessed 4 December 2018.
129. Response from VicForests spokesperson, November 16: https://www.documentcloud.org/documents/5194125-VicForests-Response.html Accessed 4 December 2018.
130. Response from DELWP spokesperson, November 16 and 18: https://www.documentcloud.org/documents/5194115-DELWP-Response.html Accessed 4 December 2018.
131. Joint statement from the Minister for Environment Lily D'Ambrosio and Minister for Agriculture Jaala Pulford, November 17: https://www.documentcloud.org/documents/5194121-Joint-Ministerial-Response.html Accessed 4 December 2018.
132. State of Victoria 2010, 'Monitoring annual harvesting performance in Victoria's State forests 2008-09', Melbourne, Victoria.
133. VicForests, 'Regrowth retention harvesting', Melbourne, Victoria http://www.vicforests.com.au/leadbeaters-possum1/regrowth-retention-harvesting-1 Accessed 4 December 2018.

Table 22. Harvest area (net hectares) 2004–05 to 2008–09 (five years) compared to the Allocation to VicForests Order 2004

	2004–05	2005–06	2006–07	2007–08	2008–09	Total	AO max. area for period 1 (5 yrs)	Total area harvested compared to AO (%)
Ash	1,271	1,078	850	1,022	933	5,154	7,810	66
Mixed-species	2,520	2,701	2,325	2,366	2,424	12,336	21,660	57

Note: Additional harvest in this time included 6,110 hectares of fire-affected and salvage harvesting. The AO provided a total allocation of 56,540 hectares of fire-affected and salvage forest stands.
(Data source: DSE[132])

Table 23. Gross coupe area 2009–10 to 2012–13 (four years) compared to AO 2013

	2009–10	2010–11 (gross hectares)	2011–12 (gross hectares)	2012–13 (gross hectares)	Total (4 yrs)	AO five-year harvest area limits (5 yrs)	Total area harvested compared to AO (%)
Ash	3,712	2,776	3,238	2,594	12,629	17,400	71
Mixed-species	5,880	5,032	3,525	2,724	9,332	71,800	24

Note: The gross coupe area listed includes forest stands impacted by fire. The use of gross area as the AO harvest area accounting parameter began in May 2010. Gross area harvest in 2009–10 (before May 2010) is provided.
(Data source: DEDJTR 2018)

Table 24. Gross coupe area 2013–14 to 2016–17 (four years) compared to AO 2013

	2013–14 (gross hectares)	2014–15 (gross hectares)	2015–16 (gross hectares)	2016–17 (gross hectares)	Total (4 yrs)	AO five-year harvest area limits (5 yrs)	Total area harvested compared to AO (%)
Ash	2,090	2,273	2,583	2,386	9,332	14,200	66
Mixed-species	2,034	2,820	2,847	3,003	10,704	70,000	15

(Data source: VicForests 2018)

Table 25. Net area harvested by regime to 2016–17

Year		Net area harvested (ha)				
	Clear fall regime (^)	Thinning regime	Salvage regime	Seed Tree	Selection regime	Total (all regimes)
2011–12	1,400	1,200	100	2,200	700	**5,600**
2012–13	1,500	1,800		1,400	800	**5,500**
2013–14	1,500	1,200		1,400	500	**4,600**
2014–15	1,300	1,000		1,700	400	**4,400**
2015–16	1,100	1,700		1,700	300	**4,800**
2016–17	900	1,500		1,800	600	**4,800**

^ Clear fall includes Regrowth Retention Harvesting (RRH) method[133]
(Source: VicForests)

Criterion 2: Maintenance of productive capacity of forest ecosystems

	Status				Trend	Data Quality
	UNKNOWN	POOR	FAIR	GOOD		
2.3 Annual production of wood products from State forests compared to sustainable harvest levels **Data Custodian** VicForests, DELWP	○	○	●	○	↘	DATA QUALITY Good

Of 7.9 million hectares of Crown land in Victoria, about 3.7 million hectares are listed as national parks and reserves, and 3.2 million hectares are listed as multi-use state forest. Both tenures have approximately 3 million hectares of forest cover. According to 2016-17 Resource Outlook, approximately 450,000 hectares in eastern Victoria are considered commercially suitable for timber production;[134] however, only a fraction on this area is actually harvested, with approximately 0.04% (gross area) commercially harvested each year since 2010.

Data shown in Table 26 and Figure 26 indicates that total timber annual production from state forests has been gradually decreasing. The production rate for sawlogs has decreased over the past two decades, from 729,000 m^3 in 1996–97 to 299,740 m^3 in 2016–17. Pulpwood production has decreased at a similar rate to sawlogs since 2004–05. However, production of other products, such as 'E grade' (low grade) logs and cull logs, has increased. Since 2012–13, overall production of wood products from state forests has been stable.

The Resource Outlook (RO) is a forecast of available sawlog hardwood timber in native forests to be commercially supplied from state forests in eastern Victoria.[135] VicForests has a statutory obligation to achieve sustainable production of timber products from native forests. Although the available Ash D+ sawlog volume is expected to reduce between 2020–21 and 2029–30, RO forecasts a consistent supply in the range of 100,000 m^3 until 2029–30 for mixed-species D+ sawlog[136] The reduction in Ash D+ sawlog will be approximately 90,000 m^3 per annum, compared to the 2013 RO. VicForests suggests that this is mainly due to:

- increased protection for Leadbeater's possum and other threatened species
- the decrease in available forest due to resource fragmentation, resulting from the proximity and density of Leadbeater's possum populations
- increased protection (12,000 m^3/annum) of old-growth forest (all pre-1900 ash stands are in a forest management area)
- the removal of forest from the model that VicForests considers unlikely to be able to be accessed due to community and/or market concerns for ecological values.[137]

Sustainable harvest levels have been more than halved over the past decade. A 2017 VEAC report, showing modelling of predicted climate change impacts, suggests that by the end of the century, standing volume and stand density will be reduced by 15%.[138] This would further reduce resource outlook.

VicForests has a statutory obligation to sustainably produce timber from native forests. It takes into account the risk of bushfires and excludes areas of high community interest, such as those with Leadbeater's possum colonies, in its modelling for commercial sawlog timber supply.[139]

134. VicForests, '2016-2017 Resource Outlook', Melbourne, Victoria http://www.vicforests.com.au/planning-1/resource-outlook-2017 Accessed 15 January 2019.
135. VicForests, '2016-2017 Resource outlook', Melbourne, Victoria http://www.vicforests.com.au/planning-1/resource-outlook-2017 Accessed 15 January 2019.
136. Ibid
137. VicForests 2017, 'Annual Report 2016-17', Melbourne, Victoria http://www.vicforests.com.au/static/uploads/files/vicforests-2016-17-annual-report-wfsjtsyiepto.pdf Accessed 4 December 2018.
138. VEAC 2017, 'Fibre and wood supply: Assessment report', Melbourne, Victoria http://veac.vic.gov.au/investigation/fibre-and-wood-supply-assessment/reports Accessed 4 December 2018.
139. VicForests, '2016-2017 Resource Outlook', Melbourne, Victoria http://www.vicforests.com.au/static/uploads/files/vicforests-resource-outlook-2016-17-wfasdtpknkdp.pdf Accessed 4 December 2018.
140. Burgman MA, Church R, Ferguson I, Giijsbers R, Lau A, Lindenmayer DB, Loyn RH, McCarthy M, Vandenberg W 1994, 'Wildlife planning using FORPLAN: a review and examples from Victorian forests', Australian Forestry, 57, pp. 131-140.
141. Blair D, McBurney LM, Blanchard W, Banks SC, Lindenmayer DB 2016, 'Disturbance gradient shows logging affects plant functional groups more than fire', Ecological Applications, 26, pp. 2280-2301.

There has been some concern about sustainable timber production predictions given strong uncertainty about bushfires and previous production rates.[140,141,142] VicForests has therefore increased exclusion areas, where timber harvesting is not allowed, leading to a reduction in wood production.[143]

Moreover, the age structure of the ash forests – mainly mountain ash *(Eucalyptus regnans)* and alpine ash *(Eucalyptus delegatensis)* species – in the Central Highlands in Victoria is heavily imbalanced due to landscape-scale bushfires, including the 1939 Black Friday bushfires and 2009 Black Saturday bushfires (Figure 27). In eastern Victoria, where most commercial native-timber harvesting takes place, most forest stands have regenerated from the 1939 bushfires. However, impacts of the 2009 fires intensified the imbalance of age-class distribution of ash species forests in eastern Victoria. As the Victorian sawlog industry currently relies heavily on the 1939 regrowth ash forests, this will cause a significant decrease of available sawlog production from native forests for a few decades.

Table 26. Annual production of wood products from state forests, 1996–97 to 2016–17

Year	Volume (cubic metres, m³)			
	Sawlogs[A]	Pulpwood	Other products[B]	Total
1996–97	729,000	1,033,000	N/A	1,762,000
1997–98	804,000	1,120,000	N/A	1,924,000
1998–99	821,000	1,165,000	N/A	1,986,000
1999–2000	820,000	1,403,000	N/A	2,223,000
2000–01	667,000	1,580,000	N/A	2,247,000
2001–02	682,000	1,365,000	111,000	2,158,000
2002–03	638,000	1,208,000	117,000	1,963,000
2003–04	[C]530,000	1,291,000	112,000	1,933,000
2004–05	[D,E] 583,000	1,335,000	123,000	2,041,000
2005–06	[D,F] 497,000	1,329,000	109,000	1,935,000
2006–07[G]	428,000	1,241,000	124,000	1,793,000
2007–08	433,000	1,478,000	147,000	2,058,000
2008–09	413,000	1,141,000	158,000	1,712,000
2009–10	443,000	1,250,000	172,000	1,865,000
2010–11	329,525	1,210,024	213,600	1,753,149
2011–12	290,546	980,889	182,503	1,453,938
2012–13	332,054	750,633	189,574	1,272,261
2013–14	304,651	756,425	209,742	1,270,818
2014–15	306,672	758,858	241,205	1,306,735
2015–16	344,746	685,612	285,305	1,315,663
2016–17	299,740	703,730	260,901	1,264,371

A Prior to 2004–05, sawlog volume is expressed as net volume (gross volume minus allowances for defects).
B Other products include E-grade (low grade) logs and cull logs. Data not available before 2001–02.
C Includes 118,000 m³ fire salvage; normal harvest was 412,000 m³.
D Gross sawlog volume
E Includes 50,000 m³ fire salvage; normal harvest was 533,000 m³.
F Includes 27,000 m³ fire salvage; normal harvest was 470,000 m³.
G Over six years (2006–07 to 2011–12), approximately 650,000 m³ of D+ sawlog was harvested from areas burnt by fire.
(Data source: VicForests[144])

142. Blair D, McBurney L, Lindenmayer DB, Banks S, Blanchard W 2017, 'The Leadbeater's Possum review', The Australian National University, Canberra, Australia.
143. VicForests, '2016-2017 Resource Outlook', Melbourne, Victoria http://www.vicforests.com.au/static/uploads/files/vicforests-resource-outlook-2016-17-wfasdtpknkdp.pdf Accessed 4 December 2018.
144. The data is derived from Harvesting History Shapefile from VicForests

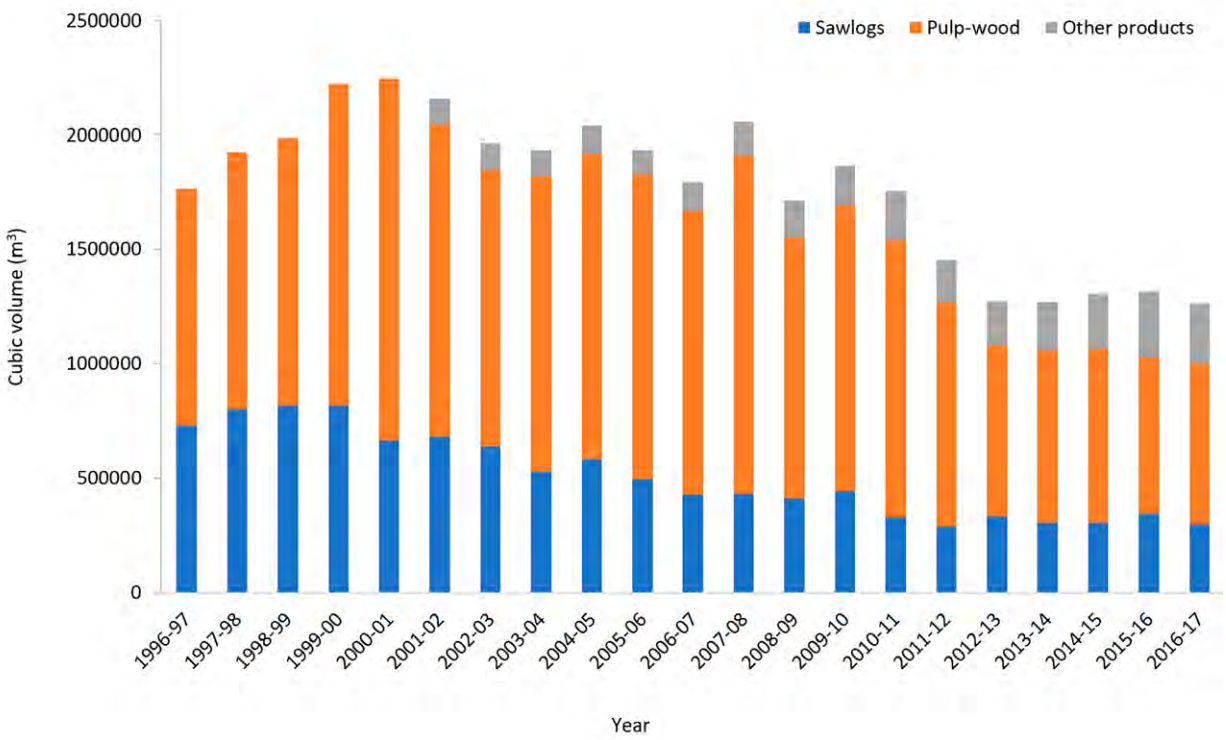


Figure 26. Annual production of wood products from state forests by sawlogs, pulpwood and other products, 1996–97 and 2016–17
(Data source: VicForests 2018)

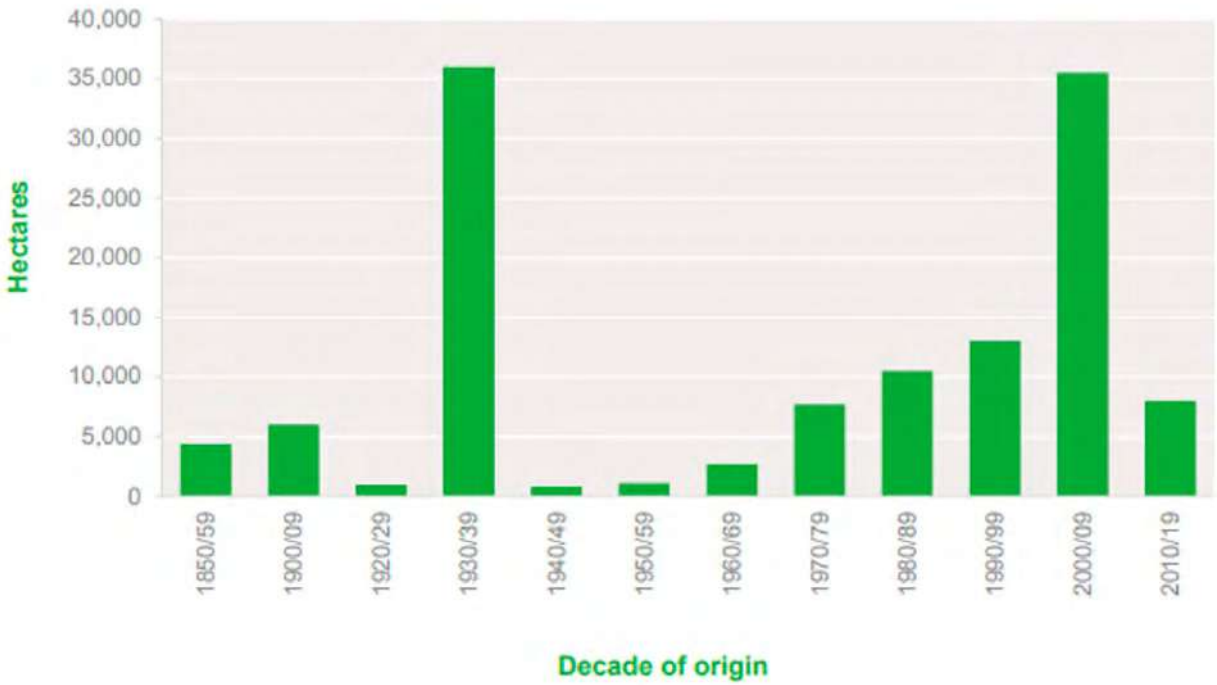


Figure 27. Age class distribution of ash forests
(Data source: VEAC[145])

145. VEAC 2017, 'Fibre and wood supply: Assessment report', Melbourne, Victoria http://veac.vic.gov.au/investigation/fibre-and-wood-supply-assessment/reports Accessed 4 December 2018.

Firewood

The collection of firewood is allowed in Victoria's state forests and in some forest parks. For many Victorians, firewood is an important energy source for heating and cooking. Most of the firewood used is collected by households for domestic use; the rest is taken by commercial firewood collectors. Firewood collection in the forest estate is restricted to certain areas and times of the year. In September 2011, the licence system for domestic firewood collection was discontinued, but licences are still required for commercial collection. Because of the discontinuation, the amount of domestic firewood collected in state forests after 2011–12 is unknown (Table 27). In terms of commercial firewood, total firewood collected in state forests and some forest parks fluctuated between 2001–02 and 2012–13.

Many invertebrate species depend on the availability of dead wood for survival. It is therefore important to monitor and respond to trends in firewood use as part of sustainable forest management. Although volume of firewood will not be an indicator of threat status to an overall ecosystem, it is difficult to assess the impacts of ongoing firewood collection on forest ecosystems.

Table 27. Volume (m^3) of firewood collected with domestic and commercial licences in state forests, 2001–02 to 2016–17

Year	Domestic	Commercial	Total
2001–02	48,207	12,256	60,463
2002–03	54,826	16,022	70,848
2003–04	54,454	18,736	73,190
2004–05	56,660	26,980	83,640
2005–06	51,330	14,149	65,479
2006–07	35,926	9,061	44,987
2007–08	24,484	12,184	36,668
2008–09	24,365	12,530	36,895
2009–10	33,645	8,348	41,993
2010–11	38,981	6,106	45,087
2011–12*	11,652	6,400	11,747
2012–13	N/A	18,165	18,165
2013–14	N/A	14,979	14,979
2014–15	N/A	26,041	26,041
2015–16	N/A	31,971	31,971
2016–17	N/A	35,720	35,720

**The volume of domestic firewood collected is unknown after 2011–12, as the requirement to licence domestic collection was discontinued. (Data source: VicForests 2018)*

	Status (UNKNOWN / POOR / FAIR / GOOD)	Trend	Data Quality
2.4 Annual production of non-wood forest products Data Custodian DELWP, DEDJTR		?	DATA QUALITY Poor

Victorian forests produce a wide range of wood and non-wood products with various uses and values. Non-wood products include beehives, seed, eucalyptus oil and salt. Consistent monitoring of relevant non-wood products can improve our understanding of productivity and trends. This can provide more detailed information for the management of non-wood forest products in Victoria's state forests.

Annual licence statistics for major non-wood product types produced on public land are reported in indicator 6.1b (Value ($) and yield of non-wood forest products), along with information about the economic value of these products.

Seed harvested between 2010/11 and 2016/17 (Figure 28) shows that annual production rate fluctuated dramatically. This is because eucalypts tend to flower very heavily about once every five years, with much lighter flowering and as a consequence, poorer seed crops occur in between.

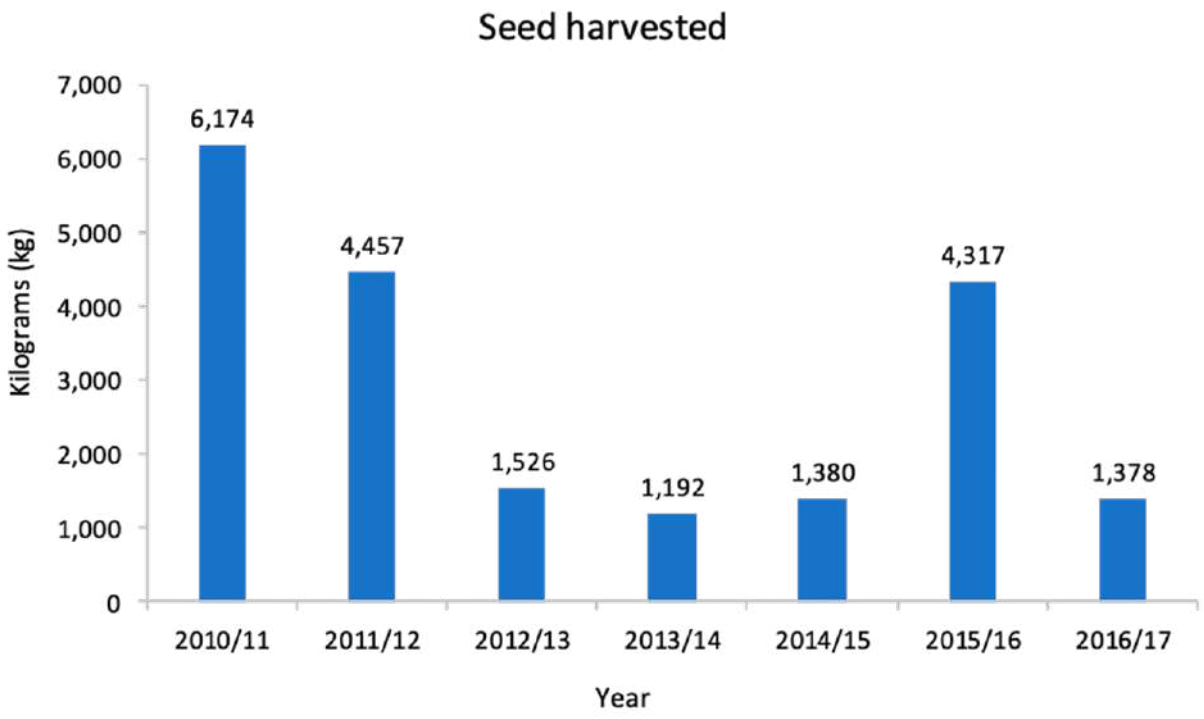


Figure 28. Seed harvested, 2010/11 to 2016/17 (Data source: VicForests 2018)

There have been inconsistencies in the processing of non-wood forest products data across SoF reporting years since 2003 (Table 28). (There is no comprehensive statewide information available for production of non-wood forest products from private land.) For example, SoF 2008 provides data on tree ferns (harvested during salvage operations for permanent clearance and selected harvesting from private and public land), seed harvest, grazing, deer hunting and sand/gravel extraction between 2000–01 and 2005–06. By contrast, SoF 2013 provides information on eucalyptus oil; duck, quail and deer hunting; mineral extractions and seed harvest. Seed harvest is the only type of information that has been consistently reported.

Table 28. Type of non-wood forest products reported in 2003, 2008, 2013 and 2018 SoF reports

Non-wood forest products type	2003 SoF	2008 SoF	2013 SoF	2018 SoF
Apiary	√			
(Value, honey produced, wax)			√	
(As licence and value)				
Seed harvested	√	√	√	√
Eucalyptus oil			√	
Mineral Extraction	√			
(Sand, gravel etc extracted)	√			
(Sand, gravel etc extracted)	√			
(By Rock type)				
Salt extraction	√			
Tree ferns		√		

These inconsistencies make projecting long-term trends and changes in value problematic, which could lead to difficulties in developing management actions. In addition, it is important to compare harvest trends to known sustainable levels to evaluate the most recent status of annual production of non-wood forest products and to develop management strategies.

Criterion 2: Maintenance of productive capacity of forest ecosystems

	Status				Trend	Data Quality
	UNKNOWN	POOR	FAIR	GOOD		
2.5 Proportion of timber harvest area successfully regenerated, by forest type **Data Custodian** VicForests, DEDJTR	○	○	●	○	→	DATA QUALITY Good

To achieve a sustainable level of timber production, regeneration following timber-harvesting activities (post-harvest regeneration) is a key part of maintaining the productive capacity of forests. Monitoring the success of forest regeneration informs understanding of the future availability of forest resources and any impacts on long-term forest productivity. This information supports forest policy and planning activities, and continual improvement in regeneration practices.

The *Code of Practice for Timber Production 2014* (the code) determines that all state forest areas subject to timber-harvesting operations will be regenerated to standards that approximate the original forest composition. Timber harvest managers are required to regenerate all harvested areas.

Successful regeneration is usually achieved at the first attempt 85% to 95% of the time. Failure of regeneration can be due to a range of environmental factors, including death from drought, browsing of seed or seedlings (for example, by wallabies or insects), and frost and snow damage. For areas not regenerated successfully the first time, the harvest manager is required to undertake further regeneration treatments until the minimum standards are met.

The 'Management standards and procedures for timber-harvesting operations in Victoria's state forests 2014', incorporated in the code, lists the minimum regeneration standards required. The standards outline three regeneration features:

1. minimum 65% of plots stocked (standard intensity)
2. no discrete unstocked areas greater than one hectare in even aged stands, or greater than two hectares in uneven aged stands
3. at least 10 acceptable seedlings/coppice of those eucalypt species present on the site prior to harvesting must be present on the regenerated site.

The code also lists the survey techniques that must be followed by the harvest manager to confirm regeneration success. The surveys are to be undertaken 15 to 30 months after seedfall and/or sowing in even aged stands, and 15 to 36 months after seedfall in uneven aged stands.

Table 29 indicates the total harvested area of native forest between 2011–12 and 2016–17, and the total harvested area effectively regenerated between 2011–12 and 2016–17. The areas reported as harvested and the areas regenerated for each year relate to different areas given the time period required to report on regeneration success. Between 2011–12 to 2016–17, 2,059 more hectares have been harvested than regenerated. However, the DEDJTR states that this is simply an indicator of the harvested versus regenerated area in the same specified five-year period, and not whether sustainable harvest was achieved. This data needs to be carefully monitored to ensure that the successful post-harvest timber harvest is fully achieved.

Note that the regeneration data supplied is for eastern Victoria only. Generally, no regeneration is required for harvesting in western Victoria, as the harvesting operations are not clearing-style harvesting, but thinning-style harvesting.

The 2013 audit report of the Victorian Auditor-General's Office (VAGO), *Managing Victoria's Native Forest Timber Resource*, found that the harvest manager, VicForests, was meeting the required regeneration standards. However, VAGO recommended improvements in reporting to better align the reporting of harvesting and its corresponding regeneration.

Table 29. Total area of native forest harvested and effectively regenerated, 2011–12 to 2016–17

Year	Native forest area harvested (ha)	Native forest area effectively regenerated (ha)	Net area regenerated (ha)
2011–12	4,298	4,055	–243
2012–13	3,327	3,397	70
2013–14	2,981	2,242	–739
2014–15	4,331	3,459	–872
2015–16	2,900	2,426	–474
2016–17[146]	2,800	2,999	199
Total	20,637	18,578	–2,059

(Data source: DEDJTR[147] and VicForests[148])

146. Cengea Site establishment cube
147. VicForests, '2015-16 sustainability report', Melbourne, Victoria http://www.vicforests.com.au/about-vicforests/corporate-reporting-1/sustainability-report-2016 Accessed 4 December 2018.
148. Department of Economic Development, Jobs, Transport and Resources, 'Harvest History database (LOGSEASON)', Melbourne, Victoria.

Credit: Wally Notman

Criterion 3: Maintenance of ecosystem health and vitality

Commissioner *for* Environmental Sustainability Victoria

Credit: Tom Fairman

Criterion 3: Maintenance of ecosystem health and vitality

	Status				Trend	Data Quality
	UNKNOWN	POOR	FAIR	GOOD		
3.1 Scale and impact of agents and processes affecting forest health and vitality - mortality, dieback, canopy health **Data Custodian** DELWP	○	○	●	○	?	DATA QUALITY Fair

Mortality, crown dieback and canopy health

Forest health and vitality are critically related to a variety of natural disturbances, which are strongly influenced by climate. In Victoria, natural disturbances can include fire, non-native species invasions, floods, disease outbreaks and climatic events such as windstorms, extreme temperatures and millennial drought events. The above events all influence the composition, structure and functions of forests.

The effects of such disturbances are not always negative. Rather, they can be an important part of natural processes essential to the long-term health of ecosystems. Forests have evolved to overcome and regenerate from certain natural disturbances. However, there have been major shifts recently in the frequency, scale and intensity of the agents and processes that can cause significant disruptions in forest ecosystems, resulting in a dramatic increase in the susceptibility of forest health and vitality. Capturing these shifts through monitoring programs is vital, as predictions indicate that forest ecosystems will be increasingly exposed to these events due to climate change.[149]

Condition of the forest canopy is used globally as an indicator of forest health.[150] This report presents three measures of tree-canopy quality: mortality, crown dieback and canopy health. Mortality is defined as the proportion of the stand basal area (m^2/ha) in dead trees. Basal area is the cross-sectional area of a tree's trunk, measured at 1.3 m above the ground. Crown dieback is the amount of withered branches within the canopy, often over a certain period. This is measured by the VFMP as the proportion of dominant branches in tree crowns lacking living foliage. The crown canopy impacted is a measure of canopy health through defoliation and discolouration, and this is gauged as the percentage of existing foliage over an estimated foliage volume. Due to the application of different methods from previous SoF reports, not all data for this indicator can be compared with previous reports for trend analysis.

Across all Victorian bioregions, the average percentage of areas showing mortality, crown dieback and canopy health impacted are 14.3%, 20.3% and 23.3%, respectively.

As a result of a wide confidence interval of the mortality rate in every forest tenure and in each bioregion (Figure 29), it is difficult to identify significant differences between bioregions and between parks, reserves and state forests except for the Victorian Volcanic Plains, where a higher mortality rate was identified in state forests.

On average, the crown dieback by bioregion was between 16% and 24% of the total large-tree basal area (Figure 30). Bioregions with more than 20% crown dieback included the Australian Alps, Murray–Darling Depression, Riverina and Victorian Volcanic Plains. The eastern parts of Victorian bioregions (South East Coastal Plain, South East Corner and South Eastern Highlands) had lower dieback rates.

In the comparison of parks and reserves with state forests, Riverina had the highest difference: dieback rates in the parks and reserves area were about three times greater than in state forests. The Australian Alps and South East Corner bioregions also had a greater proportion of dieback rates in the parks and reserves than state forests

149. Ian F 2009, 'Fires, Forests and Futures: The ANU Westoby Lecture', Australian Forestry, 72(4), pp. 195-205. DOI: 10.1080/00049158.2009.10676301.
150. Stone C, Haywood A 2006, 'Assessing canopy health of native eucalypt forests', Ecological Management & Restoration, 7, pp. S24-S30.

category (about 10% greater). This may be due to a range of factors, including different site conditions, management history and current uses.

Figure 31 summarises average canopy health affected for measured plots by bioregion. At the bioregion level, canopy condition was worst affected in the Naracoorte Coastal Plain and the western areas of the South East Coastal Plain (around Cape Otway) as well as in the pockets of the Victorian Volcanic Plain, Victorian Midlands, southern areas of the Mallee and eastern areas of the Australian Alps (Central Highlands).

Plot-derived canopy health data was interpolated across the state using the kriging method in ArcGIS software that is widely used for spatial analytics (Figure 32). This method is a geostatistical technique that can predict certain status, in this case canopy health, based on a scattered set of spatial data points from field measurements through the VFMP. This method has been used internationally to estimate forest cover[151] and forest health.[152] Figure 32 demonstrates that there are several Victorian bioregions where degree of leaf damage is more than the average of 30%: Naracoorte Coastal Plain, South Eastern Highlands (including the Otway region), Central Highlands, south of Murray–Darling Depression and Victorian Midlands.

The Australian Alps, which has experienced multiple fires over the past 10 years, has a high proportion of dead stems (Figure 29). Data suggests a similar condition in the Riverina; however, these dead stems occur in isolated pockets, leading to significant variation across the bioregion.

Overall, it would be counterproductive to determine the current status of forest health and vitality in Victoria using tree mortality and dieback rate, as there is no comparative threshold. Although the data presented cannot be used for trend analysis, recent research has shown mortality-rate trends in mountain ash forests in the Central Highlands.

151. Dindaroğlu T 2014, 'The use of the GIS Kriging technique to determine the spatial changes of natural radionuclide concentrations in soil and forest cover', Journal of Environmental Health Science and Engineering, 12(1), pp. 130.
152. Conkling BL 2011, 'Forest health monitoring: 2007 national technical report', General Technical Reports SRS-147, Asheville, NC, US Department of Agriculture Forest Service, Southern Research Station, 147, pp. 1–59.

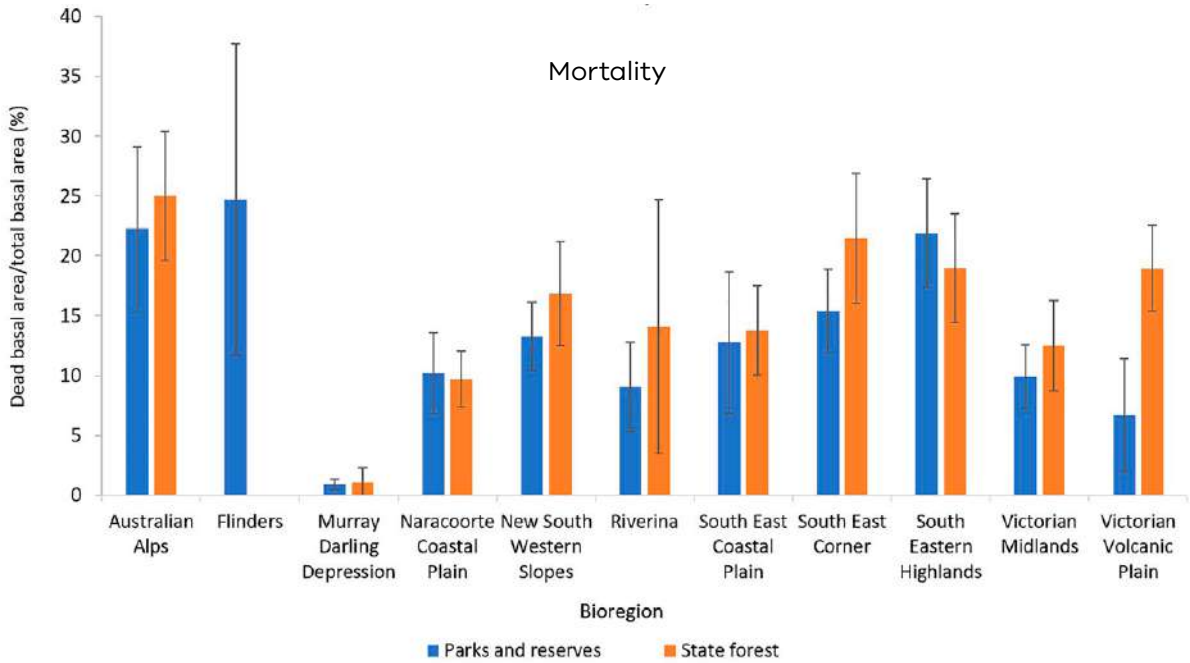


Figure 29. Mortality by bioregion as a proportion of total dead basal area to total live basal area for large trees
Note: Number of plots by bioregion is described in Table 6
(Data source: DELWP 2018)

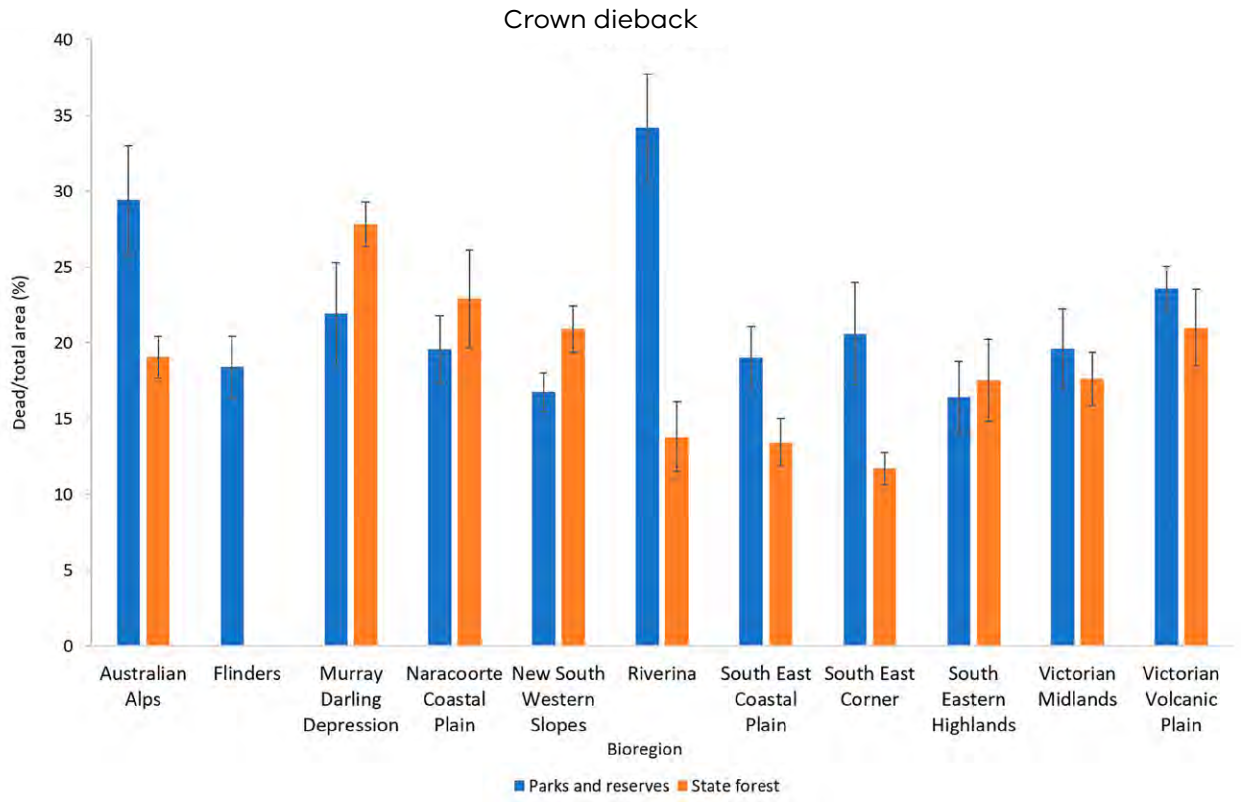


Figure 30. Average crown dieback and defoliation rates for measured plots by bioregion
Note: Number of plots by bioregion is described in Table 6.
(Data source: DELWP 2018)

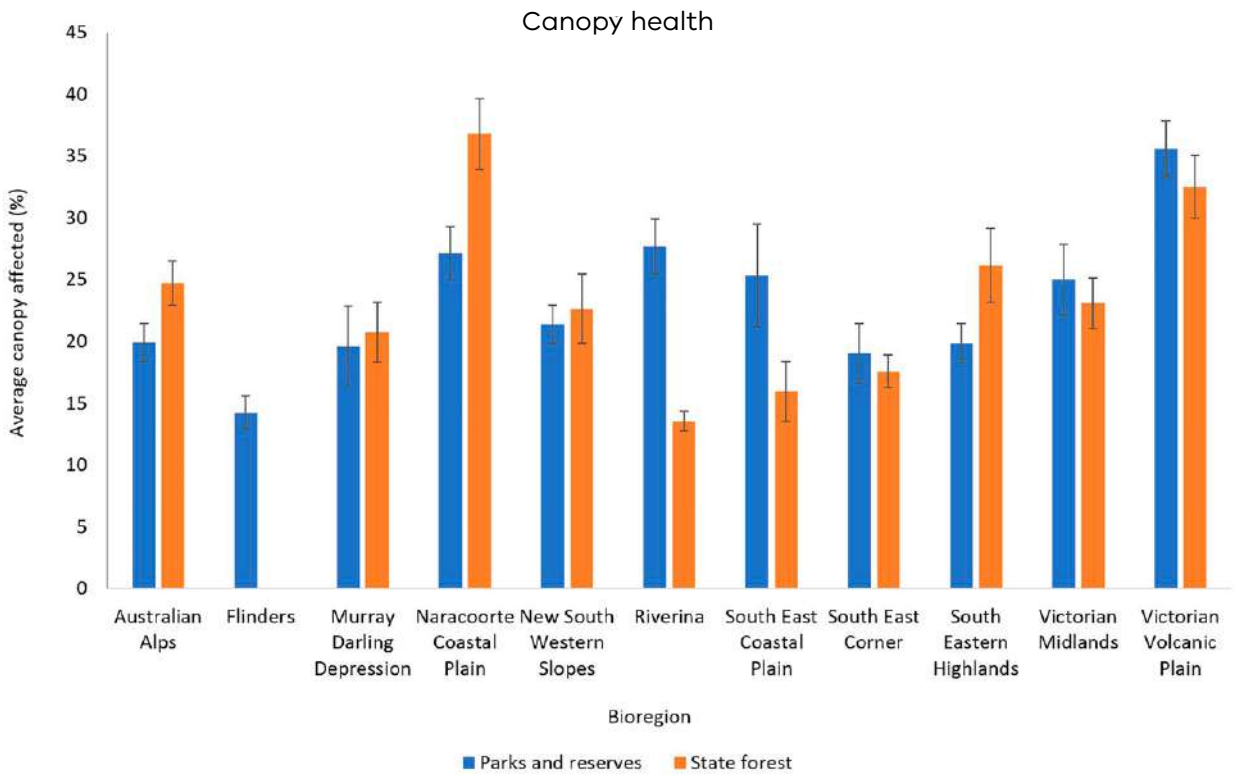


Figure 31. Canopy health as characterised through discolouration and defoliation, by bioregion
(Data source: DELWP 2018)

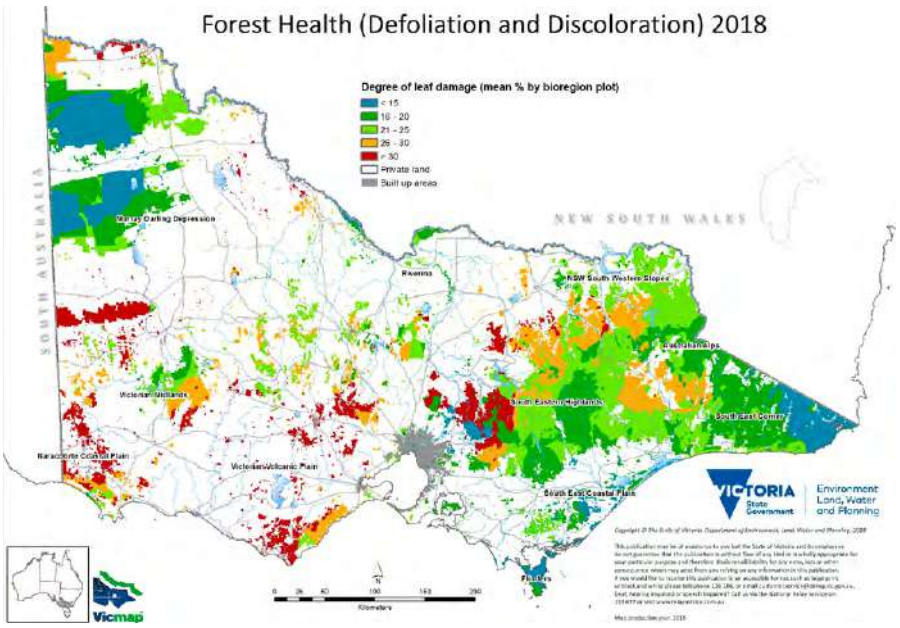


Figure 32. Canopy health (defoliation and discolouration), 2018 (Data source: DELWP 2018)

Between 1997 and 2015, 25% of the measured population died on unburnt sites, while 61% died on burnt sites.[153] Monitoring trends that relate to forest health and vitality is critical to develop strategies and management actions to mitigate deterioration.

	Status				Trend	Data Quality
	UNKNOWN	POOR	FAIR	GOOD		
3.1 Scale and impact of agents and processes affecting forest health and vitality - bushfire affected area and climate **Data Custodian** DELWP, BoM	○	○	●	○	↘	DATA QUALITY Good

Bushfire area

Native flora and fauna in Victoria evolved by adapting for bushfires of varying frequency and intensity. In fact, many native species have become dependent on natural fire regimes for health and survival. Fire regimes comprise four parameters: fire intensity, fire frequency (between-fire interval), seasonality of fire occurrence and type of fire (above or below-ground).[154]

The effects of fire on forest ecosystems are determined by fire intensity. 'Fire intensity' varies depending on the position of the periphery of the fire.[155] Victorian forests can experience very intense canopy fires during summer where warm, dry and windy weather conditions occur, and this can lead to large-scale replacement and regeneration of mature tree populations. Victorian mountain ash and alpine ash forests are especially susceptible to significant alterations, as the canopy-tree species are fire-sensitive, and can be replaced by acacia scrub if burnt by two fires at an interval less than the time it takes for the eucalypts to reach sexual maturity. The effects of intense, extensive fires also extend to long-term effects on streamflow, threatened species survival and subsequent invasions by exotic species. Therefore, it is important to understand fire-affected areas for sustainable forest management. Areas where major bushfires affected are described in Figure 33.

153. Lindenmayer DB, Blanchard W, Blair D, McBurney L 2018, 'The road to oblivion – quantifying pathways in the decline of large old trees', Forest Ecology and Management, 430, pp. 259-264.
154. Gill AM 1975, 'Fire and the Australian flora: a review', Australian Forestry, 38, pp. 4-25.
155. Ibid

Unattended campfires constitute a large proportion of the fires reported on public land. Compliance concerning campfire use is managed by Parks Victoria, together with DELWP, Victoria Police and the Country Fire Authority (CFA). The most damaging bushfire on record is the Wye River-Jamieson Track fire, instigated by lightning on 19 December 2015.

The fire exceeded control lines on Christmas Day under extreme weather conditions, burning 2,520 hectares of national park and private properties, including an estimated 160 houses.

Between 2013 and 2014, Victoria experienced its most significant fire season since 2008, which challenged emergency services and Victorian communities. Across the season, Victoria had 19 days of Extreme and Severe Fire Danger Rating and 16 days of Total Fire Ban. More than 463,000 hectares of public and private land was burnt, and 80 residences destroyed.[156]

The respective land management and fire agencies (including the CFA, Department of Environment and Primary Industries and their Networked Emergency Management partners, consisting of Parks Victoria, VicForests and Melbourne Water and the Metropolitan Fire Brigade) responded to more than 4,600 bushfires and grassfires over a five-month period. The years between 2015 to 2017 have seen relatively low fire activity (Figure 34).

156. Emergency Management Victoria 2013, 'Post season operations review: fire danger period 2013/14', Melbourne, Victoria http://files.em.vic.gov.au/EMV-web/Fire-Danger-Period-Operational-Review-2013-14.pdf Accessed 4 December 2018.

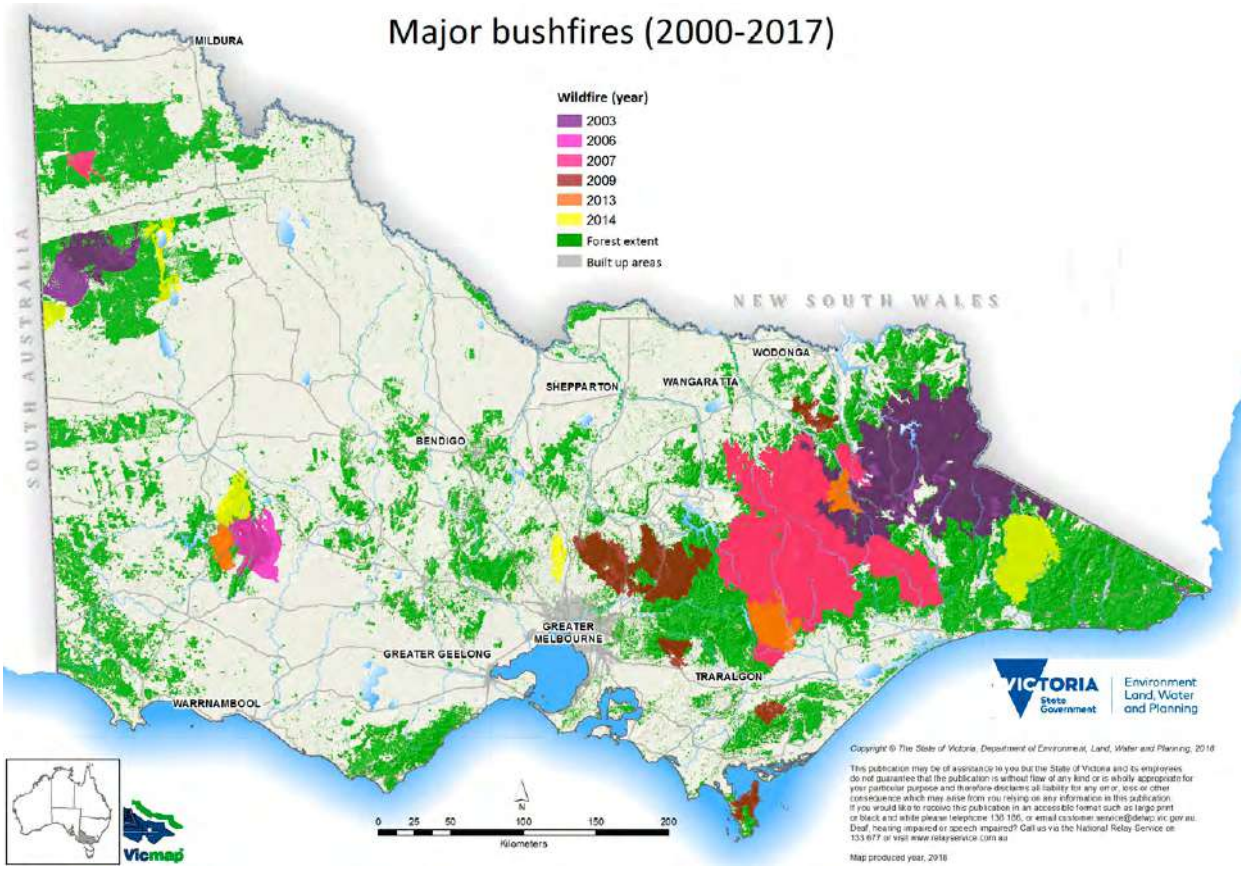


Figure 33. Major bushfires in Victoria, 2000–2017 (Data source: DELWP 2018)

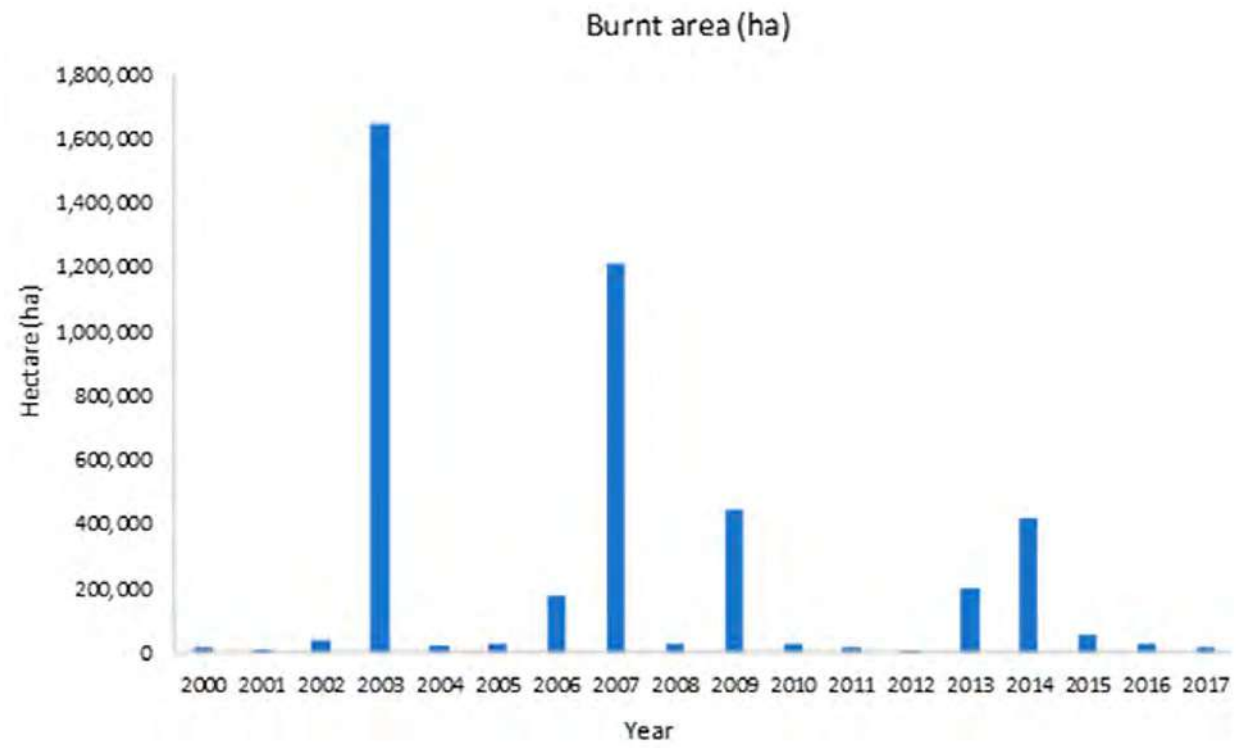


Figure 34. Total area affected by bushfires, 2000–2017 (Data source: DELWP 2018)

Climate

The health and vitality of forests is critically related to climatic patterns and events. Forest health and vitality are affected by conditions such as rainfall deficit and extreme temperatures, with impacts on mortality, defoliation and withering in trees and their understorey, reduced productivity, regenerative abilities, and resources for forest-dependent species.

High temperatures and drought induced by prolonged rainfall deficiency can also augment fire activity and degrade overall land condition. Forests in drought stress are also more prone to infections and insect invasions. Recent anthropogenic events have created an extreme climatic environment, in which it is becoming increasingly difficult to maintain healthy and vital forest ecosystems.[157] Native ecosystems in which species have evolved have been rapidly changing, and studies[158,159] have indicated that the speed of the change could be too fast for some native species to adapt. This could lead to dramatic consequences, including species extinction.

The Victorian climate has been gradually warming from the 1950s (Figure 35). Since SoE 2013, every year since has been among the top-ten warmest in Victoria on record,[160] with 2014 the second-warmest on record (behind 2007). The temperature increase is observed in both daytime (maximum) and overnight (minimum) temperatures, with the greatest degree of warming in summer (+0.14 °C per decade) and the smallest in winter (+0.06 °C per decade).

157. Keenan RJ 2015, 'Climate change impacts and adaptation in forest management: a review', Annals of Forest Science, 72(2), pp. 145-167.
158. Thuiller W 2007, 'Biodiversity: climate change and the ecologist', Nature, 448(2), pp. 550-552.
159. Dawson TP, Jackson ST, House JI, Prentice IC, Mace GM 2011, 'Beyond predictions: Biodiversity conservation in a changing climate', Science, 332, pp. 53-58.
160. Bureau of Meteorology, 'Heatwave Service for Australia', Melbourne, Victoria www.bom.gov.au/australia/heatwave Accessed 4 December 2018.

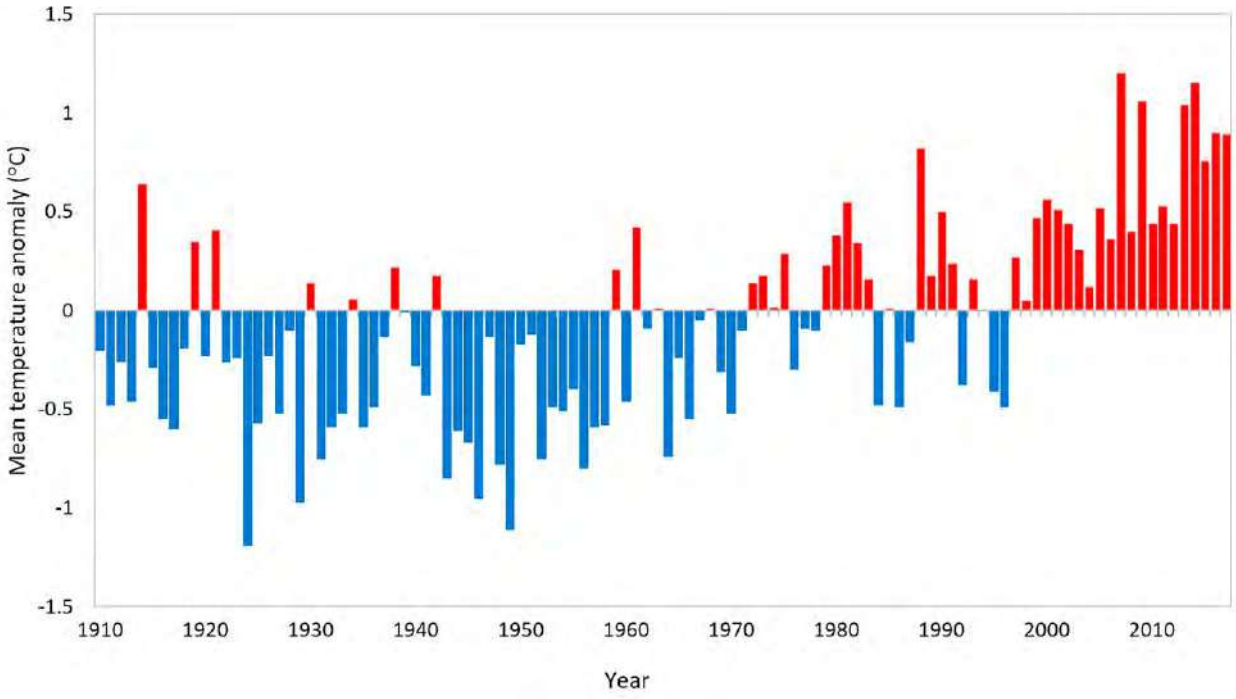


Figure 35. Victorian mean temperature anomaly, 1910–2017 (Data source:BoM[161])

The temperature increase in Victoria was widespread, with the greatest increases in the central and southern parts of the state. A uniform increase in daytime temperature can be observed throughout the state, with the exception of parts of Gippsland, the far-west, and north-east of the state, where the increase was marginally slower. The southern coastal areas have experienced the greatest increases in overnight temperature, with a smaller degree of night-time warming in inland parts of Victoria. This could be a result of reduced rainfall and cloud cover in the cool season, which may have mitigated some effects of global warming in the central region.

A greater number of extreme heat events in Victoria are a consequence of the warmer climate, as indicated by an increase in the number of unusually warm days per year in Victoria (Figure 36). Unusually warm days have been calculated based on average temperatures recorded each day from 1910 until 2015. Data for those 105 years was then used to calculate average temperature by month. This result is compared to the average temperature each day for 105 years of data: days in the top 1% for each month are counted as 'unusually warm'.

161. Bureau of Meteorology, 'Climate change and variability', Canberra, Australia. http://www.bom.gov.au/climate/change/index.shtml#tabs=Tracker&tracker=timeseries Accessed 9 January 2019.

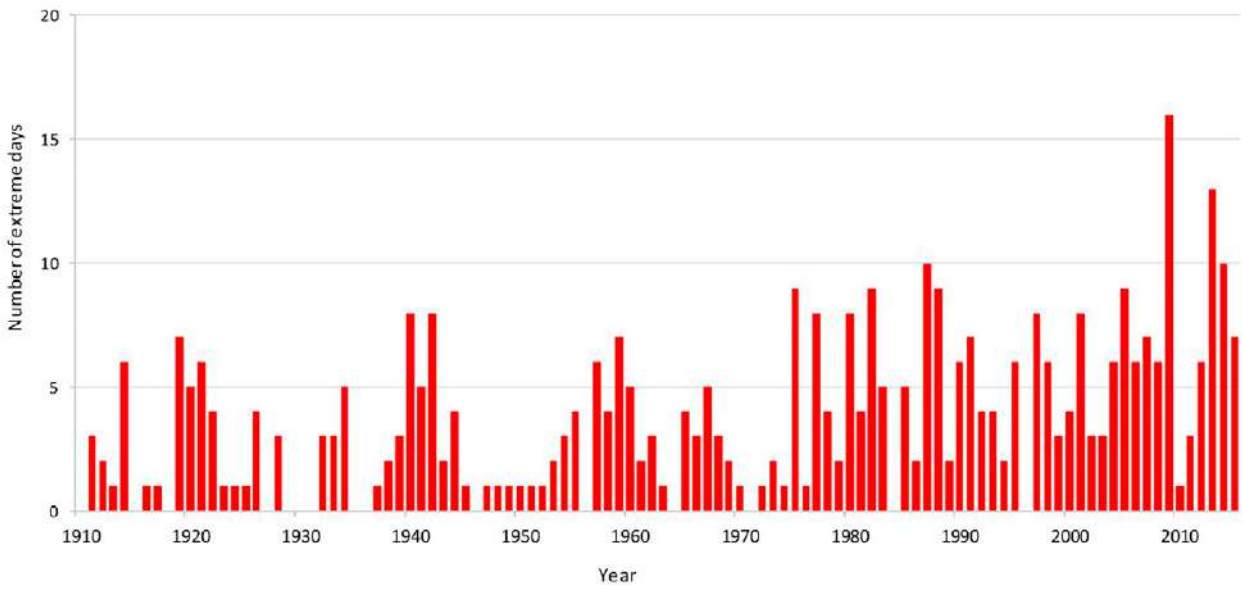


Figure 36. Number of days annually when the Victorian area-averaged daily mean temperature is 'unusually warm', 1910–2015
Note: Extreme days are those above the 99th percentile of each month from 1910–2015.
(Data source: BoM[162])

162. Bureau of Meteorology, 'Climate change and variability', Canberra, Australia http://www.bom.gov.au/climate/change/index.shtml#tabs=Tracker&tracker=timeseries Accessed 13 January 2019.

Credit: Wally Notman

Criterion 3: Maintenance of ecosystem health and vitality

	Status				Trend	Data Quality
	UNKNOWN	POOR	FAIR	GOOD		
3.2 Area and type of human-induced disturbance - planned burns **Data Custodian** DELWP	○	○	●	○	?	DATA QUALITY Good

Disturbance is the transition of a short-term change in environmental conditions to the long-term change of an ecosystem. The impacts of human-induced disturbances (intentional or unintentional) on forest ecosystems have been extensively reported throughout the world.[163] In Victoria, extensive planned fire activities, intensive grazing, and roads have been identified as factors that have great potential to affect forest ecosystem health. Observing the various forms and significance of these disturbances would allow better understanding of anthropogenic impacts on forest health, as well as help to formulate appropriate mitigation strategies. This report discusses two major causes of disturbances: planned burns and grazing.

Planned burns

Fuel management is an effective way to manage bushfire risk on large areas of public land. Fuel management reduces the amount of fuel available to a bushfire, which can reduce its intensity and rate of spread, thereby increasing opportunities for firefighters to suppress it. Victoria mainly manages fuel by planned burns, but also by mechanical treatment. Definition of planned and unplanned burns is provided in Table 30. For fuel management purposes, Victoria has four fire management zones:

- Asset Protection Zone (APZ): an area around properties and infrastructure where fuel is intensively managed to provide localised protection to reduce radiant heat and ember attack on life and property in the event of a bushfire
- Bushfire Moderation Zone (BMZ): an area around properties and infrastructure where fuel is managed to reduce the speed and intensity of bushfires and to protect nearby assets, particularly from ember attack in the event of a bushfire
- Landscape Management Zone (LMZ): an area where fuel is managed to minimise the impact of major bushfires, to improve ecosystem resilience and for other purposes (such as to regenerate forests and protect water catchments)
- Planned Burning Exclusion Zone (PBEZ): an area where planned burning is avoided, mainly because ecological assets in this zone cannot tolerate fire.

DELWP conducts planned burns to meet the objectives of the relevant fire management zone and other site-specific objectives.

Following the 2010 final report by the 2009 Victorian Bushfires Royal Commission, the Victorian Government committed to expanding its planned-burning approach by aiming to reduce fuel hazards and protect human life.

But in 2016, based on recommendations by the Inspector-General for Emergency Management, the government began to shift from a hectare-based approach to a risk-based approach to bushfire management. This focuses on areas where the likelihood of a bushfire starting, spreading and impacting on people, property and the environment is greatest, based on fire-modelling results. The government is developing a system of bushfire management strategies to reduce risk, which will be delivered by 2020.

Due to the new approaches for planned burns since 2016–17, trend analysis could not be conducted.

163. Zamorano-Elgueta C, Cayuela L, Ray-Benayas MR, Donoso PJ, Geneletti D, Hobbs RJ 2014, 'The differential influences of human-induced disturbances on tree regeneration community: a landscape approach', Ecosphere, 5(7), pp. 90.

Credit: Matt Zanini

Table 30. Definition of planned and unplanned burns

Planned Fire	Unplanned Fire
Fire started in accordance with a fire management plan, or some other type of planned-burning program or wildfire response procedure. Usual reasons for such fires may include: • fulfilling the ecological requirements of flora and fauna • protecting of human life and property • maintaining and promoting sustainable production values • maintaining cultural resources and practices.	Fire started naturally, accidentally or deliberately, but not in accordance with planned fire management activities. Examples include: • lightning strikes • escaped campfires or barbeques • fires resulting from equipment or machinery • fires deliberately lit without the necessary permits or authority (and those lit with malicious intent) • escaped planned burns.

(Data source: DELWP 2018)

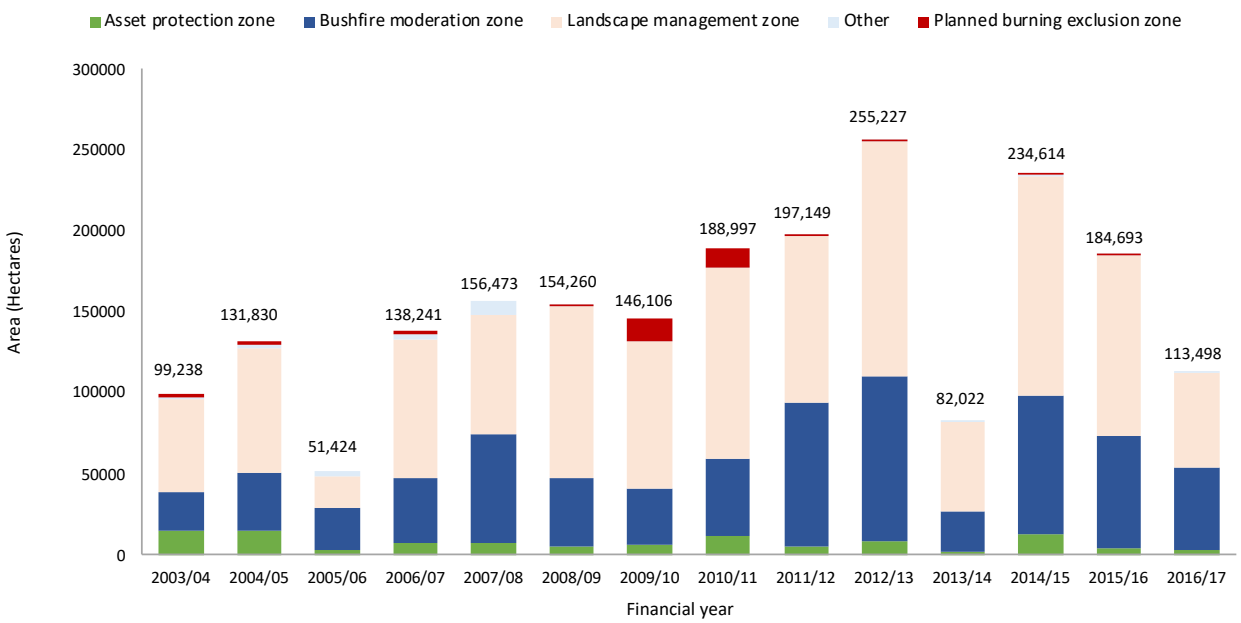


Figure 37. Annual area of planned burns on public land, by fire management zone, 2003–04 to 2016–17 (Data source: DELWP 2018)

	Status (UNKNOWN / POOR / FAIR / GOOD)	Trend	Data Quality
3.2 Area and type of human-induced disturbance - grazing Data Custodian DELWP		→	DATA QUALITY Poor

Grazing

Analysis of grazing activity helps to assess and address issues relating to conservation of native plant biodiversity, water yield and agricultural practices. Pastoral farming is a major contributor to Australia's economy. About two-thirds of Australia's land has been modified for human use, primarily grazing of livestock, including on natural vegetation.[164] Studies indicate that grazing by non-native animals such as cattle and sheep could damage native plant biodiversity and water yield.[165,166]

To balance conservation with agricultural needs, the Victorian Government regulates grazing by issuing licences and permits. These are annual licences with invoices issued each October. Licences can be issued under the *Land Act 1958* and *Forests Act 1958*. They give the licence-holder the right to occupy stipulated Crown land for agricultural purposes, grazing and some cropping (although purposes can vary).

Annual invoices, shown in Table 31, are the sum of payment for rent or other activities on Crown land. Between 2012 and 2013 and 2016 and 2017, licence numbers have been stable. However, the data does not indicate area used for grazing activities. In addition, there is no or limited information about where grazing is occurring under licence. Grazing in some areas, such as those near catchment areas, may be more harmful to the environment. Therefore, it is difficult to determine whether the current number of grazing licences is environmentally sustainable. An evidence-based approach to determining the sustainable level is urgently needed.[167]

164. Australian Bureau of Statistics 2010, '4613.0-Australia's environment: issues and trends, Jan 2010', Belconnen, Australia http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/4613.0Chapter95Jan+2010 Accessed 4 December 2018.
165. Bromham L, Cardillo M, Bennett AF, Elgar MA 2009, 'Effects of stock grazing on the ground invertebrate fauna of woodland remnants', Austral Ecology, 24(3), pp. 199-207.
166. Lunt ID 2005, 'Effects of stock grazing on biodiversity value in temperate native grasslands and grassy woodlands in SE Australia: a literature review', Technical Report 18, Wildlife Research and Monitoring, Lyneham, Australia https://www.environment.act.gov.au/__data/assets/pdf_file/0007/576520/technicalreport18effectsofstockgrazingonbiodiversityvalues.pdf Accessed 4 December 2018.
167. Dorrough J, Yen A, Turner V, Clark SG, Crosthwaite J, Hirth R 2004, 'Livestock grazing management and biodiversity conservation in Australian temperate grassy landscapes', Australian Journal of Agricultural Research, 55(3), pp. 279-295.

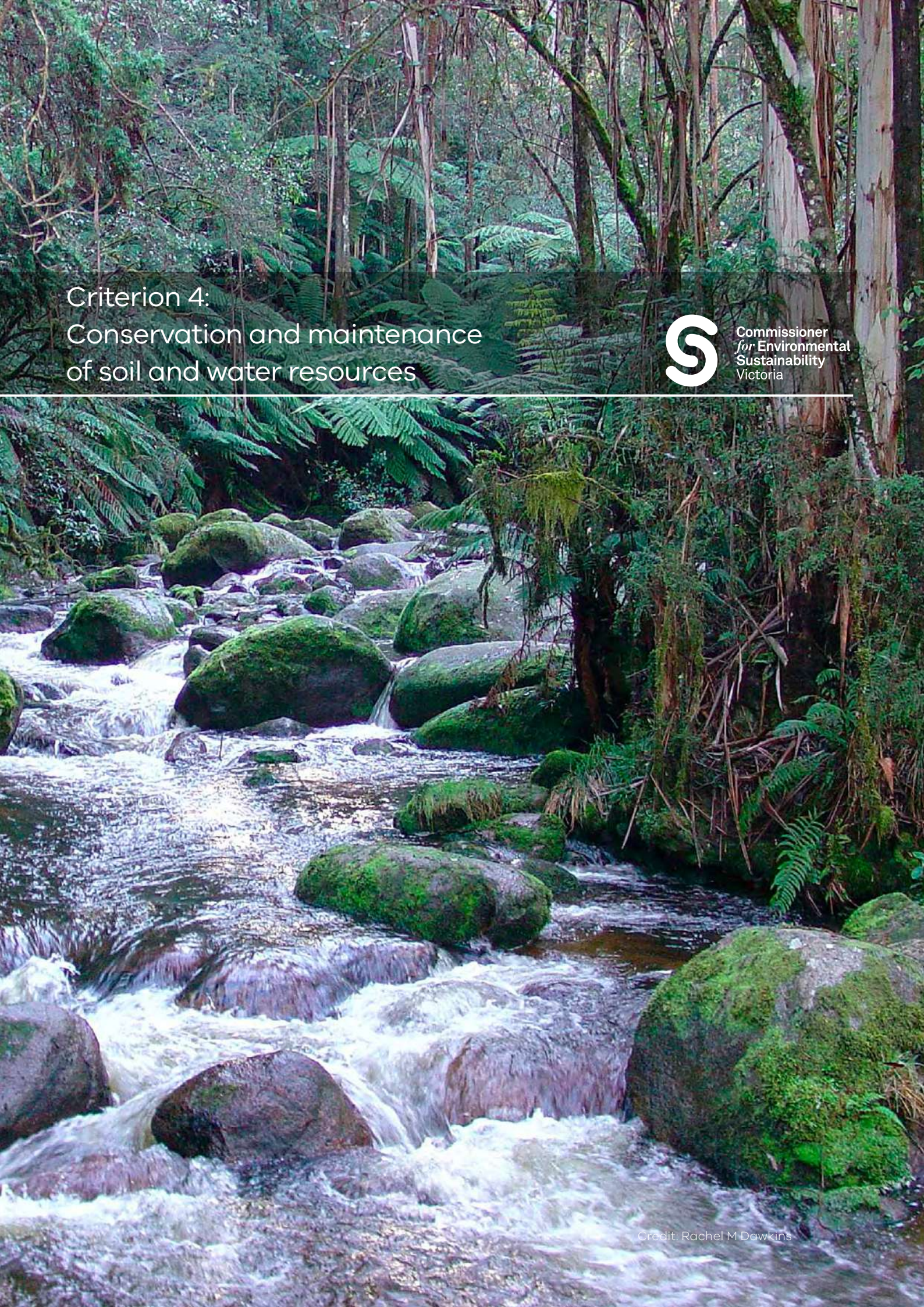
Table 31. Number of licences issued for grazing activities, 2012–13 to 2016–17

Year	No. of licences	Invoiced	Invoices (exc. GST)
2012–13	1,689	253,171	230,156
2013–14	1,681	239,307	217,551
2014–15	1,692	240,661	218,783
2015–16	1,698	240,220	218,382
2016–17	1,710	241,162	219,238

(Data source: DELWP 2018)

Criterion 4: Conservation and maintenance of soil and water resources

Commissioner *for* Environmental Sustainability Victoria



Credit: Rachel M Dawkins

Criterion 4: Conservation and maintenance of soil and water resources

	Status (UNKNOWN / POOR / FAIR / GOOD)	Trend	Data Quality
4.1 Area and percentage of forest by activity type, systematically assessed for risk to soil attributes **Data Custodian** DELWP	○ ○ ○ ●	↗	DATA QUALITY Good

Soil quality is critical to regulation processes in forest ecosystems, including plant production and ecological and hydrological functions. Soil can hold and provide water and nutrients, store organic matter and provide suitable habitat for a wide range of organisms. By assessing changes in key soil properties, appropriate forest management actions and strategies can be developed. For example, management actions may include removing and redistributing soil nutrients and soil organic matter, or altering the physical properties of soil to enhance productivity and other ecosystem services. This indicator aims to evaluate soil properties, compliance with soil disturbance standards, and current disturbances, to assess whether levels are acceptable for sustainable forest management.

To support river health and soil conservation in public forests, a regulatory framework has been established in Victoria (Table 32). The framework includes legally binding instruments, recognised and enforceable by law. The table's categories, from 1 to 4, show how each assist with soil conservation and river health.

Substantial changes have been made to elements of the regulatory framework, including:

- review and update of the Code of Practice for Timber Production 2007 to the Code of Practice for Timber Production 2014. This included streamlining the environmental regulatory framework for harvesting managers, harvesting entities and operators conducting and planning timber harvesting operations[168]
- revocation of Sustainable Forests (Timber Harvesting) Regulations 2006 in 2014 (no longer in operation)
- replacement of 'Management procedures for timber harvesting, roading and regeneration in Victoria's state forests 2009' with 'Management standards and procedures for timber harvesting operations in Victoria's state forests, 2014'.[169] This document was supplemented by 'Planning standards for timber harvesting operations in Victoria's state forests 2014'.[170]

168. Victorian Department of Environment and Primary Industries 2014, 'Code of Practice for Timber Production 2014', Melbourne, Victoria https://www.forestsandreserves.vic.gov.au/__data/assets/pdf_file/0016/29311/Code-of-Practice-for-Timber-Production-2014.pdf Accessed 5 December 2018.
169. Department of Environment and Primary Industries 2014, 'Management Standards and Procedures for timber harvesting operations in Victoria's State forests 2014', Melbourne, Victoria https://www.forestsandreserves.vic.gov.au/__data/assets/pdf_file/0023/29309/Management-Standards-and-Procedures-for-timber-harvesting-operations-in-Vics-State-forests-2014.pdf Accessed 5 December 2018.
170. Department of Environment and Primary Industries 2014, 'The Planning Standards for timber harvesting operations in Victoria's State forests 2014', Melbourne, Victoria https://www.forestsandreserves.vic.gov.au/__data/assets/pdf_file/0021/29307/Planning-Standards-for-timber-harvesting-operations-in-Vics-State-forests-2014.pdf Accessed 5 December 2018.

Table 32. Instruments that address forest-related soil attributes in Victoria

Instrument	Legally binding	Public land tenure	Forest activity	Category[A]
Catchment and Land Protection Act 1994	Yes	All	All	3
Heritage Rivers Act 1992	Yes	All	Timber production, mining, grazing, roading, clearing, water regulation	2, 3
Land Conservation (Vehicle Control) Act 1972	Yes	All	Vehicle use, general recreation	2
Water Act 1989	Yes	All		3
Environment Protection Act 1970	Yes	All	All	3
Forests (Recreation) Regulations 2010	Yes	State forest	General recreation	2
National Parks (Park) Regulations 2003	Yes	National and state parks	General recreation	2
Code of Practice for Timber Production 2014	Yes	All	Timber production	1
Code of Bushfire Management on Public Land 2012	Partially	All	Bushfire management	1
Forest management plans	Partially	State forest	All	4
Management standards and procedures for timber harvesting operations in Victoria's state forests, 2014	Partially	State forest	Timber production and roading	1
Planning standards for timber harvesting operations in Victoria's state forests, 2014	Partially	State forest	Timber production and roading	1
Native forest silviculture guidelines	No	State forest	Timber production	4
Mining and exploration guidelines	No	All	Mining	4

[A] Description of categories:

- Category 1 specifies requirements to assess risk to soil attributes, and standards and procedures for forest activities to control risks to soil attributes
- Category 2 specifies controls over the type and location of forest activities for soil conservation or river health purposes e.g. the *Land Conservation (Vehicle Control) Act 1972* prohibits use of vehicles in declared erosion hazard areas
- Category 3 provides for the administration of soil conservation or river health e.g. the *Catchment and Land Protection Act 1994* provides for the establishment of special areas (including special water supply catchment areas) and establishes management responsibilities
- Category 4 provides guidance on soil conservation methods.

(Data source: DELWP 2018)

Among the instruments, timber production and bushfire management are the only forest activities with legally binding and systematic requirements to assess risk to soil attributes. The relationship between these two activities and soil conservation and river health is well-documented.[171]

The overall objective of the Forest Audit Program (FAP) is to provide an independent, objective assessment of VicForests' level of compliance with the environmental regulations for timber production in state forests – especially with the Code of Practice for Timber Production 2014. Audits prior to 2014 related to the Code of Practice for Timber Production 2007. The audit reports are made public, to inform the community of the standard of environmental management applied to state forests. Audit results are summarised in Table 75 in indicator 7.2 (Extent to which the institutional framework supports the conservation and sustainable management of forests).

DELWP commissioned independent auditors to assess compliance with the regulatory framework for harvesting and roading activities across 34 coupes in state forests in the Central, Central Gippsland, Dandenong and East Gippsland Forest management areas (FMAs).

Selection of the coupes to audit was related to three themes:

- protection of soil, water and biodiversity values
- design construction, maintenance and closure of in-coupe roads
- forest regeneration (targeted at coupes with high-risk features, such as waterway crossings and long in-coupe roads, or at areas of special value, such as rainforests).

On average, the audited coupes fully complied with 86% of applicable environmental and roading criteria (Table 33). The average level of compliance for individual coupes ranged from 71% to 100%. The average level of compliance ranged across the audit themes as follows:

171. Weston CJ, Attiwill PM 1990, 'Effects of fire and harvesting on nitrogen transformations and ionic mobility in soils of Eucalyptus regnans forests of south-eastern Australia', Oecologia, 83(1), pp. 20-26.

Table 33. Average level of compliance ranged across six audit themes

Environmental compliance elements	%	Roading compliance elements	%
Protection of forest soils	83	Road design	57
Protection of water flows, water quality and river health	85	Road construction	79
Protection of biodiversity values	90	Road maintenance and closure	73
Overall level of compliance	86		

(Data source: DELWP 2018)

These audit reports identified issues and made recommendations to both VicForests and DELWP. The reports have been published on the DELWP website along with formal responses from VicForests and DELWP.

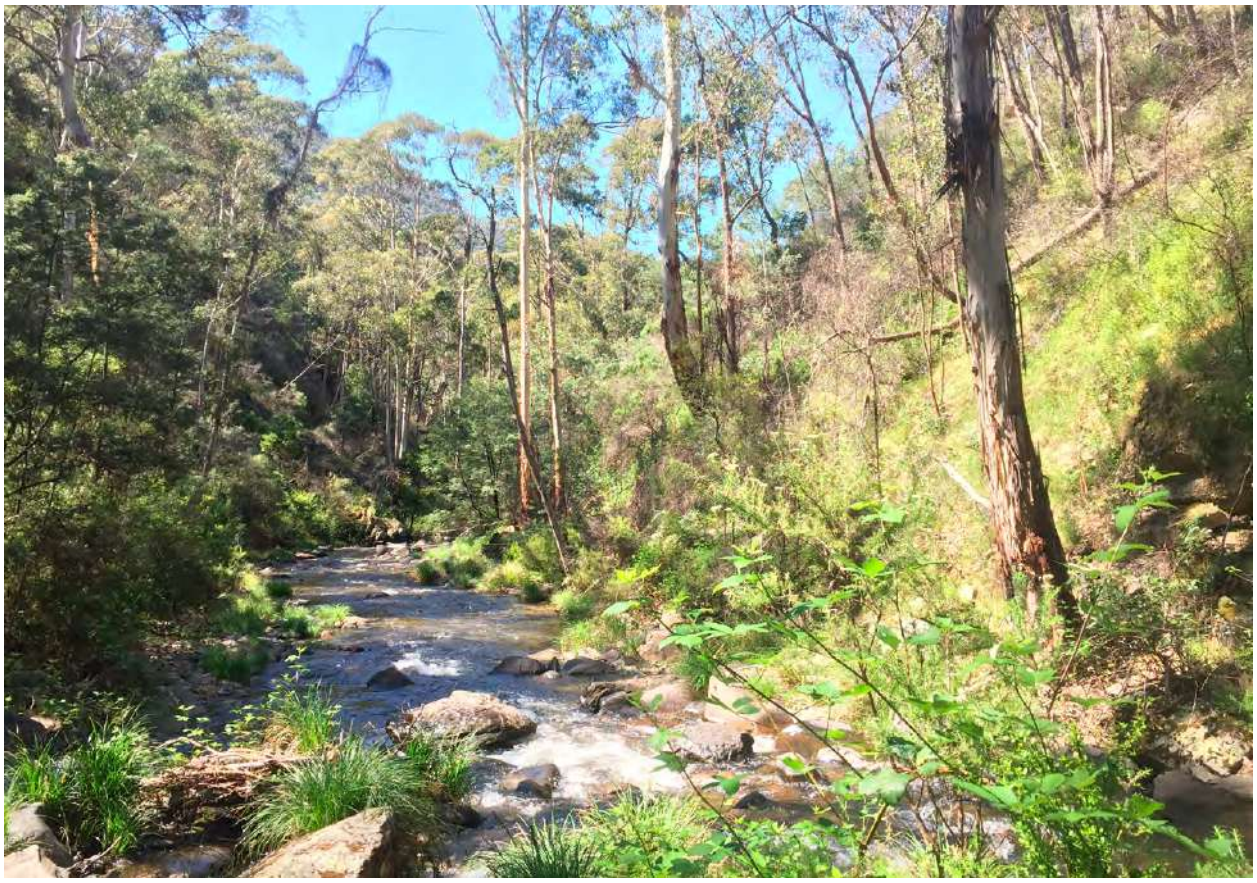
Following the 2009 bushfires, the Bushfire Rapid Risk Assessment Team (BRRAT) program began rapid assessment of the major risks to human life, infrastructure, property and the natural environment on public land after emergency events such as fire and flooding.

The BRRAT teams are comprised of multi-disciplinary members, deployed to level 2 or 3 incidents while the incident is still underway (scope of level 2 and 3 incidents are described by Emergency Management Victoria[172]). The results of each deployment need to be reported within seven days. The reports focus on providing alerts to government agencies about the magnitude of potential post-emergency risks, where more detailed rehabilitation and/or recovery planning is required.

Table 34 is a summary of some of the fires to which the BRRAT team were deployed between 2013 and 2017. The team includes a flooding and erosion discipline specialist who assesses risks caused by water quality, flooding and erosion post-fire. The specialist also makes recommendations for mitigation actions to ameliorate these risks. These assessments are used to assist land managers in identifying and minimising future (immediate and long-term) negative impacts.

In 2013, 162,000 hectares were highlighted for erosion risks and mitigation options following BRRAT deployments; in 2014, 330,130 hectares were highlighted. Since 2015, identified areas decreased significantly.

172. Emergency Management Victoria 2015, 'Fundamentals of emergency management (Class 1 emergencies)', edition 1, Melbourne, Victoria https://files-em.em.vic.gov.au/public/Doctrine/Fund/Fundamentals-EMC1.pdf Accessed 9 January 2019.



Credit: Matt Zanini

Table 34. Summary of some of the highlighted erosion risks and mitigation options identified by BRRAT deployments, 2012–13 to 2017–18

Fire	Risk description	Risk level	Likelihood	Consequence	Suggested mitigation work	Season	Area (ha)
2017 Timbarra	Flash-flooding and debris flow impacting on Timbarra Road	Moderate	Possible	Important	Alert local government to risk and road closure during high rainfall events	2017–18	8,693
2016 Wye river – Jamieson track	Landslide Great Ocean Road	Moderate	Possible	Serious	Immediate geotechnical investigation; Otways post-fire hydrology study	2015–16	2,515
2015 Lancefield	Soil erosion leading to poor water quality affecting Pyalong water supply	High	Likely	Serious	Containment line rehabilitation; sediment retainers in gullies	2014–15	3,055
2014 Orbost complex	Soil erosion leading to poor water quality in the Brodribb River catchment	Moderate	Likely	Important	East Gippsland Water to activate its Water Quality Contingency Plan	2013–14	174,600
2014 Grampians northern complex	Land and infrastructure impacted by landslide	Medium	Likely	Important	Restricted access to high-risk areas of the park; signage and education/ awareness for park users	2013–14	54,790
2014 Mallee complex	Landforms impacted by wind erosion	Moderate	Almost certain	Important	Assessment of sand dune and lunette vegetation cover; control-line rehabilitation	2013–14	100,750
2013 Baw Baw Heyfield group	Debris flows impact water quality flows to Lake Glenmaggie	High	Likely	Major	Southern Rural Water informed of risks to water quality; Southern Rural Water implement treatment options and monitoring	2012–13	87,600
2013 Grampians Victoria Valley	Land and infrastructure impacted by landslide	High	Almost certain	Important	Restricted access to high-risk areas of the park; signage and education/ awareness for park users	2012–13	35,900
2013 Alpine bushfires	Landslide Great Alpine Road	Extreme	Almost certain	Major	Closure of Great Alpine Road and geotechnical assessment	2012–13	38,500

(Data source: DELWP 2018)

Criterion 4: Conservation and maintenance of soil and water resources

	Status (UNKNOWN / POOR / FAIR / GOOD)	Trend	Data Quality
4.2 Change in forested catchment water yield characteristics through time **Data Custodian** DELWP	○ ○ ● ○	↘	DATA QUALITY Good

Water yield characteristics indicate the amount of water available for forest ecosystems and human use. In Victoria, many upstream catchments are in forested areas, meaning that changes to forest conditions, from impacts such as natural disturbances, human activities and climatic shifts, can subsequently impact water yield.

For example, following bushfire in ash-type eucalypt forests, there is a dramatic reduction in water yield as vegetation regenerates.[173] As these forests occur at high elevations and have high rainfall, fire occurs less frequently than in drier forests with lower elevations. However, when fire does occur, it is typically of high severity and induces mass seedling regeneration (in the order of millions of seedlings per hectare[174]) from the fire-killed mature trees. This high density of regenerating stems results in acute competition for available water.

Young forests use more water than older forests, and as such streamflow is often reduced in catchments dominated by regenerating forests. This is reflected in the 'Kuczera curve',[175] which indicates that 30 to 40 years after timber harvesting or wildfire, average water yields will be reduced, with a recovery period of about 150 to 200 years before water yields reach pre-disturbance levels. This has significant implications for sustainable forest management, as water yield can change dramatically in response to human activity and natural disturbances. However, it is important to note that the two major disturbances that affect catchments (timber harvesting and bushfire) tend to occur on very different scales. This indicator presents potential degree of risks to change in water yield in response to the two major disturbances.

The information for this indicator is drawn from estimations of groundwater yield change in forested catchment areas in response to logging and fire. A computer software package, called 'EnSym – Environmental Systems Modelling platform', was used to estimate the impact of these actions in the landscape. Prediction processes entail detailed knowledge of the unique aspects of activities, to estimate the magnitude of catchment-scale impacts of management actions. Interactions between various aspects – for example, between revegetation activity along a stream and available water yield for aquatic flora and fauna – are considered in the estimations.

This model has several assumptions:

- water yield estimation is the sum of: surface runoff + lateral subsurface flow + recharge
- timestep for the modelling process was daily, and predictions are only for between 2013 and 2017
- to establish the extent/total area of forest catchments area, the model used the forest extent dataset produced by the VFMP in 2018. As this is a static dataset and not updated, this modelling assumes there are no changes in forest extent and reflects just changes in forest disturbance. As VFMP plots are only located in public forests, predictions are limited to public land

173. Brown AE, Zhang Lu, McMahon TA, Western AW, Vertessy RA 2005 'A review of paired catchment studies for determining changes in water yield resulting from alterations in vegetation', Journal of Hydrology, 310, pp. 28-61.
174. Ashton, DH 1976, 'The Development of Even-aged Stands of Eucalyptus regnans (F. Muell) in Central Victoria', Australian Journal of Botany, 24, pp. 397-414.
175. Kuczera G 1987, 'Prediction of water yield reductions following a bushfire in ash-mixed species eucalypt forest', Journal of Hydrology, 94(3/4), pp. 215-236.

- the prediction result in this report is preliminary and reports only on relative change in water yield
- change in water yield through disturbance has only been modelled for ash forests, with no disturbance modelled in mixed forests. This is partly because mixed forests do not respond hydrologically to disturbance in the same way as ash forests. Mixed-species sprouting forests respond to large disturbance events with relatively little impact on catchment water yield, compared to single-stand ash forests. Research results vary from no impact on yield three years post-fire in a mixed forest[176] to 10% reduction in stream-flow one to four years post-fire in a mixed forest[177]
- to estimate the relative water-yield change between 2013 and 2017, the theoretical maximum water-yield scenario was created based on the water yield with no disturbance between 1939 and 2017, after the 1939 fires
- the impact of forest disturbance on water yield has been assumed to be the same for the following classes – that is, each of these classes of disturbance are assumed to have created a stand-replacing event (but note there will be some medium-disturbance fire events in particular that will not be stand-replacing):
  - medium-disturbance logging
  - high-disturbance logging
  - medium-disturbance fire
  - high-disturbance fire.

More descriptions of the software can be found at https://ensym.biodiversity.vic.gov.au/cms/.

The modelling shows 15 Victorian catchments containing ash forests estimated to have a more than 5% reduction in water yield in 2017, compared to a theoretical maximum water-yield scenario (Figure 38). Among the 15 catchments, Tarago River, Kilmore and Kinglake catchments were estimated to have a significant reduction (>25%). Fire is a much greater agent for disturbance than logging. The reduction of water yield from most of the catchments in Figure 38 was mainly due to fire.

176. Turnbull T 2013, 'Quantifying the impact of fire on tree water use', Fire Note, Bushfire CRC & University of Sydney, issue 115, East Melbourne, Victoria http://www.bushfirecrc.com/sites/default/files/managed/resource/fire_note_115_low_res.pdf Accessed 4 December 2018.
177. Nolan RH, Lane PN, Benyon RG, Bradstock RA, Mitchell PJ 2015, 'Trends in evapotranspiration and streamflow following wildfire in re-sprouting eucalypt forests', Journal of Hydrology, 525, pp. 614-624.

Credit: Matt Zanini

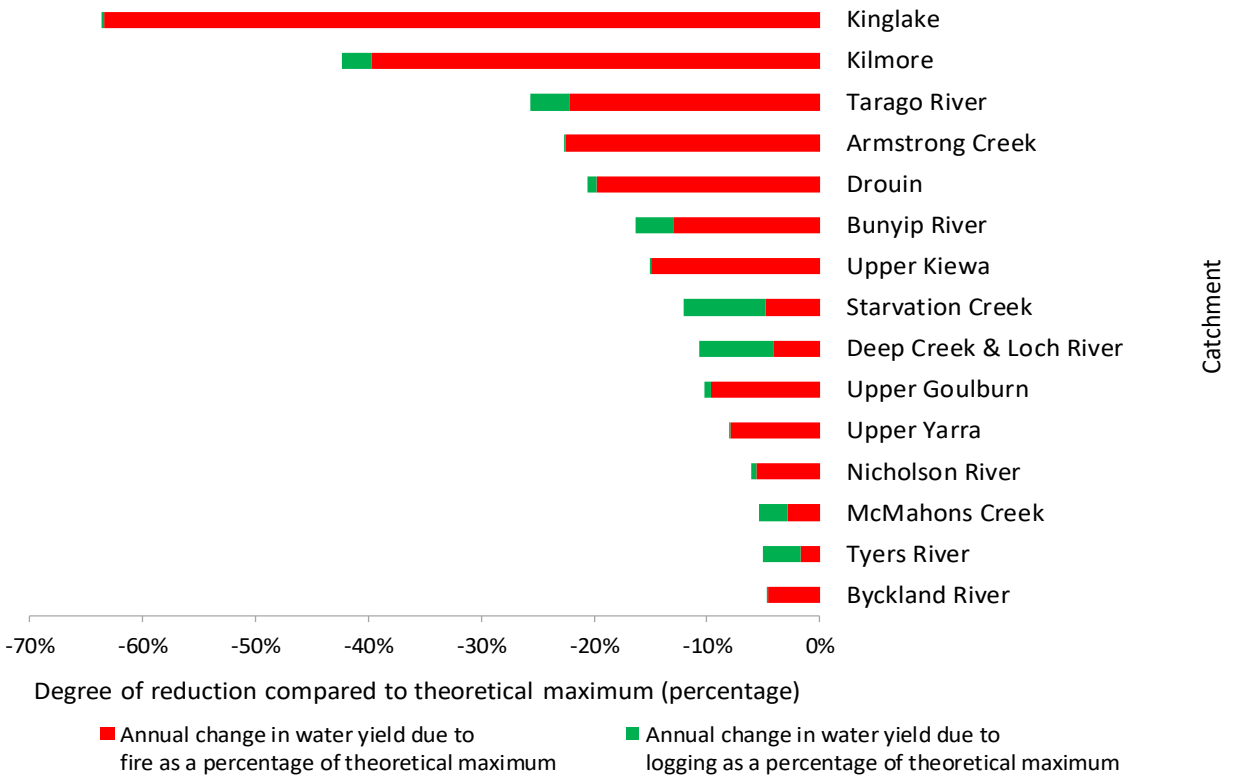


Figure 38. Catchments predicted to have more than 5% reduction in water yield due to logging and fire compared to a theoretical maximum water-yield scenario, 2017
(Data source: DELWP 2018)

The information provided in this indicator, as based on a statistical prediction model, demonstrates that there are several catchment areas in ash forests that are at risk of dramatic changes in water yield due to timber harvesting and wildfire. Note that this data provides a 'coarse filter', as estimated water yield could vary with topography, underlying surficial material, forest type and regional weather patterns.

In future reports, the causes of disturbances, whether natural or anthropogenic, and the potential effects of climate change, should be considered in the interpretation of this indicator. The potential effects of climate change on ash-type eucalypt forests include a highly likely increase in fire-prone weather conditions, resulting in more frequent bushfires. When fires are more frequent, ash-type eucalypt forests change their composition to ash-acacia stands, which alters water yields. In particular, species-level physiological change may decrease catchment evapotranspiration and increase streamflow in ecosystems such as mountain ash forests.[178]

178. Hawthorne SND, Benyon RG, Lane PNJ 2018, 'Changes in evapotranspiration components following replacement of Eucalyptus regnans with Acacia species', Wiley, 32(2), pp. 241-252.

Criterion 4: Conservation and maintenance of soil and water resources

	Status (UNKNOWN / POOR / FAIR / GOOD)	Trend	Data Quality
4.3 Change in forested catchment river health characteristics through time **Data Custodian** DELWP		?	DATA QUALITY Poor

Many Victorian catchment areas are forested. River health is closely linked to the condition of forested catchments. Disturbances such as bushfire in forested catchments can damage river health. Monitoring activities help land managers develop and refine river-health programs, and thereby maintain the various benefits of river health for Victorians.

In Victoria, river health is monitored through the Index of Stream Condition (ISC). The ISC provides a snapshot of river health for 29,000 km of major rivers and tributaries at six-year intervals from 1999. The ISC measures five parameters to assess river health for individual reaches:

1. hydrology (river-flow characteristics)
2. physical form (artificial barriers; in-stream large wood; bank)
3. streamside zone (riparian or streamside vegetation condition)
4. water quality (turbidity and chemical characteristics)
5. aquatic life (macroinvertebrate condition).

Individual streams are assessed based on the condition of their five parameters, and categorised as either 'excellent', 'good', 'moderate', 'poor' or 'very poor'. As this program aims to provide a snapshot, and not a trend assessment, due to changes in methodology, it is difficult to compare the results of one ISC benchmark with another.[179]

The last ISC report was prepared with data up to 2010 after a second report was released in 2004, and no update has been made.[180] The last report indicates that 66% of Victoria's river reaches were in moderate, good or excellent condition; 32% were in poor or very poor condition; and 2% were not assessable due to insufficient data.

In 2017, the Victorian Catchment Management Council used the three ISC reports to assess changes in stream condition. These were minimal over each of the three assessments (see Figure 26 on page 45 of the report).[181] The report also indicates that Victoria's current river condition is likely to be either stable or declining. However, this assessment is also based on outdated data, leading to a difficulty in evaluating recent status and trend of stream condition.

In addition, the State of the Environment 2018 report demonstrates that the condition of water quality in river basins is generally poor, and deteriorating (SoE indicator WQ:08). In addition, the increasing impacts of climate change and population growth will make it harder to maintain current river conditions. Improvements to current conditions can be achieved through counteracting activities at local and regional scales, with management interventions in restoring riparian land and enhancing flow regimes.

179. Department of Environment and Primary Industries 2010, 'Index of Stream Condition: The third benchmark of Victorian river condition', Melbourne, Victoria https://www.water.vic.gov.au/__data/assets/pdf_file/0024/34809/ISC_Part1_Introduction.pdf Accessed 27 August 2018.
180. DELWP, 'Third index of stream condition report', Melbourne, Victoria https://www.water.vic.gov.au/water-reporting/third-index-of-stream-condition-report Accessed 9 January 2019.
181. Victorian Catchment Management Council 2017, 'Catchment condition and management report', Melbourne, Victoria http://www.vcmc.vic.gov.au/pdf/CCMR_Report_2017.pdf Accessed 27 August 2018

Criterion 5:
Maintenance of forest contribution to global carbon cycles

Commissioner *for* Environmental Sustainability Victoria

Credit: Wally Notman

Criterion 5: Maintenance of forest contribution to global carbon cycles

	Status (UNKNOWN / POOR / FAIR / GOOD)	Trend	Data Quality
5.1 Total forest ecosystem biomass and carbon pool by forest type, age class and successional stages **Data Custodian** DELWP	○ ○ ● ○	?	DATA QUALITY Fair

Carbon is a fundamental component of terrestrial forest ecosystems, including above- and below ground biomass, organic soil matter, woody debris and litter. The natural process of photosynthesis by plants enhances terrestrial uptake of atmospheric carbon,[182] making forests ideal for reducing net carbon emissions from anthropogenic activities. Strategies to increase forest-stored carbon would thus assist in meeting state and national carbon emissions commitments.

This indicator provides information on the contribution of Victorian forests to the carbon cycle. Estimates of total forest biomass over time are vital to monitor the changes in regional and localised carbon pool distribution, particularly as carbon stocks are contingent on environmental and land-use conditions.[183]

The total biomass is estimated through field measurements taken between 2011 and 2015 from 786 plots of the VFMP across Victoria, located in parks and reserves and state forests. A standard biomass factor of 0.5[184] is applied in converting total biomass to the amount of carbon (C), to obtain the values found in Figure 39 and Figure 40. The carbon mass is presented by each bioregion, tenure, type and pool. A single time period is presented as provided from the VFMP; however, trend analysis will be possible from 2020, once the five-year panel system is fully implemented.

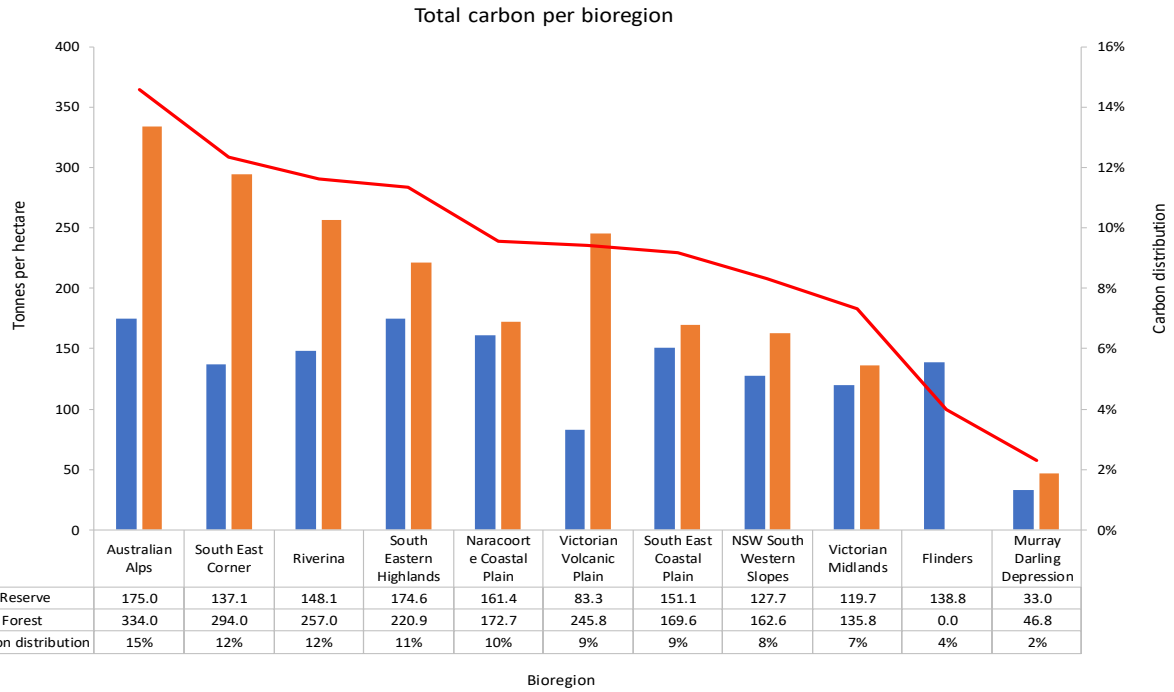
Existing data shows that across all Victorian public forests, the average C and biomass per hectare is 166.2 and 332.3 tonnes per hectare, respectively. The Murray–Darling Depression[185] has the lowest average C and biomass per hectare, with 39.9 and 79.9 tonnes per hectare, respectively.

With the exception of Flinders, total carbon per hectare is 40% higher on average in state forests than in parks and reserves in all bioregions. Although parks and reserves are known to occupy a higher proportion of total Crown land,[186] state forests support greater sink capacity through total plant biomass. The higher prevalence of old-growth trees restricted for timber harvest in state forests,[187] relative to younger stands, may contribute to better carbon storage.[188] The following factors also play a role:

- Parks and reserves often have areas of non-forest areas. For example, in the Australian Alps bioregion, the reserve area includes the area above the tree line.
- State forests are managed to achieve high stocking rates, while reserves are not managed in the same manner.
- Carbon from large dead trees in the Australian Alps reserves is disproportionately higher comparative to the rest of the bioregions because of successive firest in 2003, 2007 and 2009, producing at least two times more carbon from large dead trees than in any other bioregions.

182. Zhu K, Zhang J, Niu S, Chu C, Luo Y 2018, 'Limits to growth of forest biomass carbon sink under climate change', Nature Communications, 9(1), pp. 2709.
183. Keith H, Mackey B, Lindenmayer D, Likens G 2009, 'Re-evaluation of forest biomass carbon stocks and lessons from the world's most carbon-dense forests', Proceedings of the National Academy of Sciences of the United States of America, 106(28), pp. 11635-11640.
184. Penman J, Gytarsky M, Hiraishi T, Krug T, Kruger D, Pipatti R, Buendia L, Miwa K, Ngara T, Tanabe K, Wagner F 2003, 'Good practice guidance for Land Use, Land Use Change and Forestry', Intergovernmental Panel on Climate Change National Greenhouse Gas Inventories Programme, Institute for Global Environmental Studies (IGES), Kanagawa, Japan https://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf_files/GPG_LULUCF_FULL.pdf Accessed 4 December 2018.
185. Australian Department of the Environment and Energy 2008, 'Murray-Darling Depression bioregion', Canberra, Australia https://www.environment.gov.au/system/files/resources/a8015c25-4aa2-4833-ad9c-e98d09e2ab52/files/bioregion-murray-darling-depression.pdf Accessed 4 December 2018.
186. Victorian Department of Environment and Primary Industries 2013, 'Victorian Crown Land Area Statement', Melbourne, Victoria https://www.parliament.vic.gov.au/images/stories/committees/enrc/Invasive_Animals_on_Crown_land/210A_2016.09.13_Attachment_1_-_Victorian_Crown_Land_Area_Statement.pdf Accessed 4 December 2018.
187. VAGO 2013, 'Managing Victoria's native forest timber resources', Melbourne, Victoria http://www.vicforests.com.au/static/uploads/files/20131211-timber-resources-wfsdlrklejjj.pdf Accessed 4 December 2018.
188. Keith H, Lindenmayer D, Mackey B, Blair D, Carter L, McBurney L, Okada S, Konishi-Nagano T 2014, 'Managing temperate forests for carbon storage: impacts of logging versus forest protection on carbon stocks', Ecosphere, 5(6), p.75.

Having been burnt in successive fires, in 2003, 2007 and 2009, carbon from large dead trees in the Australian Alps reserves is high compared with other bioregions. The reserves have at least twice as much carbon from large dead trees than any other bioregion.



	Australian Alps	South East Corner	Riverina	South Eastern Highlands	Naracoorte Coastal Plain	Victorian Volcanic Plain	South East Coastal Plain	NSW South Western Slopes	Victorian Midlands	Flinders	Murray Darling Depression
Park/Reserve	175.0	137.1	148.1	174.6	161.4	83.3	151.1	127.7	119.7	138.8	33.0
State Forest	334.0	294.0	257.0	220.9	172.7	245.8	169.6	162.6	135.8	0.0	46.8
Carbon distribution	15%	12%	12%	11%	10%	9%	9%	8%	7%	4%	2%

Figure 39. Total carbon (tonnes) per hectare in Victoria's public forest (state forests and parks/reserves) by bioregion estimated based on field measurements between 2011 and 2015
Note: Weighted means by bioregion. Proportional distribution of carbon in Victoria's forest per region is indicated as a red line on the secondary y-axis.
(Data source: DELWP 2018)

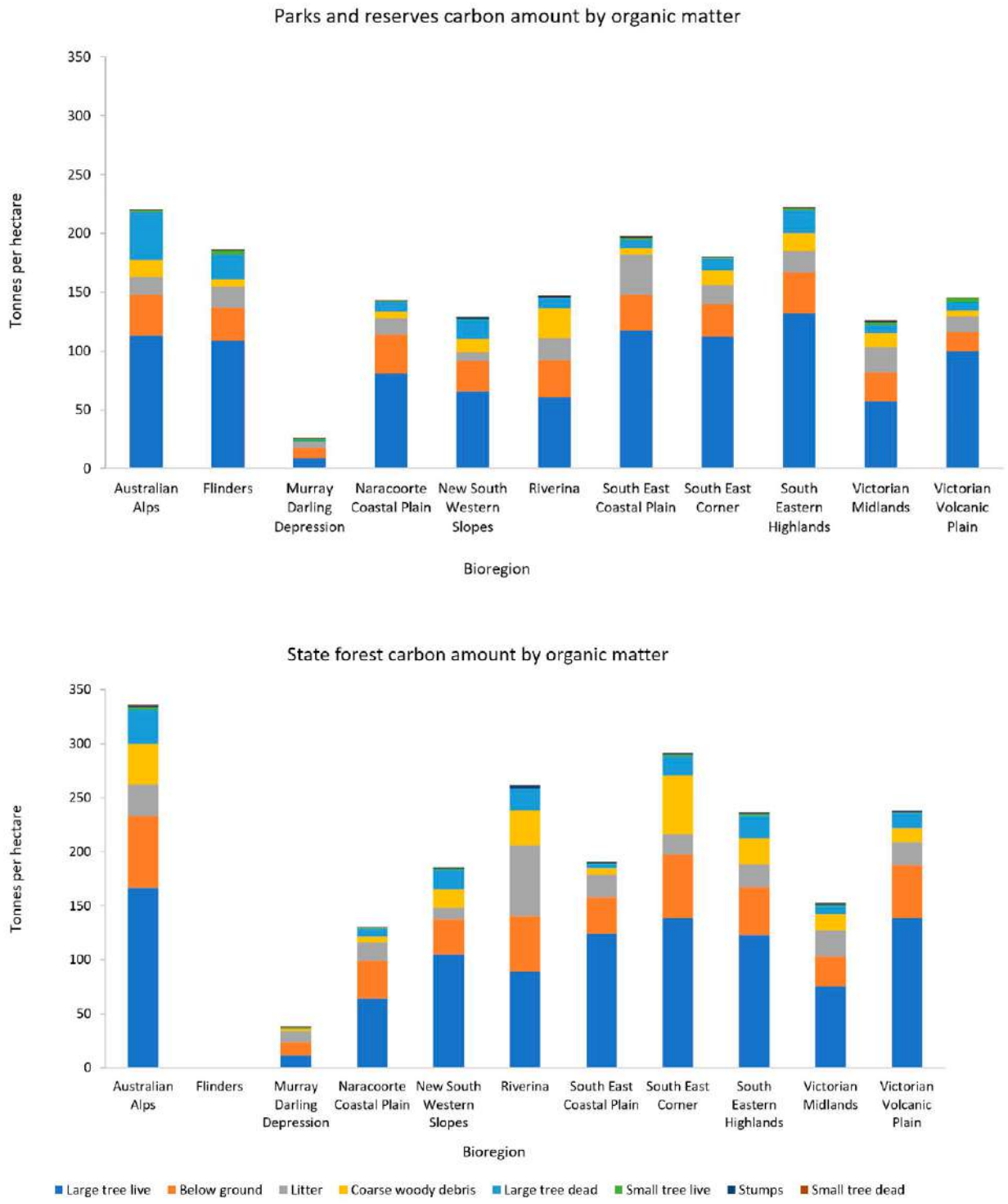


Figure 40. Carbon stores by pool and bioregion in Victoria's public forests (state forests and parks/reserves) (Data source: DELWP 2018)

Criterion 5: Maintenance of forest contribution to global carbon cycles

	Status				Trend	Data Quality
	UNKNOWN	POOR	FAIR	GOOD		
5.2 Contribution of forest ecosystems to the global greenhouse gas balance Data Custodian DELWP	○	●	○	○	↗	DATA QUALITY Good

Increasing the concentration of greenhouse gases (GHG) intensifies climate change. Monitoring the contribution of Victorian forest ecosystems to the global GHG balance is vital, as forest management can have a positive or negative impact on the balance.[189]

In 2017, the Victorian Government announced that Victoria's *Climate Change Act 2017* would establish a target of net-zero GHG emissions by 2050.[190] For about 20 years, from 1990, Victoria's net GHG emissions gradually increased by 35% to 110,469 gigagrams $CO_{2\text{-e.}}$ In 2016, net GHG emissions in Victoria were 91,459 gigagrams CO_2 - about a 12% increase from 1990 emissions (Figure 41).

The 20-year increase from 1990 was due principally to emissions from the energy sector, the greatest contributor to net emission outflow. The sector includes production of electricity and direct combustion of fossil fuels in other industries, such as manufacturing.

However, the energy sector's contribution has stabilised since 2004, and the Land Use, Land-Use Change and Forestry (LULUCF) sector has become a net sink of carbon emissions, except for the years when major bushfires occurred, including 2003, 2007 and 2009 (see forest management net outflow in Figure 42). The primary driver of forest-related carbon sequestration (removal) is afforestation/reforestation activities; however, these figures peaked in 2012 and decreased gradually until 2016.

By contrast, since 2011, sequestration from forest management activities has increased, primarily due to 20 vegetation projects funded by the Emissions Reduction Fund over the past five years. This trend is observed through an upsurge in the Kyoto Australian Carbon Credit Unit (KACCU, Figure 43), which represents abatement from activities that contribute to the nation's emission targets under the Kyoto protocol.

However, estimated net contribution of the fund to the sequestration in LULUCF is still relatively low. Compared to other sectors, including waste and agriculture, proportional contribution of forest-related activities is minimal. As indicated in indicator 1.1a (Area of forest type and tenure - plantation forest in private land), no area of new plantation has been established since 2011. In 2016, about 10% of total carbon emissions were sequestrated by forest-related activities (afforestation, reforestation, forest management and revegetation) (Figure 41 and Figure 42).

189. Keenan R, Nitschke CR 2016, 'Forest management options for adaptation to climate change: a case study of tall, wet eucalypt forests in Victoria's Central Highlands region', Australian Forestry, 79(2), pp. 96–107.
190. DELWP, 'Emissions reduction targets', Melbourne, Victoria https://www.climatechange.vic.gov.au/reducing-emissions/emissions-targets Accessed 4 December 2018.

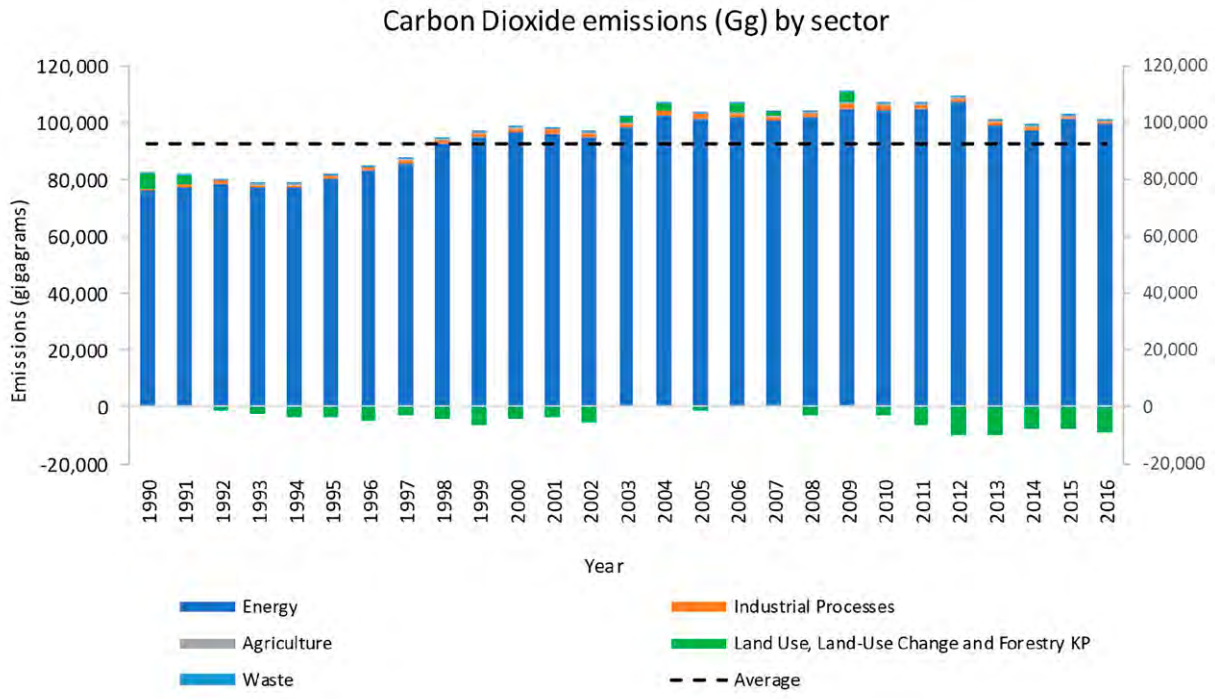


Figure 41. GHG inventory (carbon dioxide) trend by sector in Victoria, 1990–2016
(Data source: Australian Government, Australian Greenhouse Emissions Information System)

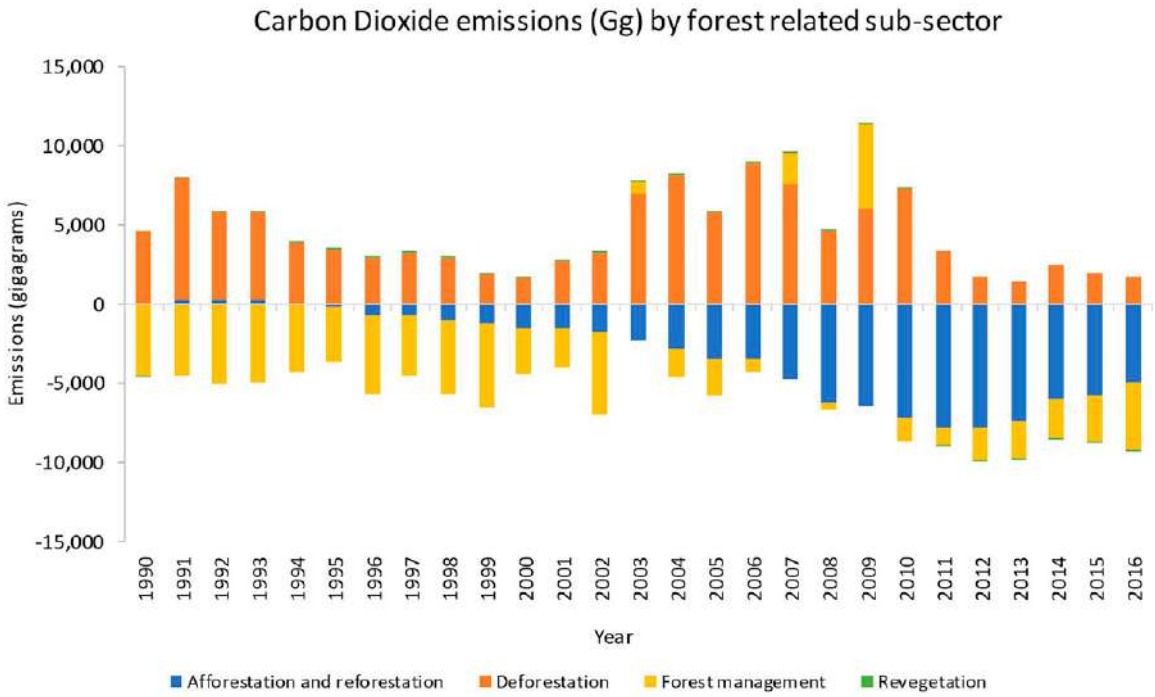


Figure 42. GHG inventory (carbon dioxide) trend by subsector in Victoria, 1990–2016
(Data source: Australian Government, Australian Greenhouse Emissions Information System)

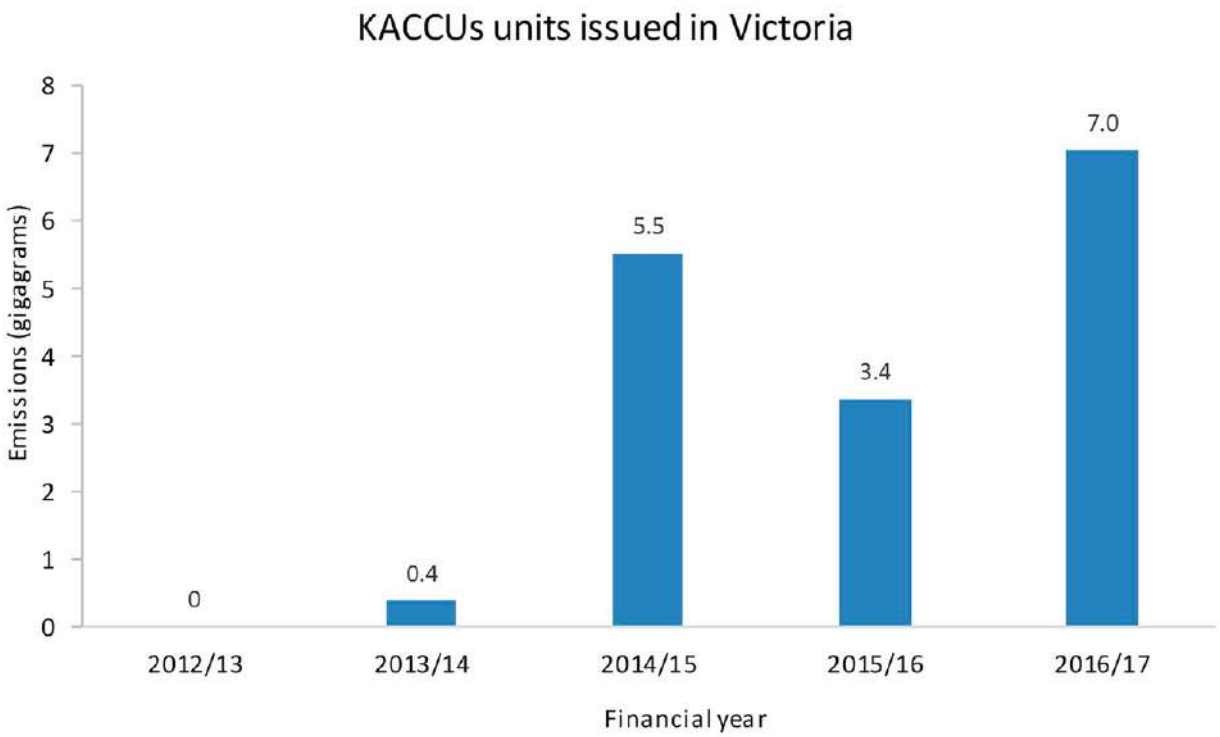


Figure 43. Kyoto Australian Carbon Credit Units (KACCUs) using the 'vegetation method'
Note: Each KACCU unit represents one tonne of carbon dioxide equivalent (tCO_{2-e})
and converted to gigagrams to match Figure 41 and Figure 42.
(Data source: Australian Government 2018)

Criterion 6: Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies

Commissioner *for* Environmental Sustainability Victoria

Credit: Chris M McNamara

Criterion 6: Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies

	Status				Trend	Data Quality
	UNKNOWN	POOR	FAIR	GOOD		
6.1a Value of wood products Data Custodian VicForests; Australian Government	○	○	●	○	↘	DATA QUALITY Good

Forests are a resource for several economically significant industries in Victoria. The forest products industry alone provides about 15,696 direct and indirect jobs in the Victorian forest industry as of 2017.[191] Direct job is any jobs directly generated by primary production or secondary processing. Indirect job is employment generated in other industries as a result of forest industry activity.[192] Recent figures show Victoria has the largest total area of forest plantations in Australia, with 433,000 hectares of commercial hardwood and softwood plantations in 2013–14, up 13% from 2003–04.[193] Successful management of Victoria's plantation forests is vital to the state's economy.

This indicator provides information on the relative contribution of wood and wood products to the Victorian economy. There is a risk to maintaining Victorian forests producing wood and wood products sustainably, when demand by Victorians exceeds domestic and foreign supply. This could lead to higher prices for wood products which will put economic pressure on Victorian community. Therefore, this indicator will present changes in:

- value and volume of wood products from state forests
- value and volume of pulplog productions from plantations
- value and volume of forest-product exports and imports.

Value ($) and volume of wood products from state forest

In general, there was a decrease in the volume and value of wood products from Victorian state forests between 2008–09 and 2016–17, mainly because the volume of pulpwood production halved, while sawlog production was stable (Table 35). The 'other' category covers products including firewood, lower-quality sawlogs, posts, poles, pallets and fire-salvage logs. Although the increase in the production and value of firewood production is significant, it is still minimal in proportion to other products.

Note that data about annual production of wood products between 2007–08 and 2016–17 (Table 35) differs from the data in Table 26 because:

- the data in Table 26 includes eastern Victorian data only
- the 'other' category in Table 26 is predominantly firewood. A significant proportion of firewood sold is inclusive of harvest cost, but exclusive of haulage
- all dollar values are GST-exclusive
- annual volume production includes fire salvage and sawlog volumes, and values include E-grade sawlog.

191. Schirmer J, Mylek M, Magnusson A, Yabsley B, Morison J 2018, 'Socio-economic impacts of the forest industry Victoria (exc. The Green Triangle)', Forest and Wood Products Australia, Melbourne, Victoria https://www.fwpa.com.au/resources/reports/other/1631-socio-economic-impacts-of-the-forest-industry-victoria-exc-the-green-triangle.html Accessed 20 September 2018.
192. Ibid
193. Victorian Association of Forest Industries 2018, 'Industry', Melbourne, Victoria. http://www.vafi.org.au/industry/ Accessed 9 January 2019.

Table 35. Mill-door equivalent value[A] ($ million) and volume ('000 m³) of wood products from state forest in eastern Victoria, 2007–08 to 2016–17

Year		Sawlogs[B]	Pulpwood	Other	Total
2007–08	Volume ('000 m³)	551.0	1343.4	1.5	1895.9
	Value ($ million)	49.9	74.5	0.1	124.5
2008–09	Volume ('000 m³)	550.0	1156.1	1.8	1707.8
	Value ($ million)	54.3	71.2	0.1	125.6
2009–10	Volume ('000 m³)	581.7	1229.5	1.4	1812.6
	Value ($ million)	55.7	75.8	0.1	131.5
2010–11	Volume ('000 m³)	540.8	1210.0	2.3	1753.2
	Value ($ million)	55.0	76.1	0.1	131.2
2011–12	Volume ('000 m³)	468.2	980.9	4.8	1453.9
	Value ($ million)	50.8	65.0	0.2	116.0
2012–13	Volume ('000 m³)	547.6	830.6	18.2	1396.4
	Value ($ million)	56.6	47.1	0.6	104.4
2013–14	Volume ('000 m³)	518.2	792.1	15.1	1325.4
	Value ($ million)	55.7	48.0	0.4	104.1
2014–15	Volume ('000 m³)	535.6	818.7	13.1	1367.5
	Value ($ million)	57.5	49.3	0.4	107.2
2015–16	Volume ('000 m³)	615.4	747.8	17.0	1380.1
	Value ($ million)	65.9	44.3	0.6	110.8
2016–17	Volume ('000 m³)	544.7	757.3	14.0	1316.0
	Value ($ million)	56.9	45.4	0.5	102.8

[A] Mill-door equivalent prices include harvesting and transport costs on top of stumpage prices.
[B] E grade log is included in the "sawlogs" category in this table.

Note: The harvesting volumes reported in this table include volumes harvested and put in temporary storage to provide continuity of supply over winter, so the timber may not be sold in the financial year it was harvested. (Data source: VicForests[194])

Value ($) and volume of pulpwood productions from plantations

Between 2006–07 and 2016–17, the volume of pulplogs harvested from plantations in Victoria increased by 53% (Figure 44).[195] There was a dramatic 11-times increase from hardwood plantations – mainly due to investments by managed investment schemes, popular in the early 2000s. (Several high-profile agribusiness managed investment schemes subsequently collapsed, leaving investors with substantial losses.)

Since 2010–11, plantation areas have gradually decreased, due to a decrease in the rate of new plantation establishments since 2000. Given the delay between planting and harvesting trees, the increase in pulpwood production will continue for a few years, then decrease sharply (Figure 12 and Figure 13).

There was a similar spike (by 230%) in the value of pulplogs harvested from plantations in Victoria between 2006–07 and 2016–17 (Figure 45). While the value of pulplog from softwood plantations increased by one-third, the value from hardwood plantations increased by more than 14 times.

(Note: state forests are native forests and do not contain plantation areas. This data is from private industry lands only)

194. The data is from Cengea Sales cube for 2013/14 onwards, Logtracker Sales cube for 2008/09 to 2012/13 and logsales sales cube for 2007/08 from VicForests.
195. Department of Agriculture and Water Resources 2018, 'Australian forest and wood products statistics', Canberra, Australia http://www.agriculture.gov.au/abares/publications/display?url=http://143.188.17.20/anrdl/DAFFService/display.php?fid=pb_afwpsd9abfe20180524.xml Accessed 29 August 2018.

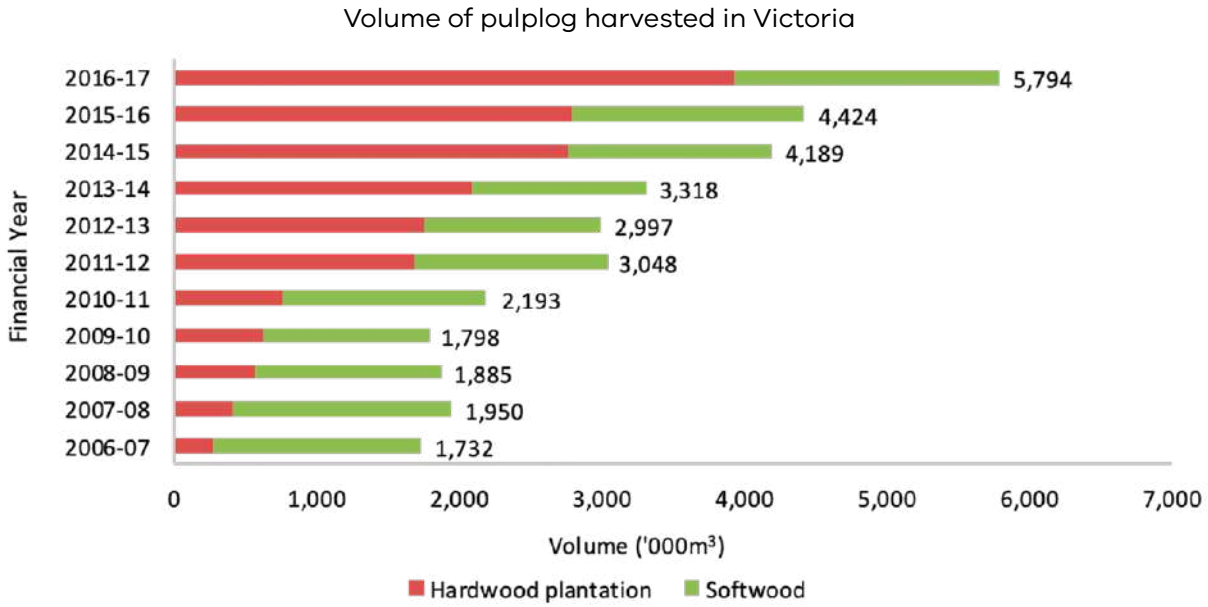


Figure 44. Volume (m³) of pulplog from plantations, 2006–07 to 2016–17
(Data source: Australian Department of Agriculture and Water Resources ABARES 2018)

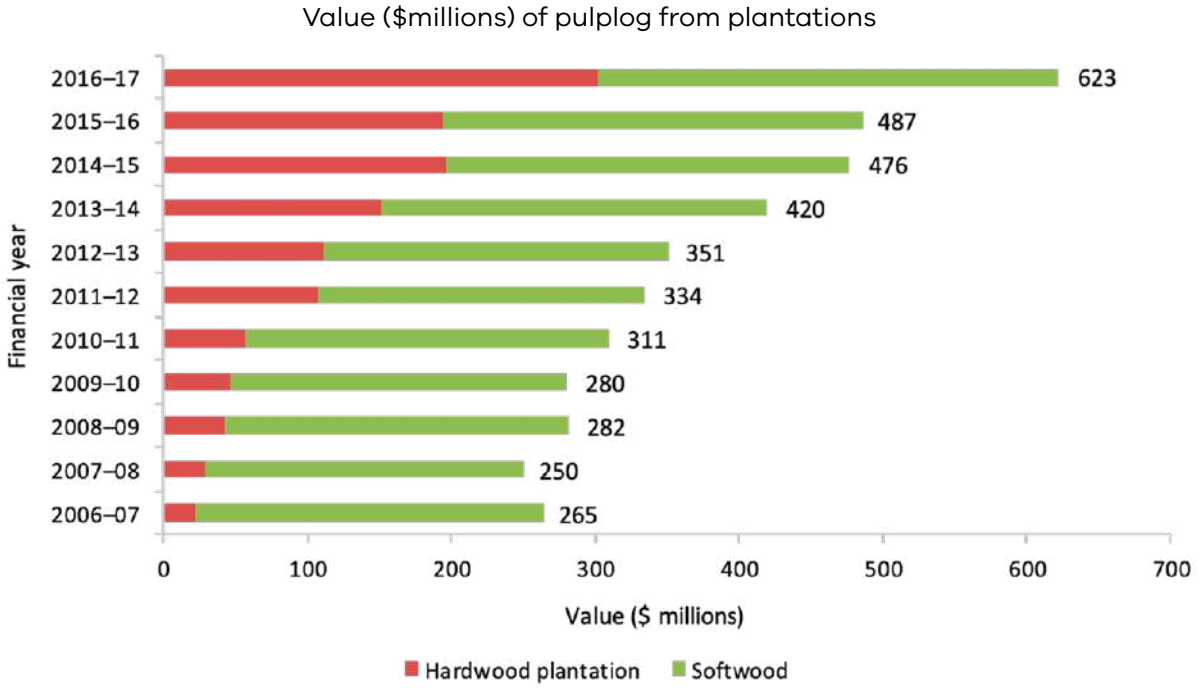


Figure 45. Value ($ millions) of pulplog from plantations, 2006-07 to 2016-17
(Data source: Australian Department of Agriculture and Water Resources ABARES 2018)

Value ($) and volume of forest-product exports and imports

The Victorian forestry industry produces a wide range of wood products, from structural-grade timbers to woodchips, paper and paper board. In 2016–17, Australia imported $5.253 billion of wood and wood products – an increase of about 20% compared to 2006–07. In the same year, Australia exported $3.485 billion of wood and wood products – an increase of 48% compared to 2006–07.

The trade deficit widened between 2006–07 and 2015–16, primarily due to trends in the wood-based panels and woodchips sectors, but narrowed again in 2016–17 (Figure 46). The Australian trade deficit is expected to be maintained, but the trend is unclear in Victoria, as there is no state breakdown of the relevant data. However, there is a state breakdown of import/export trade deficit data of secondary wood products by value, which provides some indication of trends in trade deficit of wood products.

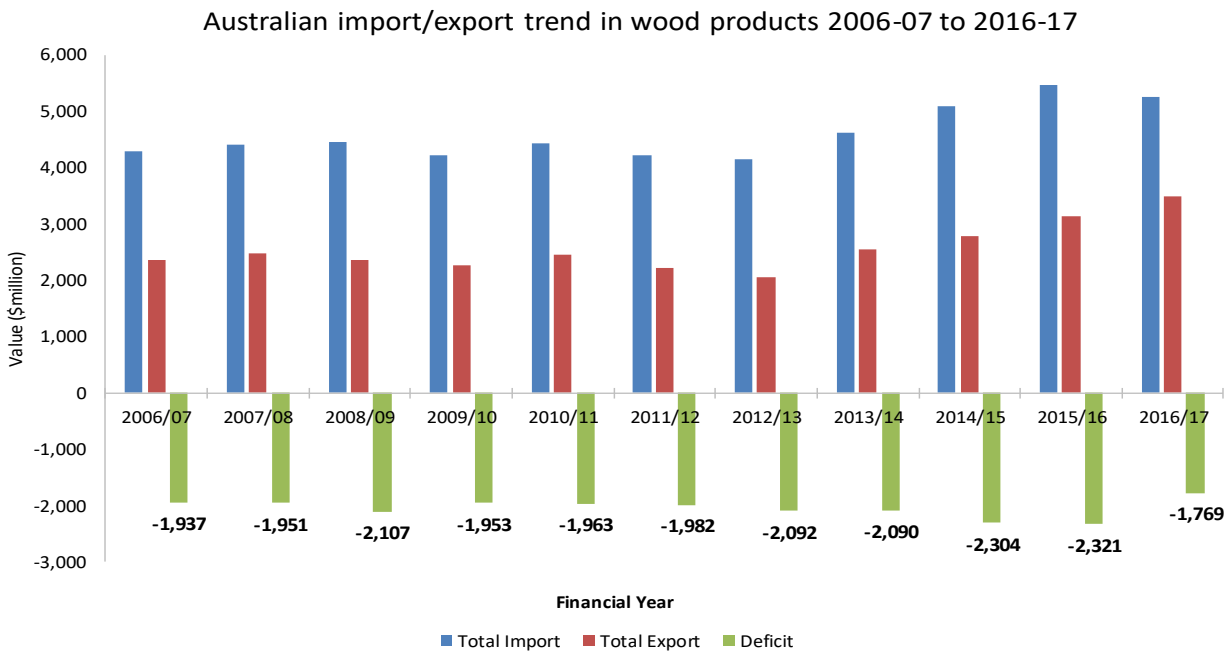


Figure 46. Import/export trend in wood products in Australia, 2006–07 to 2016–17 (Data source: Australian Department of Agriculture and Water Resources ABARES 2018)

Secondary wood products (SWP) include wooden furniture, prefabricated buildings and printed articles. The printed articles include newspapers, printed books, magazines, journals and other printed paper products.

The value of SWP imported to Victoria has increased significantly, by about 46%, from $0.646 billion to $0.943 billion between 2006–07 and 2016–17. By contrast, the value of SWP exported has decreased by 15%, from $0.097 billion to $0.082 billion.

The sharp rise in import value is mainly due to imports of wooden furniture (up by 200%) and prefabricated buildings (up by 400%). This has contributed to the widening of the Victorian trade deficit for SWP by about 57% between 2006–07 and 2016-17.

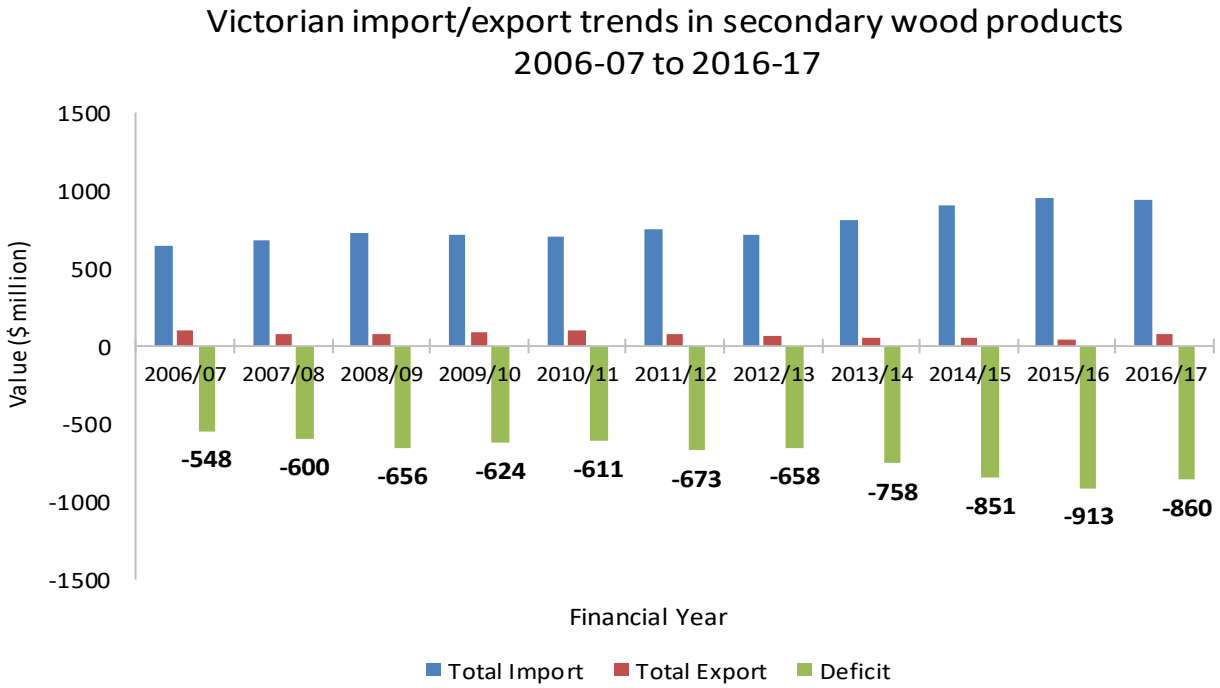


Figure 47. Import/export trends in SWP in Victoria, 2006–07 to 2016–17
(Data source: Australian Department of Agriculture and Water Resources ABARES 2018)

Globally, demand for wood and wood products is growing as the world's population grows.[196] Australia's population is expected to grow by 44% to 34 million by 2050. Victoria had the fastest-growing population of the states in 2017, with a growth rate of 2.3%, compared to the Australian average of 1.6%. Therefore, demand for wood products in Victoria is likely to grow, and at a faster rate, than in other states (Figure 46 and Figure 47).

At the same time, local supply is likely to fall. Many plantation areas developed under the managed investment schemes of the early 2000s are not being replanted (Nationally, as much as 40% of the 1 million hectares planted under the schemes will be returned to agricultural areas[198]) The total area of the plantation estate has decreased sharply: the area of new, established plantations plummeted to zero since 2011–12. In addition, VicForests' Resource Outlook has reduced the available timber production area in state forests, for reasons of sustainable forest management (See indicator 2.1 (Area and percentage of forest and net area of forest available and suitable for wood production)).

In summary, demand for wood and wood products in Victoria is likely to grow in-line with strong population growth, while all available data indicates that the state's supply of these products will decline.

196. Forest and Wood Products Australia 2016, 'Megatrends and the Australian forest and wood products sector: opportunities and challenges for sustainable growth', Canberra, Australia https://www.fwpa.com.au/images/Latest-News/2016/20160316_CSIRO_RIRDC_Megatrends_FINAL.pdf Accessed 9 January 2019.
197. Australian Demographic Statistics 2017, December quarter 2017 statistics, Canberra, Australia.
198. Forest and Wood Products Australia 2016, 'Megatrends and the Australian forest and wood products sector: opportunities and challenges for sustainable growth', Canberra, Australia https://www.fwpa.com.au/images/Latest-News/2016/20160316_CSIRO_RIRDC_Megatrends_FINAL.pdf Accessed 9 January 2019.

Criterion 6: Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies

	Status (UNKNOWN / POOR / FAIR / GOOD)	Trend	Data Quality
6.1b Value and yield of non-wood forest products - game-hunting and apiary business **Data Custodian** Game Management Authority		↗	DATA QUALITY Fair

Non-wood products provide a range of economic benefits for the Victorian community. This indicator provides information on the value and volume of wood and wood products. The collection, processing and use of non-wood forest products are important dimensions of the economic value of forests. For some parts of rural communities in Victoria, non-wood forest products are vital to their livelihoods and lifestyles. The value of non-wood products reflects the scale of these benefits. This measure monitors socio-economic benefits and ascertains the trends for comparison with management objectives.

Two types of non-wood products are presented: game hunting participants and apiary licences on public land. Information on game hunting participants for hunting duck, quail and deer by year between 2012/13 and 2016/17 is provided and this data is issued by the Game Management Authority. Harvest reports from Game Management Authority (GMA) and environmental research reports from the Arthur Rylah Institute (unpublished reports), were used to assess the current trend. Data on apiary licences and revenue is sourced from DELWP.

Game-hunting

Data (Figure 48) suggests demand for game-hunting is growing. Between 2012–13 to 2016–17, the number of game licences increased by 20%, from 42,583 to 50,157. While duck and quail entitlements increased by about 5%, deer entitlements increased by about 40%. Total revenue from game hunting grew by about one-third.

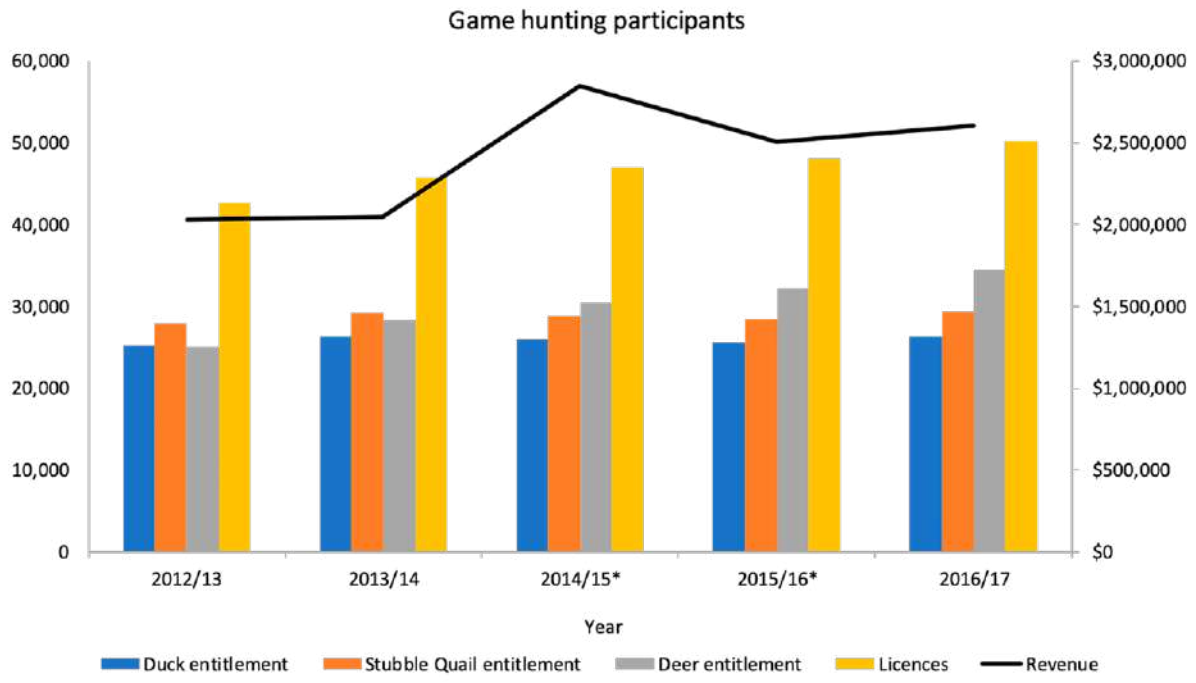


Figure 48. Game hunting participants and revenue, 2012–13 to 2016–17
**Restricted duck season*
(Data source: GMA 2018)

The following information is an estimate of the number of duck, stubble quail and deer harvested in Victoria between 2009 and 2017, based on surveys of licence-holders.

Duck

An estimated 438,353 ducks were harvested in Victoria in the 2017 season. By contrast, the average estimated annual harvest from 2009 to 2017 was 385,571 (blue line in Figure 49).

Two factors contributed to a spike between 2016 and 2017: first, a change in bag limits, from four ducks per day in 2016 to 10 ducks per day in 2017; and second, a wet winter and spring in 2016, which improved breeding conditions.198

The most commonly harvested species were grey teal, Pacific black duck and Australian wood duck.

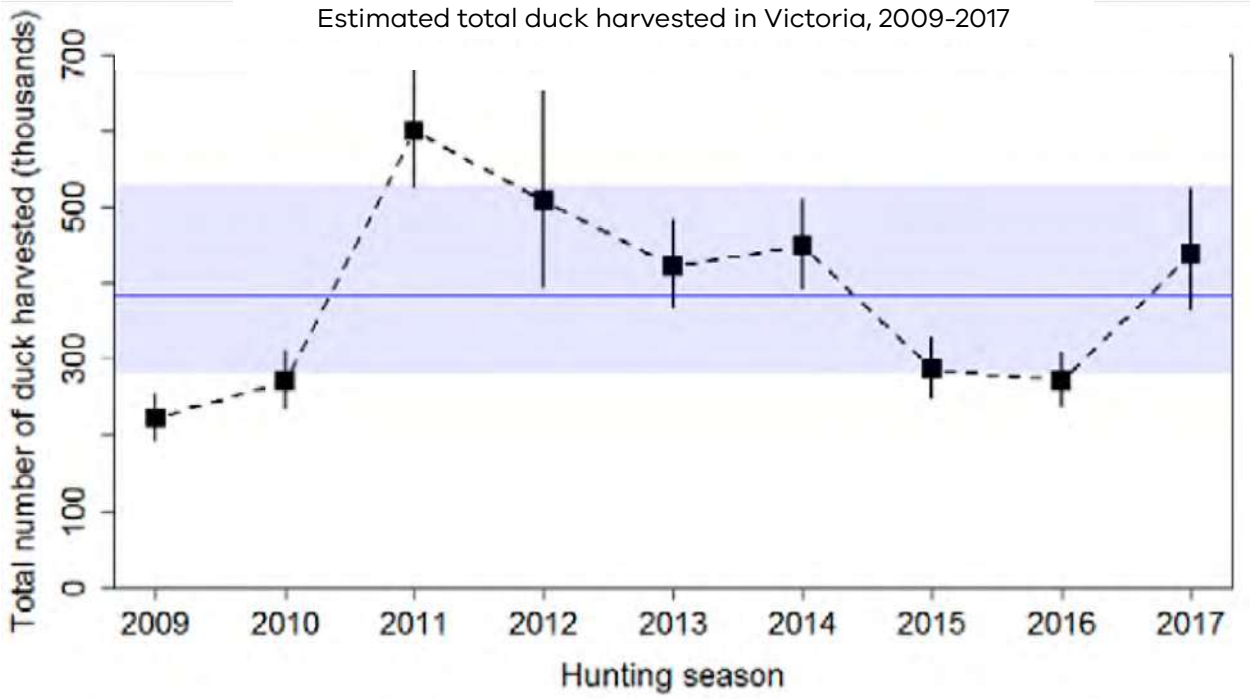


Figure 49. Estimated total duck harvest ('000) in Victoria, 2009–17
Note: Squares show the estimated total harvest for each season. The solid vertical line indicates the 95% confidence interval for each year's harvest; the blue line is the average harvest. The shaded area is the 95% confidence interval for the average harvest.
(Data source: GMA[199])

199. Game Management Authority 2017, 'Estimates of harvest for duck and Stubble Quail in Victoria: results from surveys of Victorian Game Licence holders in 2017', Melbourne, Victoria http://www.gma.vic.gov.au/__data/assets/pdf_file/0004/373603/Game-Bird-Harvest-Report-2017-V2-FOR-WEB.pdf Accessed 23 January 2019.

Stubble quail

An estimated 186,691 stubble quail were harvested in Victoria in the 2017 season, consistent with the 2009 to 2017 average of 177,771 (Figure 50). As for duck, there was a significant increase between 2016 and 2017, most likely in response to improved environmental conditions.[200]

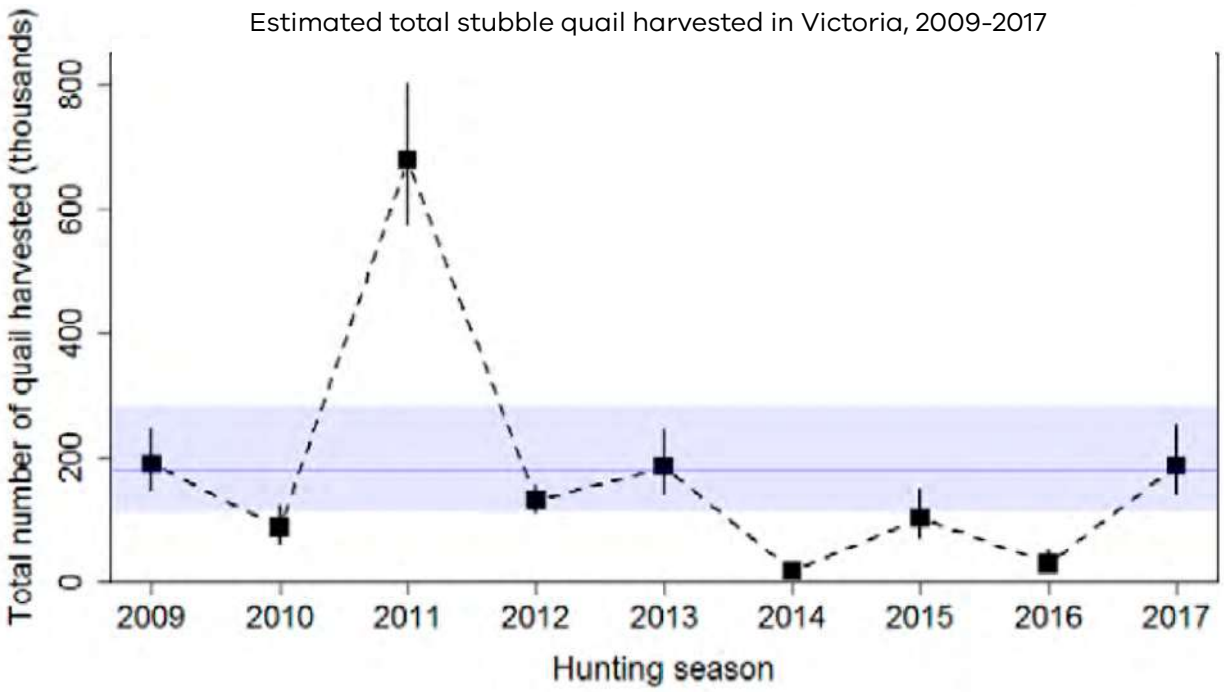


Figure 50. Estimated total stubble quail harvest ('000) in Victoria, 2009–17
Note: Squares show the estimated total harvest for each season. The solid vertical line indicates the 95% confidence interval for each year's harvest; the blue line is the average harvest. The shaded area is the 95% confidence interval for the average harvest.
(Data source: GMA[201])

200. Ibid
201. Ibid

Deer

An estimated 106,275 deer were harvested in Victoria in the 2017 season. This was significantly more than the 2009 to 2017 average of 61,302 (Figure 51). The average increase in deer harvest has been 15% each year since 2009.

GMA suggests several causes, including increased hunting days and hunter efficiency. In particular, hunter efficiency has improved because of the use of scent-trailing hounds – a more efficient method than 'stalking'. The GMA will conduct more detailed analyses in 2018, by changing its survey method and having separate surveys for different hunting groups, to further validate the trend seen in Figure 51.

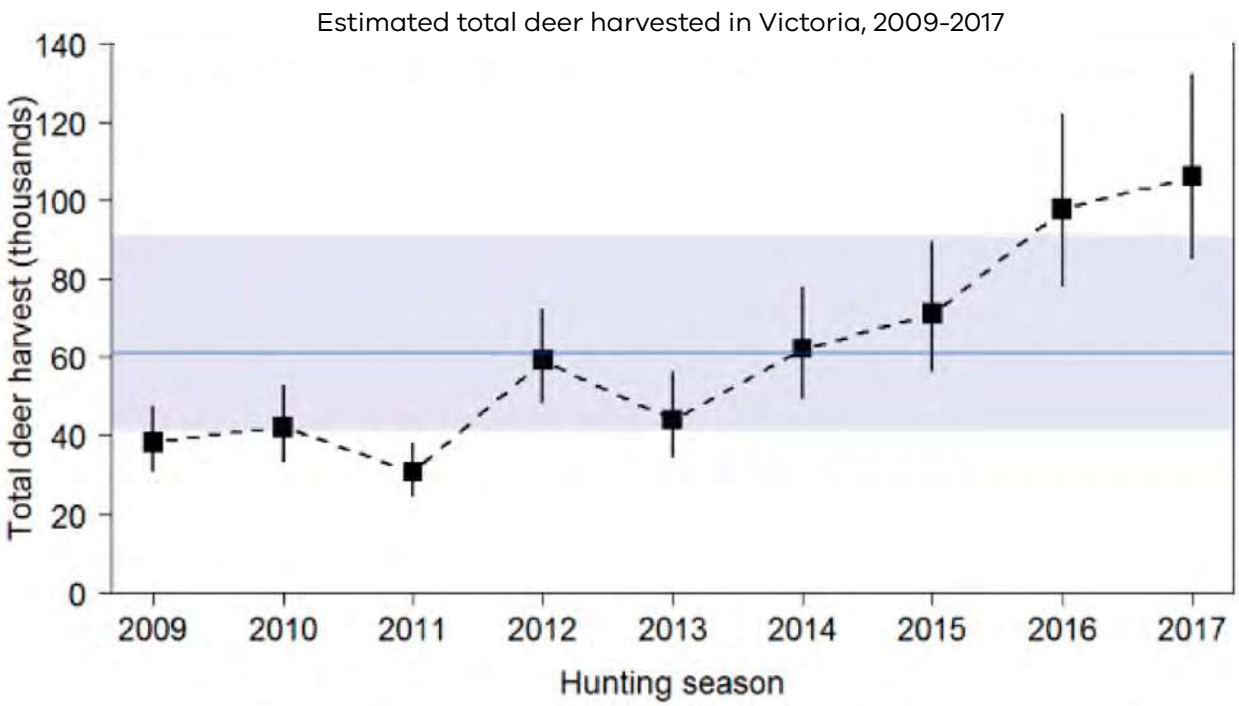


Figure 51. Estimated total deer harvested ('000) in Victoria, 2009–2017
Note: Squares show the estimated total harvest for each season. The solid vertical line indicates the 95% confidence interval for each year's harvest; the blue line is the average harvest. The shaded area is the 95% confidence interval for the average harvest.
(Data source: GMA[202])

202. Ibid

Apiary licences

Data (Figure 52) suggests increased demand for the apiary business. Between 2012–13 and 2017–18, the number of apiary licences increased by about 20%, from 3,112 to 3,757. Revenue from apiary licences also increased in the period.

Note that in 2016–17, the amount invoiced for licence fees dropped significantly due to the introduction of 10-year licences, (allowing licensees to pay 10 years of fees upfront) and the consequent waiving of invoices until 2017–18.

In 2017–18, the invoiced amount spiked for two reasons. First, for the first time in three decades, the licence fee was increased. Second, there were 709 additional licences where the customer decided to pay the 10-year upfront payment option.

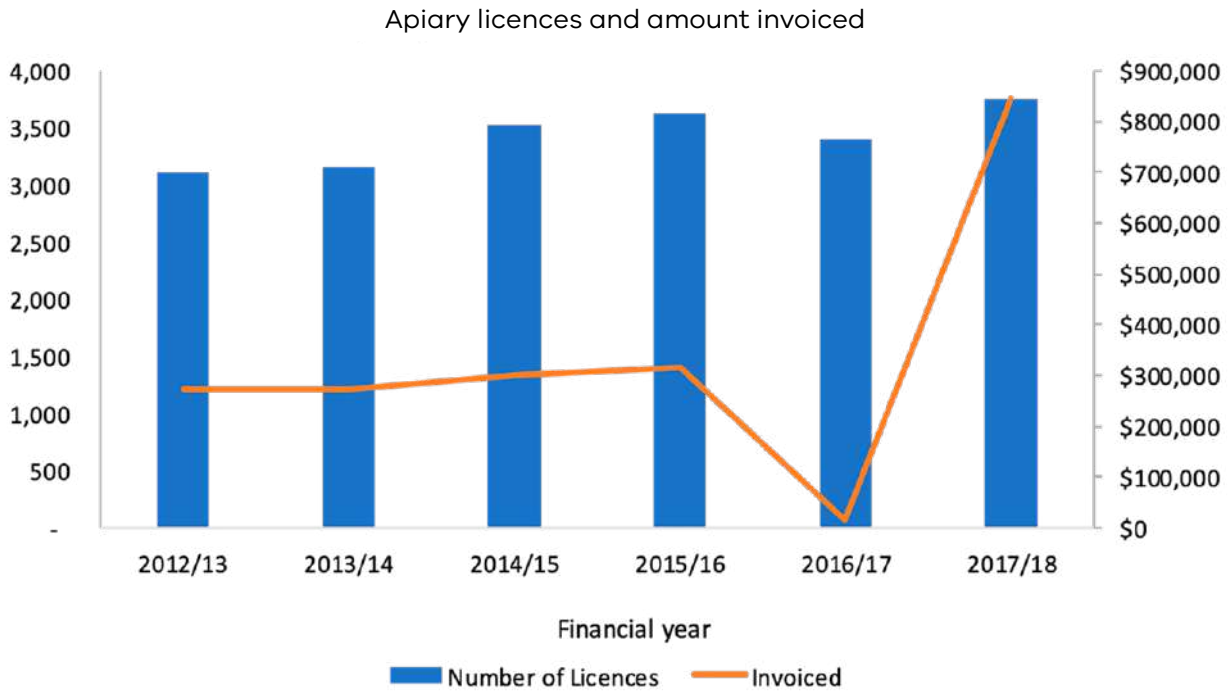


Figure 52. Apiary licences on Crown land in Victoria, and amount invoiced, 2012–13 to 2017–18 (Data source: DELWP 2018)

Currently, a sustainable level has not been established for game hunting and apiary licences. Both non-wood forest products were found to have an increase of demand over the past few years. This indicates that the number of licences needs to be carefully managed based on detailed analysis of the sustainable population levels for duck, quail, deer and bees

Criterion 6: Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies

	Status (UNKNOWN / POOR / FAIR / GOOD)	Trend	Data Quality
6.1c Value ($) of forest-derived ecosystem services Data Custodian DELWP	○ ○ ● ○	?	DATA QUALITY Fair

Environmental-economic accounting provides a framework for valuing the economic benefit of ecosystem services to the economy and society. The contribution forests make to the economy is partly captured in the System of National Accounts (SNA), which accounts for goods and services from forests, such as timber and tourism, when they are produced and consumed in the economy. The SEEA extends the SNA by including forest environmental assets, and the natural inputs and ecosystem services forests produce.

Forest ecosystems provide a suite of ecosystem services, including climate regulation, carbon sequestration, water supply and filtration, and habitat. The management and condition of forests determines the level and extent of these services and, in turn, the benefits to the economy and community. A qualitative example of forest ecosystem accounting – from asset to benefits – is set out in Table 36.

Table 36. Qualitative example of ecosystem accounting for Victorian forests

Asset extent	Asset condition	Asset services	Benefits
Forests can be classified into different assets using EVCs or production forest classes	Condition assessment must be linked to the impact on asset's ability to provide ecosystem services Size of habitat	Examples include: • habitat • water supply and filtration • climate regulation (carbon sequestration) • temperature regulation • nourishment for bees • opportunities for recreation and tourism • opportunities for cultural connection • landscape.	Examples include: • Water consumption by humans and animals • Timber • Avoided impacts from climate change • Urban cooling • apiculture (pollination or crops and honey) • recreation and tourism • avoided health impacts • cultural connection • visual amenity.

(Data source: DELWP 2018)

Ecosystem accounting has increasingly been applied to forest areas in Australia and around the world. In 2015, Parks Victoria and DELWP accounted for forest ecosystem assets in parks as part of an assessment of benefits from ecosystem services provided by Victorian parks.[203]

203. Varcoe T, Betts O'Shea H, Contreras Z 2015, 'Valuing Victoria's parks: Accounting for ecosystems and valuing their benefits', DELWP and PV, Melbourne, Victoria https://parkweb.vic.gov.au/__data/assets/pdf_file/0010/695764/Valuing-Victorias-Parks-Report-Accounting-for-ecosystems-and-valuing-their-benefits.pdf Accessed 4 December 2018.

The analysis estimates that Victorian parks contribute about $1 billion in gross value and 14,000 jobs. The park-based apiary sector was estimated to contribute between $3.4 million and $4.6 million per annum (between $0.6 million and $1 million per annum, respectively).

At the regional scale, the Australian National University has published ecosystem accounts for the Central Highlands across state forests and parks, focusing on water provisioning, timber provisioning, tourism and carbon sequestration.[204] The key findings show that the value of ecosystem services for agriculture production has the greatest value ($121 million) – because of pollination services as an ecosystem service – followed by the water provisioning service ($101 million). By contrast, the native timber provisioning service was valued at just $19 million. The tourism sector in the Central Highlands is estimated to produce benefits of $71.1 million as direct and indirect gross value added, with corresponding increases in employment of 470 direct jobs and 280 indirect jobs after 10 years of investment in the tourism industry.[205]

Forests provide a key natural input that is priced in the economy: timber. Once harvested, timber is accounted for in the SNA. Environmental–economic accounts can record the stock of native forest and plantation forest assets over time, which can increase due to natural growth or decrease due to timber harvesting or other events such as bushfires. The Australian Bureau of Statistics produces accounts on native and plantation timber resources for the whole of Australia, and reported a net value of $11.6 billion in 2016–17, or $471.60 per person. Of this, $9.9 billion is plantation timber and $1.7 billion is native timber.

Currently, there is no state-scale approach to quantifying the dollar-value of forest-derived ecosystem services in Victoria. Environmental–economic accounting provides a consistent framework for assessing the range of natural inputs and ecosystem services provided by forests, and the benefits each of these deliver to the economy and community. This type of information, presented in a consistent and comparable format, can help to improve understanding of the different benefits forests provide and can be used to inform land-use and forest-management trade-offs and decision-making.

Case study: a pilot approach to estimating the potential for forests to provide habitat services

A key service provided by forest ecosystems is habitat for species. Fauna and flora species have different habitat requirements. They need a place to live and reproduce. They also need to tolerate changes in the weather as well as flood and fire disturbances. Because of these different needs, species are found in different locations across the landscape. Some species have highly specific habitat requirements (such as hollow-dependent arboreal marsupials that are present only in limited parts of mountain ash and alpine ash forests that support hollow-bearing trees), while other species can thrive in many different habitat types.

Habitat distribution models (HDMs) have been developed for all rare or threatened Victorian species where sufficient data is available. For this assessment, 1,750 HDMs were used. HDMs collect and compare information on where a species has been recorded and relate that data to environmental variables, such as soil, prevailing climate and topography. Sophisticated statistical and mathematical processes are then used to estimate the distribution of a species's habitat.

204. Keith H, Vardon M, Stein JA, Stein J, Lindenmayer DB 2017, 'Experimental Ecosystem Accounts for the Central Highlands of Victoria', The Australian National University and the Threatened Species Recovery Hub, Canberra, Australia.
205. Nous Group 2017, 'Great forests national park: economic contribution of park establishment, park management, and visitor expenditure: The Wilderness Society', Melbourne, Victoria https://www.greatforestnationalpark.com.au/uploads/1/5/5/7/155574924/nous_gfnp_economic_contribution_study_3_february_2017.pdf Accessed 4 December 2018.

The HDMs do not predict whether or not a species currently occupies the habitat at a particular location. Many factors can influence whether a species is present in the habitat at any given time, including: biogeography; size of the habitat patch and distance from other suitable habitat; the condition of the habitat; natural disturbance cycles; historical catastrophes; the impact of predators or disease; and seasonal factors.[206]

A pilot approach to estimating the potential for forests to provide habitat services is to examine the links between the distribution of important Victorian species to the extent of forest cover in Victoria. This approach describes the relative importance of forests in providing potential habitat for species. However, as HDMs do not predict if a species will occupy the habitat at a given location, this approach does not reveal whether forest assets are really providing habitat services. Forest-cover extent is used as a proxy for potential habitat, and this approach does not incorporate the condition of forest ecosystem assets, which is a key factor in providing habitat.

In 2015, this approach was used to account for the habitat services provided by Victorian parks.[207] Approaches to measuring the flow of habitat services provided by ecosystem assets is a complex area that can be refined in the lead-up to a systematic approach to accounting for the environment (see Recommendation 19 in the State of the Environment 2018 report).

Figure 53 and Table 37 show the extent of forest cover within the intersection of bioregions[208] and natural resource management[209] (NRM) regions across Victoria. Figure 53 shows an intersection between bioregion/NRM class and the 1,750 HDMs. It represents the number of HDMs that intersect with each bioregion/NRM class, which indicates the potential for these areas to provide habitat services.

206. DELWP 2017 'Biodiversity information explanatory document: measuring value when removing or offsetting native vegetation', Melbourne, Victoria https://www.environment.vic.gov.au/__data/assets/pdf_file/0025/91267/Biodiversity-information-explanatory-document-Measuring-value-when-removing-or-.pdf Accessed 4 December 2018.
208. Varcoe T, Betts O'Shea H, Contreras Z 2015, 'Valuing Victoria's parks: Accounting for ecosystems and valuing their benefits', DELWP and Parks Victoria, Melbourne, Victoria https://www.forestsandreserves.vic.gov.au/__data/assets/pdf_file/0027/57177/Valuing-Victorias-Parks-Report-Accounting-for-ecosystems-and-valuing-their-benefits.pdf Accessed 4 December 2018. Australian Department of the Environment and Energy, 'Interim Biogeographic Regionalisation for Australia (IBRA7) codes', Canberra, Australia http://www.environment.gov.au/land/nrs/science/ibra/ibra7-codes Accessed 4 December 2018.
209. CSIRO, 'Impacts and adaptation information for Australia's NRM regions', Climate Change in Australia: projections for Australia's NRM regions, Canberra, Australia https://www.climatechangeinaustralia.gov.au/en/impacts-and-adaptation/nrm-regions/ Accessed 4 December 2018.

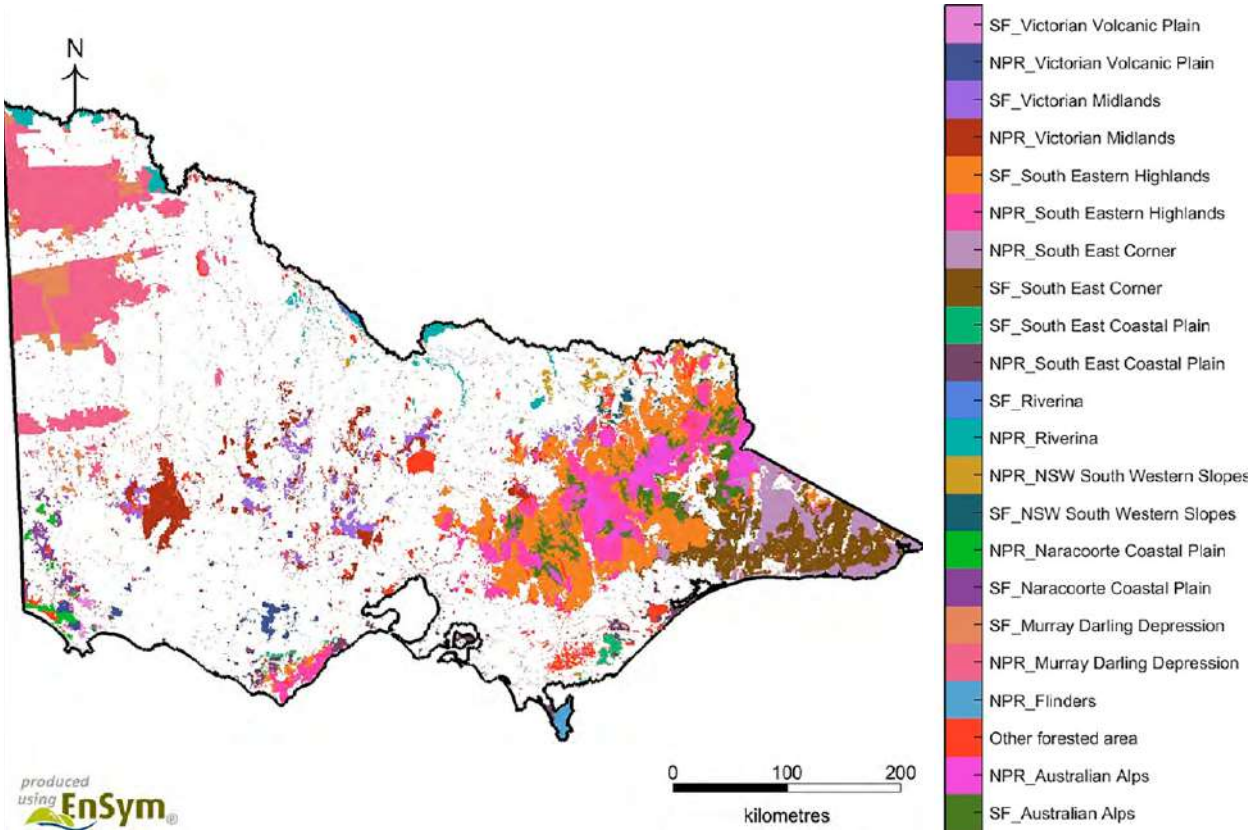


Figure 53. Forest cover by bioregion/NRM class in Victoria (Data source: DELWP 2018)

Table 37. Area in each bioregion/NRM class in Victoria

Bioregion	NRM Region	Area (ha)	Forest (%)
Australian Alps	Murray Basin	370,412	5
Flinders	Murray Basin	40,141	1
Murray–Darling Depression	Murray Basin	1,476,822	19
Naracoorte Coastal Plain	Murray Basin	67,847	1
NSW South Western Slopes	Murray Basin	68,926	1
Riverina	Murray Basin	211,861	3
South East Coastal Plain	Murray Basin	156,420	2
South East Corner	Murray Basin	429,514	5
South Eastern Highlands	Murray Basin	684,825	9
Victorian Midlands	Murray Basin	420,261	5
Victorian Volcanic Plain	Murray Basin	96,739	1
Australian Alps	Southern Slopes	336,865	4
Murray–Darling Depression	Southern Slopes	302,859	4
Naracoorte Coastal Plain	Southern Slopes	71,981	1
NSW South Western Slopes	Southern Slopes	43,108	1
Riverina	Southern Slopes	11,688	0
South East Coastal Plain	Southern Slopes	51,924	1
South East Corner	Southern Slopes	696,317	9
South Eastern Highlands	Southern Slopes	1,373,900	17
Victorian Midlands	Southern Slopes	284,708	4
Victorian Volcanic Plain	Southern Slopes	23,838	0
Other forested area	Southern Slopes	641,911	8
Total		**7,862,867**	**100**

(Data source: DELWP 2018)

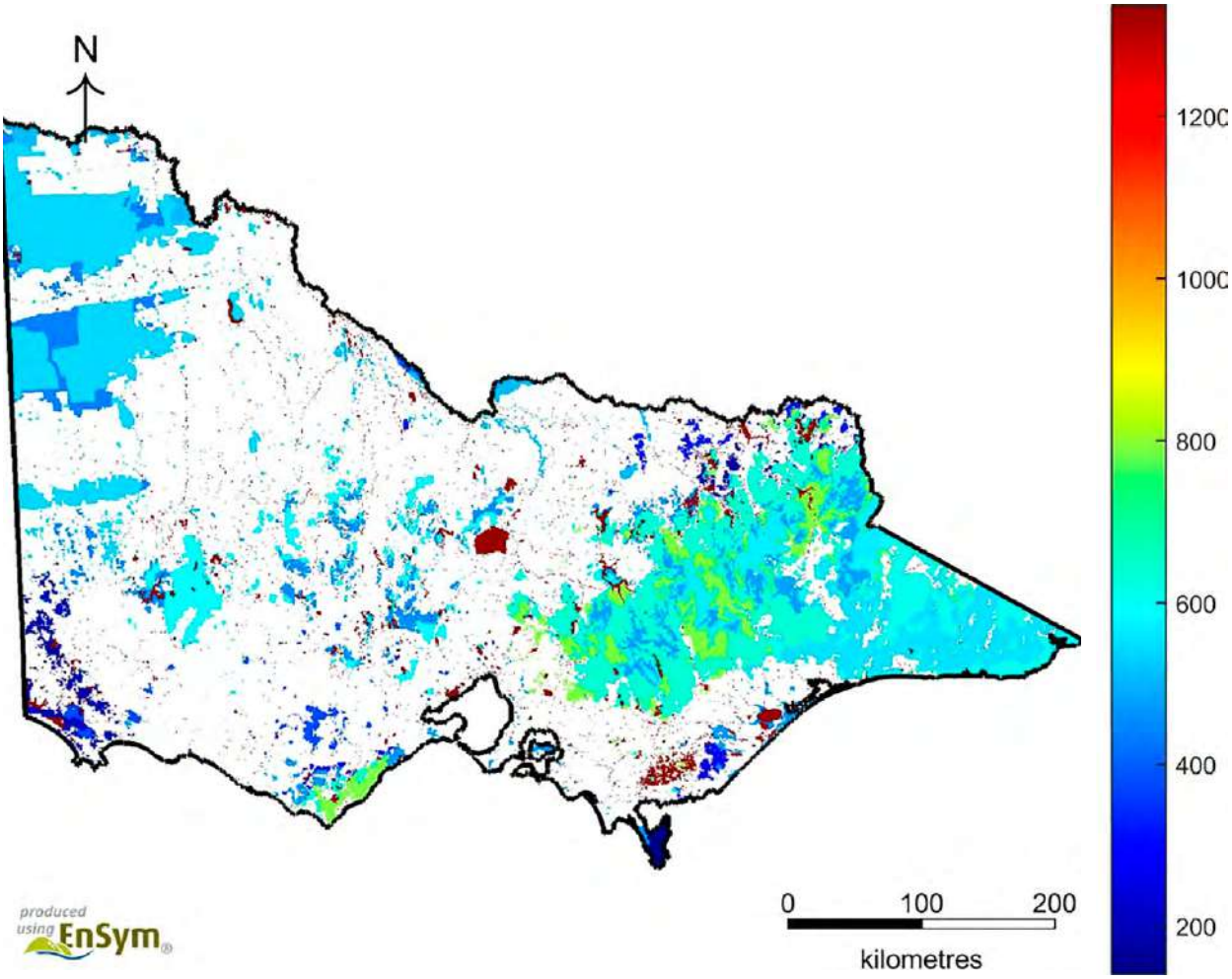


Figure 54. Number of HDMs in each bioregion/NRM class in Victoria (Data source: DELWP 2018)

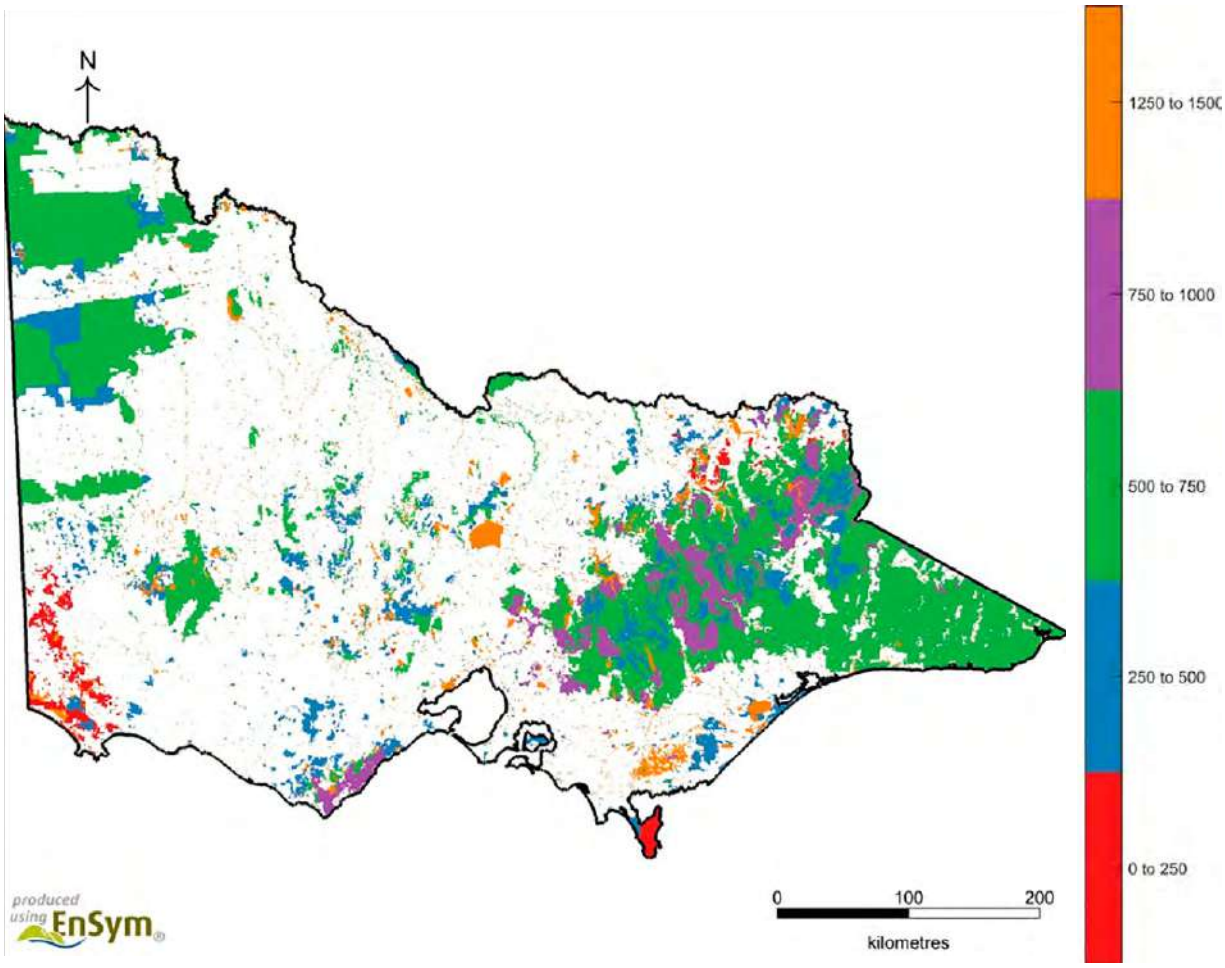


Figure 55. Number of HDMs in each bioregion/NRM class in Victoria – grouped by count (Data source: DELWP 2018)

Figure 55, is the same as Figure 54, but with data classified for easier viewing. Note that there are large areas that intersect with more than 500 HDMs, suggesting that these forest areas may potentially provide valuable habitat services.

Table 38. Number of HDMs for species within bioregion/NRM classes in Victoria

Bioregion	NRM region	Number of species HDM				
		Low		Medium		High
		0–250	250–500	500–750	750–1,000	1,250–1,500
Australian Alps	Murray Basin			√		
Flinders	Murray Basin	√				
Murray–Darling Depression	Murray Basin			√		
Naracoorte Coastal Plain	Murray Basin	√				
NSW South Western Slopes	Murray Basin		√			
Riverina	Murray Basin			√		
South East Coastal Plain	Murray Basin		√			
South East Corner	Murray Basin			√		
South Eastern Highlands	Murray Basin				√	
Victorian Midlands	Murray Basin			√		
Victorian Volcanic Plain	Murray Basin		√			
Australian Alps	Southern Slopes		√			
Murray–Darling Depression	Southern Slopes		√			
Naracoorte Coastal Plain	Southern Slopes	√				
NSW South Western Slopes	Southern Slopes	√				
Riverina	Southern Slopes		√			
South East Coastal Plain	Southern Slopes		√			
South East Corner	Southern Slopes			√		
South Eastern Highlands	Southern Slopes			√		
Victorian Midlands	Southern Slopes		√			
Victorian Volcanic Plain	Southern Slopes	√				
Other forested area	Southern Slopes					√
Total		**5**	**8**	**7**	**1**	**1**

(Data source: DELWP 2018)

Table 38 shows the potential species habitat presence for each bioregion/NRM class, out of the 1,750 species for which habitat distribution has been modelled. 9 out of 22 classes have potential habitat for species presence of greater than 500 species based on the HDMs. These nine bioregion/NRM classes represent 80% of the bioregion area. Note that the larger areas are expected to have an intersection with more species HDMs. Further work would be required to disaggregate the larger areas into specific management areas (for example, into regions and coupes) to gain a more accurate representation of the links to HDMs.

Table 39. Number HDMs for endangered species within bioregions/NRM classes in Victoria

Bioregion	NRM region	Number of endangered species HDM				
		Low		Medium		High
		0–250	250–500	500–750	750–1,000	1,250–1,500
Australian Alps	Murray Basin		√			
Flinders	Murray Basin	√				
Murray–Darling Depression	Murray Basin			√		
Naracoorte Coastal Plain	Murray Basin	√				
NSW South Western Slopes	Murray Basin		√			
Riverina	Murray Basin			√		
South East Coastal Plain	Murray Basin		√			
South East Corner	Murray Basin		√			
South Eastern Highlands	Murray Basin			√		
Victorian Midlands	Murray Basin			√		
Victorian Volcanic Plain	Murray Basin		√			
Australian Alps	Southern Slopes	√				
Murray–Darling Depression	Southern Slopes		√			
Naracoorte Coastal Plain	Southern Slopes	√				
NSW South Western Slopes	Southern Slopes	√				
Riverina	Southern Slopes		√			
South East Coastal Plain	Southern Slopes	√				
South East Corner	Southern Slopes		√			
South Eastern Highlands	Southern Slopes		√			
Victorian Midlands	Southern Slopes			√		
Victorian Volcanic Plain	Southern Slopes		√			
Other forested area	Southern Slopes				√	√
Total		**6**	**10**	**5**	**1**	**1**

(Data source: DELWP 2018)

Table 39 and Table 40 show potential species habitat presence for each bioregion/NRM class, specifically for endangered and vulnerable species.

Table 39 shows the potential endangered species habitat presence for each bioregion/NRM class.

6 classes have potential endangered species habitat presence of greater than 100 species, based on the HDMs. 10 bioregions have potential endangered species habitat presence of 50 to 100; 6 bioregions have potential endangered species habitat presence of less than 50.

Table 40. Number of HDMs for vulnerable species within bioregions/NRM classes in Victoria

Bioregion	NRM region	Number of vulnerable species HDM				
		Low		Medium		High
		0–250	250–500	500–750	750–1,000	1,250–1,500
Australian Alps	Murray Basin			√		
Flinders	Murray Basin	√				
Murray–Darling Depression	Murray Basin			√		
Naracoorte Coastal Plain	Murray Basin	√				
NSW South Western Slopes	Murray Basin		√			
Riverina	Murray Basin			√		
South East Coastal Plain	Murray Basin		√			
South East Corner	Murray Basin			√		
South Eastern Highlands	Murray Basin				√	
Victorian Midlands	Murray Basin			√		
Victorian Volcanic Plain	Murray Basin		√			
Australian Alps	Southern Slopes		√			
Murray–Darling Depression	Southern Slopes			√		
Naracoorte Coastal Plain	Southern Slopes	√				
NSW South Western Slopes	Southern Slopes	√				
Riverina	Southern Slopes		√			
South East Coastal Plain	Southern Slopes	√				
South East Corner	Southern Slopes			√		
South Eastern Highlands	Southern Slopes			√		
Victorian Midlands	Southern Slopes		√			
Victorian Volcanic Plain	Southern Slopes	√				
Other forested area	Southern Slopes					√
Total		**6**	**6**	**8**	**1**	**1**

(Data source: DELWP 2018)

Table 40 shows the potential vulnerable species habitat presence for each forest class. 10 forest classes have potential vulnerable species habitat presence of greater than 150 species, based on the HDMs. 6 forest classes have potential vulnerable species habitat presence of 100 to 150. And 6 forest classes have potential vulnerable species habitat presence of less than 50.

Case study: accounting for water supply from forests

This case study shows how an environmental–economic accounting framework can be applied – both conceptually and quantitatively – to forest ecosystems to demonstrate the link between biophysical information and socio-economic benefits.

Asset extent and condition

As shown in Table 41, and illustrated in Figure 56, there are 3,499,602 hectares of forest across the prescribed water supply catchment (PWSC) areas that contain ash forest in Victoria. Of this, 459,393 hectares (or 13%) are eucalypt ash forest of mountain ash *(Eucalyptus regnans)* and alpine ash *(Eucalyptus delegatensis)*. The largest extent of forest asset is in the catchment areas of Lake Hume, Mitchell River, Ovens River, Upper Goulburn and Tambo River. The largest extent of ash forest asset is in the catchment areas of Mitchell River, Lake Hume, Upper Goulburn and Upper Yarra.

Table 41. Extent of forest assets by catchment area in Victoria

PWSC with ash forest	Ash forest (ha)	Other forest (ha)	Other land cover (ha)	Total area (ha)
Armstrong Creek	2,039	2,074	73	4,186
Barham River	3,566	1,591	1,198	6,355
Bemm River	2,009	88,592	2,647	93,248
Britannia Creek	1,580	239	-	1,819
Brodribb River (Orbost)	455	91,903	1,247	93,605
Buchan River (Buchan)	10,930	67,629	3,072	81,631
Buckland River	6,414	25,520	446	32,380
Buffalo River (Lake Buffalo)	9,697	101,633	4,283	115,613
Bunyip River	3,084	859	32	3,975
Cann River	241	59,039	3,075	62,355
Cement Creek	808	0	0	808
Deep Creek & Loch River (Noojee)	6,686	4,691	517	11,894
Drouin	309	1,081	36	1,426
Gellibrand River	3,086	36,122	10,121	49,329
Gellibrand River (South Otway)	1,971	11,526	3,131	16,628
Glenmaggie	18,753	155,843	15,546	190,142
Kilmore	1,186	1,952	141	3,279
King River (Lake William Hovell)	8,469	24,303	258	33,030
Kinglake	5,006	5,913	89	11,008
Lake Hume	44,058	211,065	65,756	320,879
Lake Hume Northern Section	55,617	434,098	197,642	687,357
Lorne	1,001	1,651	28	2,680
Maroondah	13,605	4,135	197	17,937

Table 41. Extent of forest assets by catchment area in Victoria Cont'd

PWSC with ash forest	Ash forest (ha)	Other forest (ha)	Other land cover (ha)	Total area (ha)
McCraes Creek	192	353	0	545
McMahons Creek	3,689	728	8	4,425
Merrimans Creek (Seaspray)	27	31,748	21,896	53,671
Micks Creek	29	325	129	483
Mitchell River	58,553	315,098	17,349	391,000
Nicholson River	724	45,386	1,587	47,697
Ovens River (Bright)	7,503	25,088	2,070	34,661
Ovens River (Wangaratta)	5,153	148,930	143,344	297,427
Starvation Creek	3,532	88	25	3,645
Tambo River	18,476	202,815	49,227	270,518
Tanjil River	13,168	29,297	8,221	50,686
Tarago River	7,818	905	2,342	11,065
Tarra River	391	2,201	237	2,829
Thomson River (stage 3)	5,540	8,886	738	15,164
Thomson River (stages 1,1a,2)	15,693	17,310	182	33,185
Tomahawk Creek (Gembrook)	287	30	0	317
Tyers River	7,039	22,085	2,834	31,958
Upper Barwon	1,475	12,608	1,210	15,293
Upper Goulburn	49,679	178,606	50,711	278,996
Upper Goulburn (Upper Delatite)	4,876	12,270	6,741	23,887
Upper Kiewa	15,435	17,717	7,549	40,701
Upper Kiewa (East Kiewa U2)	1,627	75	0	1,702
Upper Yarra	37,915	9,395	871	48,181
Total	459,391	2,413,403	626,806	3,499,600

(Data source: DELWP 2018)

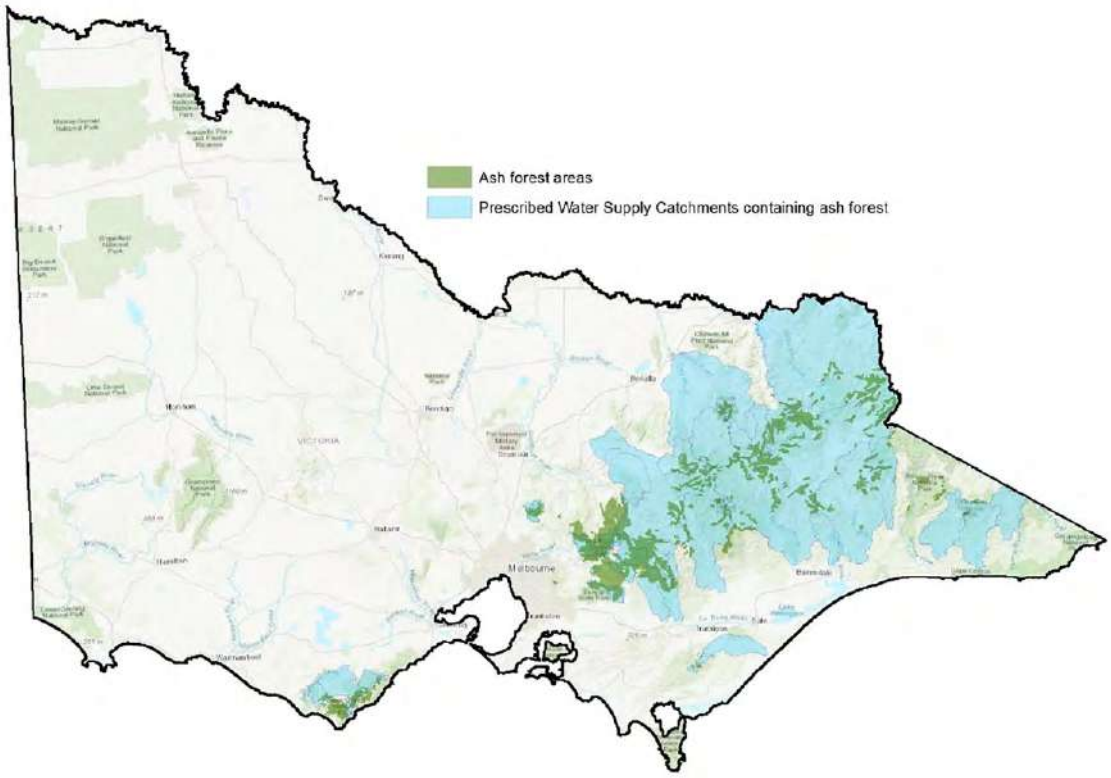


Figure 56. Prescribed water supply catchments and ash forest extent in Victoria (Data source: DELWP 2018)

Ecosystem services and benefits

Forest assets provide a range of ecosystem services, as outlined in Figure 57. This case study focuses on quantifying the water supply services provided by forest assets in the Kilmore, Mitchell River and Nicholson River catchment areas.

Due to stream flow data limitations, absolute yearly flows could not be determined for other catchment areas listed in Figure 58, including the Melbourne water catchments.

Asset extent

422,899 hectares of forest across Kilmore, Mitchell and Nicholson catchments:

- 60,463 hectares of ash forest
- 362,436 hectares of other forest

Asset condition

63% of ash forest across Kilmore, Mitchell and Nicholson catchments has been disurbed since 1989:

- 62% of ash forest disturbed by fire
- 1% of ash forest disturbed by logging

Asset services

- Habitat
- Water supply and filtration
- Climate regulation (carbon sequestration)
- Temperature regulation
- Nourishment for bees
- Opportunities for recreation and tourism
- Opportunities for cultural connection
- Landscape

Benefits

- Water
- Climate change mitigation
- Timber resources
- Pollination services
- Recreation and tourism

Figure 57. Forests in an environmental–economic accounting framework

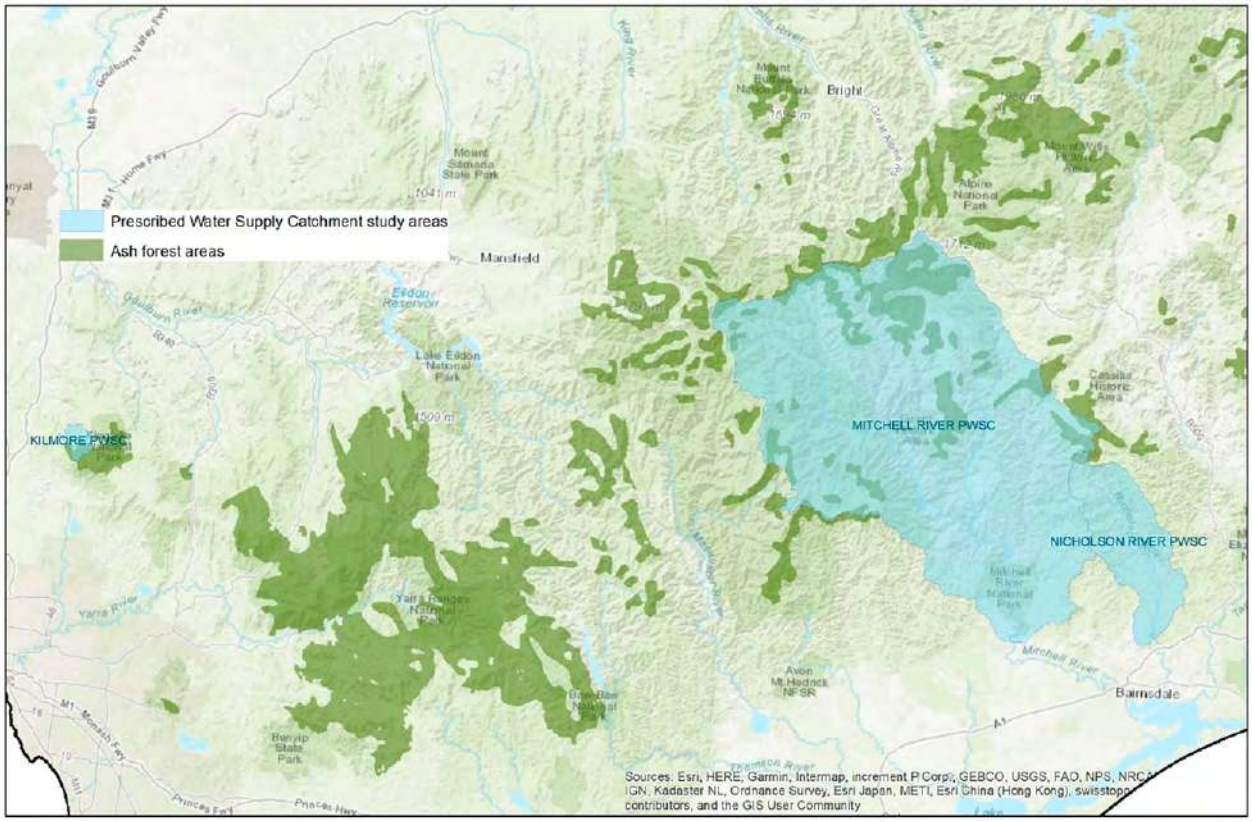


Figure 58. Case study catchment areas (Data source: DELWP 2018)

The extent of forest ecosystem assets and yearly flow of water supply services for the three catchment areas is presented in Table 42 and Table 43.

In 2017, the Kilmore PWSC area supplied 1,646 ML of water, the Mitchell River PWSC area supplied 504,098 ML of water, and the Nicholson River PWSC area supplied 4,979 ML of water.[210]

Table 42. Forest ecosystem asset extent across three catchments

Forest type	Kilmore (ha)	Mitchell (ha)	Nicholson (ha)	Total (ha)
Ash forests	1,186	58,553	724	60,463
Other forests	1,952	315,098	45,386	362,436
Other land cover	141	17,349	1,587	19,077
Total	**3,279**	**391,000**	**47,697**	**441,976**

(Data source: DELWP 2018)

Table 43. Ecosystem service flow – water supply – for three catchments, 2013–17

Catchment	Recorded annual flow (ML) – actual				
	2013	2014	2015	2016	2017
Kilmore	3,767	2,891	1,570	2,245	1,646
Mitchell River	841,139	519,979	486,647	1,125,627	504,098
Nicholson River	37,303	38,891	51,950	62,492	4,979
Total	**882,209**	**561,761**	**540,167**	**1,190,364**	**505,744**

(Data source: DELWP 2018)

Table 43 shows the annual flow of water-supply ecosystem services. However, to understand and value the benefit for the economy and society, the relevant agencies must develop an understanding of water use.

An example in the context of the Mitchell River is useful. The largest remaining river system in Victoria that is not dammed, it provides valuable irrigation water to Lindenow Valley farmers in East Gippsland, as well as supplying urban water users.

The Mitchell River supplies water to Bairnsdale and Paynesville, and to towns in adjacent river basins including Bruthen, Nicholson, Nowa Nowa, Johnsonville, Swan Reach, Metung and Lakes Entrance. It also supplies environmental flows to the Gippsland Lakes.

210. Stream gauge data sourced from the Victorian Water Measurement Information System (WMIS) http://data.water.vic.gov.au/monitoring.htm Accessed 4 December 2018.

The Mitchell River underpins a substantial economic base in the region, including irrigated agricultural production, tourism, a growing number of small businesses and manufacturers, and an increasing population. The Gippsland Lakes are important environmental assets and are partially dependent on water from the environmental water reserve in the Mitchell Basin. The lakes are listed as internationally significant wetlands under the Ramsar Convention and rely on freshwater inputs from the Mitchell Basin to function ecologically. Other environmental assets that rely on the environmental water reserve include heritage river reaches, fish populations (Australian grayling, black bream), waterbirds (great egret) and botanical values (yellowwood).

Diversions take out a relatively small proportion of total inflows, varying from approximately 1.5% during wetter years to 4.5% during drier years.[211] Applying these proportions to the amount of water supplied annually from forest assets gives the volumes outlined in Table 44. In 2017, water supply that can be attributed to diversion for use was estimated at 7,561 ML to 22,684 ML.

Table 44. Water supply to Mitchell River – diversions (ML), 2013–17

	2013	2014	2015	2016	2017
Lower bound (1.5%)	12,617	7,800	7,300	16,884	7,561
Upper bound (4.5%)	37,851	23,399	21,899	50,653	22,684
Total	**50,468**	**31,199**	**29,199**	**67,537**	**7,561**

(Data source: DELWP 2018)

For the forest assets supplying regional and rural Victoria, water supply can be valued for agricultural users and regional townships using current entitlement prices.[212] This valuation approach is conservative, because the value of water to households is likely to be higher than for irrigated agriculture in many situations.

The value of water yields flowing to regulated rivers can be calculated using average high-reliability entitlement prices ($1,350/ML) across Victorian-regulated trading zones. This approach reflects the fact that the water is callable from water storages, and high-reliability entitlements are, therefore, the appropriate valuation basis.

The value of water yields flowing to unregulated rivers can be calculated using low-reliability entitlement prices ($190/ML) across Victorian unregulated trading zones. For unregulated flows outside trading zones (such as flows to Bass Strait), a zero value can be assumed, as these are likely non-consumptive uses. This approach yields conservative valuation estimates.

As the Mitchell River is an unregulated (undammed) river, applying the second value to the proportion of annual water supply from forest assets that is expected to be diverted gives an estimated value of the benefit from ecosystem services of between $1.4 million and $4.3 million in 2017. There are also additional benefits from environmental flows which have not been estimated.

Impact of ash forest disturbance on water-supply services

Major disturbance to ash forests, and subsequent seed-bed regeneration, causes major reductions in water yield for up to 100 years, peaking at approximately 33 years post-disturbance with approximately 50% reductions in flow.[213]

211. Southern Rural Water 2014, 'Local Management Plan: Mitchell River Basin', Maffra, Victoria. http://www.srw.com.au/files/Local_management_rules/Mitchell_River_Basin_LMP_January_2014.pdf Accessed 4 December 2018.
212. This valuation approach was used in Varcoe T, Betts O'Shea H, Contreras Z 2015, 'Valuing Victoria's parks: Accounting for ecosystems and valuing their benefits', DELWP and Parks Victoria, Melbourne, Victoria https://parkweb.vic.gov.au/__data/assets/pdf_file/0010/695764/Valuing-Victorias-Parks-Report-Accounting-for-ecosystems-and-valuing-their-benefits.pdf Accessed 4 December 2018.
213. Kuczera G 1987, 'Prediction of water yield reductions following a bushfire in ash-mixed species eucalypt forest', Journal of Hydrology, 94(3-4), pp. 215-236.

Post-1989 disturbance in the Kilmore, Mitchell River and Nicholson River catchment area is illustrated in Table 45.[214]

Theoretical maximum water yield from these catchments has been modelled and is reported in Table 46. Theoretical maximum water yield has been calculated using the 3PG+ model within the EnSym[215] framework, assuming no forest disturbance since the 1939 'Black Friday' bushfires. This will create a conservative maximum yield estimate, as the water-yield impact of the 1939 bushfires is still being experienced and will not return to normal until the middle of this century.

The difference between actual recorded flows and theoretical maximum flows is reported in Table 47. For instance, if there was no ash forest disturbance post-1939 in the Mitchell River catchment area, there would have been an additional 18,503 ML of water supply in 2017. This type of analysis can help to assess the potential impacts of fire, fire management and forest harvesting on forest assets and the ecosystem services they provide.

214. CRCSI, '4.104 LandFor: Landsat for forests – a monitoring and forecasting framework for the sustainable management of SE Australian forests at the large area scale', Docklands, Victoria
215. DELWP, 'EnSym native vegetation regulations tool', Melbourne, Victoria https://ensym.biodiversity.vic.gov.au/cms/ Accessed 4 December 2018.

Table 45. Forest ecosystem asset condition across three catchments, since 1989

	Kilmore (ha)	Mitchell (ha)	Nicholson (ha)	Total (ha)
Ash disturbed by fire since 1989 (%)	87	61	54	62
Ash disturbed by logging since 1989 (%)	5	1	4	1
Total ash disturbed since 1989 (%)	**92**	**62**	**58**	**63**

(Data source: DELWP 2018)

Table 46. Ecosystem-service flow – theoretical maximum water supply from forest assets in three catchments, 2013–17

Catchment	Theoretical maximum annual flow with no post-1939 ash forest disturbance (ML)				
	2013	2014	2015	2016	2017
Kilmore	6,511	4,776	2,732	3,567	2,853
Mitchell River	857,006	535,634	506,186	1,144,856	522,601
Nicholson River	38,234	39,823	52,749	63,525	5,301
Total	**895,240**	**575,457**	**558,935**	**1,208,381**	**522,601**

(Data source: DELWP 2018)

Table 47. Ecosystem-service flow – theoretical loss of water supply due to disturbance in three catchments, 2013–17

Catchment	Theoretical additional recorded annual flow (ML) under a no post-1939 ash forest disturbance, compared to actual recorded flow				
	2013	2014	2015	2016	2017
Kilmore	2,744	1,885	1,161	1,322	1,207
Mitchell River	15,867	15,655	19,539	19,228	18,503
Nicholson River	931	932	799	1,033	322
Total	**16,798**	**16,587**	**20,338**	**20,261**	**18,825**

(Data source: DELWP 2018)

Criterion 6: Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies

	Status (UNKNOWN / POOR / FAIR / GOOD)	Trend	Data Quality
6.1d Degree of reuse and recycling of wood products **Data Custodian** Sustainability Victoria	GOOD	↗	DATA QUALITY Good

This indicator examines the extent to which forest-derived products are reused and recycled. Reuse and recycling of forest-derived products can reduce industry reliance on environmentally damaging fossil fuels, and increases long-term carbon storage. An increase in recycling of forest products indicates more efficient and sustainable use of forest resources.

The terms 'waste recycling' and 'waste recovery' are used frequently in this indicator. Waste recycling is defined as bringing waste back to a state of raw material for the creation of a new product. Waste recovery describes ways of processing of waste – other than destroying it or sending it to landfill – such as burning waste wood as a fuel source.

Recycling of forest-derived products increased by 28% between 2008–09 and 2016–17 (Figure 59). The largest contribution to the increase was paper and paperboard, which increased by about 32%, from about 1.1 million tonnes to 1.45 million tonnes. Sustainability Victoria, in its 2016–17 annual report, indicated that the increase started in 2006–07, but that the figure has been relatively stable from 2012–13.[216]

The amount, in tonnes, of timber products recycled between 2008–09 and 2016–17 increased by 15%.

216. Sustainability Victoria 2017, 'Victorian recycling industry annual report 2015-16', Melbourne, Victoria http://www.sustainability.vic.gov.au/Government/Victorian-Waste-data-portal/Victorian-Recycling-Industry-Annual-Report Accessed 14 January 2019.

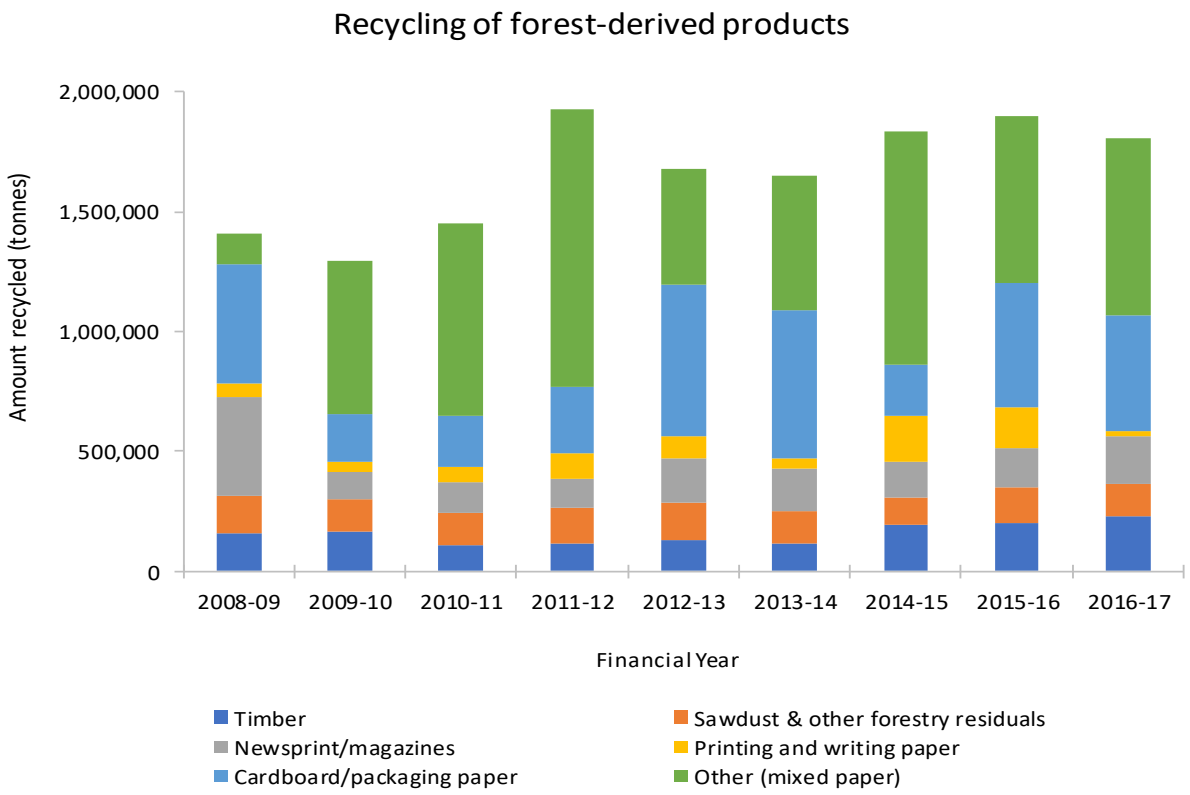


Figure 59. Recycling of various forest-derived products in Victoria, 2008–09 to 2015–16 (Data source: Sustainability Victoria 2018)

Over the same period, the waste recovery rate for forest-derived products has fluctuated, between 42% and 54% for wood and timber (average 49%), and between 66% and 78% for paper and paperboard (average 73%) (Figure 60). Victoria's rate for paper and paperboard waste recovery is much higher than the national average of 60%.[217] National waste recovery rate of wood and timber products was not found.

Sustainability Victoria forecasts that waste recovery rates for paper and paperboard, and organic materials (including wood and timber), will continue to increase, with potential fluctuations, in-line with past trends.[218] It is therefore likely that Victoria will continue to have a high rate of waste recovery.

217. Australian Department of the Environment and Energy 2016, 'National waste report 2018', Canberra, Australia http://www.environment.gov.au/system/files/resources/7381c1de-31d0-429b-912c-91a6dbc83af7/files/national-waste-report-2018.pdf Accessed 21 January 2019.
218. Sustainability Victoria 2017, 'Victorian recycling industry annual report 2016-17', Melbourne, Victoria http://www.sustainability.vic.gov.au/Government/Victorian-Waste-data-portal/Victorian-Recycling-Industry-Annual-Report Accessed 21 December 2018.

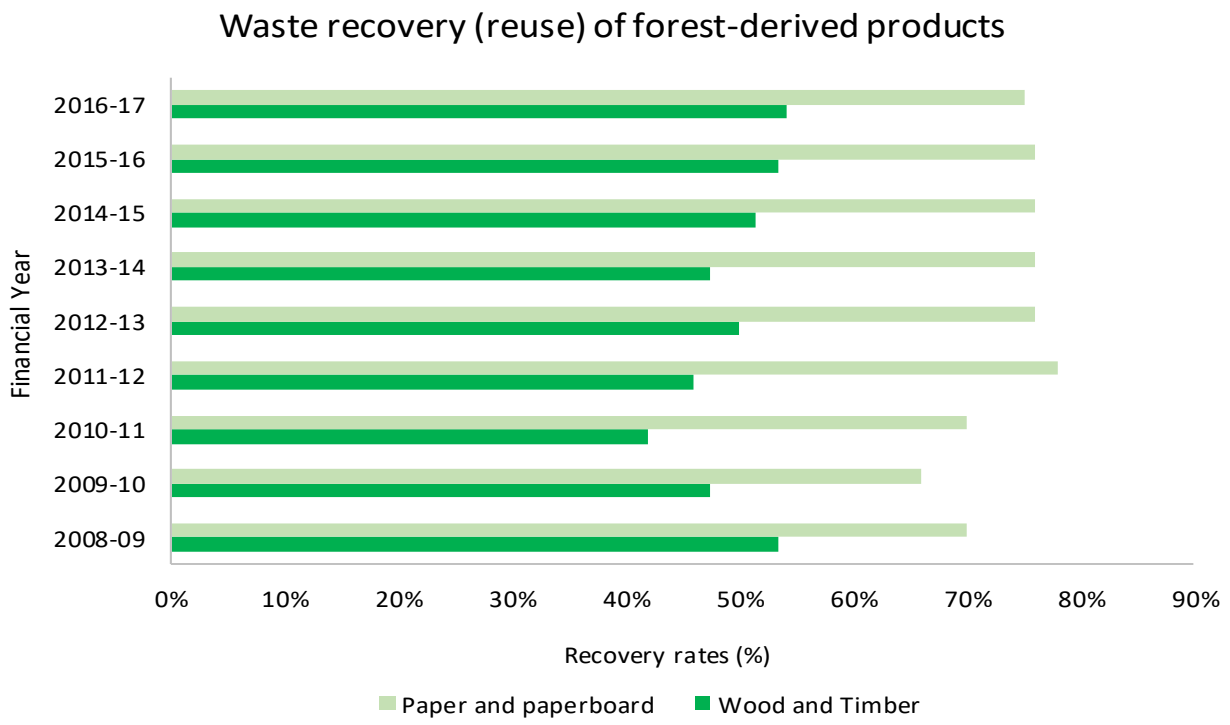


Figure 60. Waste recovery rates for forest-derived products in Victoria, 2008–09 to 2015–16
Note: Waste recovery is defined as the use of waste as an input material to create new products.
(Data source: Sustainability Victoria 2018)

Criterion 6: Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies

	Status (UNKNOWN / POOR / FAIR / GOOD)	Trend	Data Quality
6.2a Investment and expenditure in forest management Data Custodian DELWP	○ ○ ● ○	→	DATA QUALITY Good

Effective sustainable forest management relies on adequate investment and expenditure. This ensures that infrastructure, facilities, forest health and conservation values are maintained.

This indicator measures trends in forest management expenditure, reported as Victorian Government expenditure on forest-management-related activities. This includes expenditure on state forests and parks and reserves, as well as VicForests's expenditure on forest management.

There are two main investment components: forest and fire management, and conservation and recreation.

The agency responsible for managing natural resources, including state forests, in Victoria has changed several times during the reporting period. In April 2013, the Department of Sustainability and Environment merged with the Department of Primary Industries to form the Department of Environment and Primary Industries (DEPI). In January 2015, DELWP, which has broad responsibility for Victoria's natural environments (including forest management, and fire and emergency management), was created following a government restructure. Together with Parks Victoria and VicForests, DELWP is responsible for managing Victoria's parks and reserves, and state forests. VicForests is a separate government-owned business responsible for the harvest, commercial sale and regrowing of wood from Victoria's state forests.

Table 48 shows expenditure on managing Victoria's forests, parks and public land between 2012–13 and 2016–17. Expenditure has steadily increased over the five-year period. Forest and fire expenditure have remained comparatively steady, with a slight decrease in 2016–17 mainly attributed to a less-severe fire season. Expenditure on conservation and recreation increased significantly in 2013–14 and continued to increase during the period. The changes over five years may indicate that the Victorian Government has increased focus on and investment in conservation and recreational values in state forests, parks and reserves.

Table 48. Victorian Government expenditure on forest management, 2012–13 to 2016–17

	Expenditure ($ millions)				
Expenditure category	**2012–13**	**2013–14**	**2014–15**	**2015–16**	**2016–17**
Forest and fire management	383.5	382.3	347.8	396.5	372.3
Conservation and recreation	199.0	199.3	298.9	328.2	369.8
Total	582.5	581.6	646.7	724.7	742.1

(Data source: DELWP 2018)

Table 49 shows the forest management expenditure on general maintenance, capital roading and capital bridge works between 2012–13 and 2016–17. Total expenditure decreased across the period, particularly on maintenance work.

This was mainly due to decreasing timber production and available production areas, which reduced the maintenance works required for state forests, and parks and reserves.

Table 49. Victorian Government forest management expenditure on maintenance, capital roading and capital bridges, 2012–13 to 2016–17

	Expenditure ($ millions)				
Expenditure category	**2012–13**	**2013–14**	**2014–15**	**2015–16**	**2016–17**
Maintenance	16.0	16.8	12.6	9.0	7.9
Capital roading	0.2	0.7	0.4	0.3	0.2
Capital bridges	2.2	2.4	2.6	3.2	1.4
Total	18.3	19.9	15.5	12.5	9.5

(Data source: DELWP 2018)

Credit: Wally Notman

Criterion 6: Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies

	Status (UNKNOWN / POOR / FAIR / GOOD)	Trend	Data Quality
6.2b Investment in research and development and education **Data Custodian** DELWP, ForestWorks, Forest and Wood Products Australia	○ ○ ● ○	↘	DATA QUALITY Fair

To maintain and enhance the long-term multiple socio-economic benefits from forests in meeting the needs of Victorians, investment in building knowledge to ensure sustainable forest management plays an important role. This indicator demonstrates the level of commitment to research and development (R&D) and education by the government and industry.

Information available for this indicator was limited to annual investments in forest management R&D and education. Table 50 shows that about $39 million has been invested in forest-related R&D and education since 2010–11 (an average of about $5.6 million per year). The annual data includes research payments, but does not split payments for multi-year research projects. Therefore, some years may have a 'spike' in payments. For instance, the $5.9 million expenditure in 2013–14 with the University of Melbourne reflects the incorporation of total payments against multiple multi-year projects.

Between 2010–11 and 2016–17, six agencies and research organisations received funding. Consistently, the largest investment – $25 million over seven years (64% of the overall investment) – was provided to the University of Melbourne. The second-largest was to the Victorian Forest Monitoring Program (VFMP), which received about $5.9 million over seven years (15% of the overall investment).

The Victorian Government also contributed 20% of overall investments ($7.8 million) to the Arthur Rylah Institute and the Bushfire and Natural Hazards Cooperative Research Centres (CRC). Investment in research and development by VicForests in 2015–16 was approximately $161,000.

(Note that all states and territories that manage public production forests also contribute to R&D through a forest grower's levy, which supports the delivery of programs by Forest and Wood Products Australia.)

The University of Melbourne is a high-quality R&D and education provider in forest research in Victoria, through its School of Ecosystem and Forest Science (SEFS). The Victorian Government and SEFS established an integrated forest ecosystem research (IFER) program in 2010 to secure research services to improve public land management in Victoria. The program has six core themes:

- landscape biodiversity
- landscape carbon
- landscape hazards
- landscape socio-economics
- landscape vulnerability
- landscape water.

The program provides confidence in funding and government support, enabling the joint development of robust research projects, as well as recruitment and retention of research staff, and encouragement and support of more postgraduate students. Land managers have used research findings from IFER in decision-making processes. The program outcomes for the period 2010 to 2016 have been published.[219]

219. DELWP 2016, 'Integrated Forest Ecosystem Research (IFER) – program outcomes 2010-16', Melbourne, Australia https://www.ffm.vic.gov.au/__data/assets/pdf_file/0018/70254/EoC1-May-2017-final.pdf Accessed 4 December 2018.

Table 50. Victorian Government investment in forest management R&D and education, 2010–11 to 2016–17

Research provider	Expenditure ($)							
	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	Total
The Arthur Rylah Institute	975,000	710,000	430,000	836,273	232,244	655,397	281,493	4,120,407
The University of Melbourne	3,200,000	3,100,000	2,920,000	5,890,000	3,235,000	3,665,000	3,025,000	25,035,000
VFMP	727,000	1,253,000	750,000	800,000	830,000	830,000	740,000	5,930,000
CRC for Forestry	50,000	50,000						100,000
Bushfire and Natural Hazards CRC	213,000	746,000	200,000	875,000	550,000	200,000	880,000	3,664,000
Toolangi Forest Discovery Centre	48,393	52,115						100,508
VicForests						161,000		161,000
Total	5,213,393	5,911,115	4,300,000	8,401,273	4,847,244	5,511,397	4,926,493	39,110,915

(Data source: DELWP 2018)

Education in the forestry sector is important for the future of Victoria's forests. Decision-makers will need to learn and develop skills to meet the many future challenges facing Victorian forests, and to address national and global challenges.

There are three relevant types of forestry education:

1. Formal training, involving university or TAFE education
2. Vocational Education and Training (VET) – skill-based training completed by someone employed in the industry (TAFE and industry-specific programs)
3. Informal or 'on-the-job' training (including training of volunteers).

Table 51 lists some of the institutes offering forest-industry-related training, as well as forest-related courses and training types.

Table 51. Forest-industry-related education and training institutes in Australia

Institute	Forest-related course or training type
University of Melbourne	Post-graduate studies – Masters, PhD, Doctorate
Australian National University (ANU)	Post-graduate studies – Masters, PhD, Doctorate
Southern Cross University	Bachelor of Forest Science and Management
South Regional TAFE, TAFE WA	Diploma of Forest and Forest Products
FITEC Australia	Certificate III in Timber Merchandising
Vocational Education and Training (TAFEs, and Registered Training Organisations)	Certificates (I, II, III, IV, Diplomas, Advanced Diplomas) in saw-doctoring, processing, wood panel products, silviculture, harvesting and haulage, and occupational health and safety
DSE, VicForests, DPI, environmental groups	Informal training and work experience

(Data source: Good Education Group Pty Ltd [220])

220. Good Education Group, 'Education & training for a forester', Melbourne, Victoria https://www.gooduniversitiesguide.com.au/careers-guide/browse/forester Accessed 10 January 2019.

Note that recently, the University of Melbourne and the ANU closed their forestry undergraduate degree programs. However, at both institutes, students can still study forest-related courses as part of an undergraduate degree. For example, the University of Melbourne offers a Bachelor of Science with an ecosystem or environmental science major. Graduates can then choose one of several Masters programs that offer specialist training in ecosystem and/or forest management.

Formal training

Formal training at higher education institutes provides policy, management and leadership skills, as well as advanced technical skills, relevant to forestry. The University of Melbourne is the only Victorian university that provides high-level education, such as postgraduate research degrees, in forestry.

The steady decline in forestry graduates from Australian universities has caused concern in the forestry sector. There was a 50% decrease in the number of undergraduate pass-degree completions in forestry between 1994 and 2007.[221] As a result, Australian forest organisations have resorted to recruiting foresters from overseas, including from countries such as South Africa and New Zealand.[222]

Tertiary education providers offer degree places (in forestry and other areas) based on both student and industry demand. However, the connection between industry demand and tertiary education forestry opportunities is becoming increasingly difficult to identify and track. As indicated above, the boundary between 'forestry' and 'forest sector' is fading, as universities provide alternative ways for students to study forestry-related courses – for example, as a part of science, ecosystem science and forest management degrees. More relevant information needs to be collected to capture the changing trends in education.

Vocational Education and Training

Vocational Education and Training (VET) provides education and training in technical and operational forest industry skills. This type of education also includes TAFEs, which offer a range of certificates and diplomas in forest management, timber harvesting and haulage and harvesting.

SoF 2013 identified a decline in forestry graduates, overall reduction in resource availability (2.1 Area and percentage of forest and net area of forest available and suitable for wood production) and the shrinking of the broader forest industry since 2009.

This trend has since intensified. Table 52 demonstrates that enrolments in forestry training packages dropped by 73% between 2009 and 2016. The only industry qualification that showed a growing demand was timber merchandising, where enrolments increased about 4 times (201 enrolments in 2016). The greatest decline in enrolments was in forest growing and management, which decreased by 1122 enrolments. Since 2013, enrolments for wood panel and board production industry qualification is zero.

Demand for wood and wood products is likely to increase as the population increases. However, the amount of forest resources available to harvest has been declining, and will most likely continue to decline (see indicator 6.1a (Value ($) of wood and wood products)). Resource Outlook has forecast that the available area for timber harvesting in State forests will decline in the future, meaning that demand for wood product industry workers is likely to be reduced in the future. In addition, a sharp decline of new, established plantations over the last 10 years in the commercial forest industry (Figure 13) also exacerbates deterioration of the industry regarding the available area to harvest in Victoria.

221. Pratley J, Kanowski P, Bull L 2010, 'Education and training challenges for the Australian forestry sector: an analysis based on recent trends in university and VET completions', Australian Forestry, 73(4), pp. 227-233.
222. Forest and Wood Products Australia 2010, 'Review of Australian Forestry and Wood Products – education and training needs', Melbourne, Victoria https://www.fwpa.com.au/images/corporatedocuments/FWPA_Fegely_2010_Australian_Forestry_Education_Review.pdf Accessed 10 January 2019.

Table 52. Forestry training package enrolments in Victoria, 2009–2016

Industry qualification	Enrolments								% Change
	2009	2010	2011	2012	2013	2014	2015	2016	
Forest growing and management	1555	1174	1146	163	234	322	215	433	-72
Harvesting and haulage	498	480	326	148	94	23	54	44	-91
Saw-milling and processing	427	389	201	107	120	139	124	93	-78
Timber manufactured products	110	78	91	99	115	82	54	39	-65
Wood panel and board production	38	30	80	77	0	0	0	0	-100
Timber merchandising	39	64	36	29	24	34	161	201	415
Pulp and paper manufacturing	393	458	113	301	179	19	10	26	-93
Total	3060	2673	1993	924	766	619	618	836	-73

(Data source: Industry Skills Scans[223])

Informal training

Informal training includes on-the-job training of volunteers working for government agencies, environmental corporations and interest groups. No data was available to report accurately on informal training.

Education – summary

A sharp decline in forest graduates from universities has forced forest organisations to recruit international workers. This decline needs to be addressed.[224]

VET pressures affecting training delivery include declining Australian and state government funding, reduced demand from employers for accredited qualifications and increased fees and tighter standards for regulations of training organisations.[225]

Skill shortages in several diverse areas of the forest products sector have been identified in the ForestWorks 2014 Industry Skills Scan. This includes forest growth and management, sawmilling and processing, paper and pulp manufacture, timber manufactured products, and wood panel and board production.[226] Gaps in skills include business management, resource analysis, critical thinking and digital literacy. Prospective trends for the shortage of skilled workers within the sector include the following:

- Institutional memory loss because of the recent curtailment in working demand, and the associated negative perception that the sector has poor job security
- A higher level of training and literacy is required to undertake harvesting processes with increased automation, with fewer manual workers needed
- Ageing of the existing workforce with less entry-level workers in replacement

223. ForestWorks, 'Industry Skills Scans', Melbourne, Victoria http://www.forestworks.com.au/publications/industry-skills-scans/ Accessed 10 January 2019.
224. de Fegely R 2010, 'Review of Australian forestry and wood products education and training needs', Forest and Wood Products Australia Limited, Melbourne, Victoria https://www.fwpa.com.au/images/corporatedocuments/FWPA_Fegely_2010_Australian_Forestry_Education_Review.pdf 10 January 2019.
225. ForestWorks, 'Industry Skills Scans', Melbourne, Victoria http://www.forestworks.com.au/publications/industry-skills-scans/ Accessed 10 January 2019.
226. ForestWorks 2014, 'Industry skills scan 2014', North Melbourne, Victoria http://www.forestworks.com.au/wp-content/uploads/2016/08/2014_IndustrySkillsScan.Web_.pdf Accessed 10 January 2019.

- Decline in industry enrolments have increased the cost pressures facing educational institutions in delivering university level programs, VET qualifications and short courses
- During economic uncertainty, there is an increasing trend for companies to deliver skills development informally to reduce costs and emphasise immediate business viability. Currently, more than 90% of the training in the forest products sector is delivered in-house, which reduce enrolments into registered courses.[227]

In providing the sector with a skilled workforce, it is imperative to enhance the attraction of a career in forestry. A challenge is the migration of forestry workers to other sectors with superior wage and job security.[228] High quality recruits are also inhibited by poor community awareness of the benefits from working in, and supporting, the forests products sector, its diversified range of careers and its contribution to society. Attempts at addressing these issues have been made by several national campaigns. For example, Growing Careers, a website supported by Forest and Wood Products Australia, provides career information for existing and prospective recruits at http://www.growingcareers.com.au/.

This indicator has also demonstrated that the changing nature of forest-industry employment, and tertiary education, means that focusing solely on courses with 'forest' or 'forestry' in the title is no longer meaningful.

Employers are recruiting graduates from a much broader range of courses than in the past – in part, responding to the broader range of skills required for managing the multifaceted values of forests. There are now many more tertiary pathways for training and employment in forests than what current information provides. These pathways include a multitude of programs in environmental management and conservation, which patently develop the breadth of skills required in forest management. As an example, environmental management and conservation graduates may have more specific skills in conservation and recreation, which are critical aspects of managing forests for socio-economic benefits.

Tertiary funding models also mean that 'niche' courses generally are rarely sustainable. Therefore, across multiple fields of work, 'niche', job-specific skills are increasingly developed through less formal processes, such as internships and on-the-job training. (This is a broad trend seen in many industries.)

Therefore, this report recommends the development of more appropriate datasets for this indicator, to better assess status and trends in education for the forests industry.

227. Ibid
228. Ibid

Criterion 6: Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies

	Status				Trend	Data Quality
	UNKNOWN	POOR	FAIR	GOOD		
6.2c Extension and use of new and improved technologies **Data Custodian** DELWP, CSIRO, University of Melbourne	○	○	○	●	Not applicable	DATA QUALITY Good

This indicator monitors Victoria's continuous effort to improve, through technology, forest management and forest-based industries, and ensure the sustainable use of forests. Ongoing research is needed to meet the evolving challenges facing forests. Adoption of new technologies will provide opportunities to have more efficient resource use and improved management of forests by land managers. Ongoing research to achieve this is an important part of adapting to new emerging challenges in the future.

New technology relevant to this indicator includes the development of the Forest Climate Risk Tool, developed by CSIRO, which provides information on factors such as the likely period of drought, rainfall, number of heatwaves days, temperatures and fire risk in detail. (Resolution is as fine as a 5km x 5km grid for almost all forested and plantation areas of Australia.) This will assist land managers to manage climate change risk and improve productivity. More information can be found at the Forests and Wood Products Australia website at https://www.fwpa.com.au.[229]

Other technological developments include:

- development of a mobile platform ('More to Explore') with more accessible information for visitors of public land attractions. The app provides comprehensive spatial, descriptive and grading information about activities including camping, picnicking, walking, fishing, four-wheel driving, mountain-biking and trail-bike-riding
- development of a new web application to assist bushfire and planned-burning personnel to better interpret forecasted bushfire weather. There was already a range of products to help front-line users interpret forecasted fire weather, but their feedback showed a need for a consolidated tool to improve how information was accessed and interpreted. The 'Foresight' platform, a partnership between Predictive Services and Code for Australia, was the first step in addressing this demand. Further enhancements, and the full use of the system, will benefit bushfire and planned-burning personnel across Victoria.
- using Light Detection and Ranging (LiDAR) technology to map Leadbeater's possum habitat. LiDAR is a remote-sensing technique that captures detailed data on forest structure. It can provide precise estimates of tree and canopy heights, the number of vegetation layers within a forest, total canopy cover, and the size and location of individual trees. LiDAR data has allowed for the first tenure-blind, landscape-scale estimates of hollow-bearing tree abundance in the Central Highlands. The detailed spatial information on the distribution of habitats in differing stages of decay provides critically important guidance for strategic conservation planning for Leadbeater's possum. It also provides a framework for developing strategic and tactical plans for forest conservation and management, as well as monitoring strategies to assess landscape-level changes in Leadbeater's possum habitat, and in forest structure.

Details about each of these technological developments can be found on the Commissioner for Environmental Sustainability website, https://www.ces.vic.gov.au/.

229. Forests and Wood Products Australia, 'Predict forestry climate change with the click of a mouse thanks to new tool', Melbourne, Victoria https://www.fwpa.com.au/news/1633-predict-forestry-climate-change-with-the-click-of-a-mouse-thanks-to-new-tool-2.html Accessed 2 January 2018.

Criterion 6: Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies

	Status (UNKNOWN / POOR / FAIR / GOOD)	Trend	Data Quality
6.3a Area and quality of forest actively utilised for recreation and tourism - quality of state forests **Data Custodian** DELWP		?	DATA QUALITY Poor
6.3a Area and quality of forest actively utilised for recreation and tourism - parks and conservation reserves and area for state forests **Data Custodian** DELWP, Parks Victoria		↗	DATA QUALITY Good

Recreation and tourism in forests provide social, economic and environmental benefits. There are around 23 million visits to Victorian parks per year, primarily for physical activity. This number has been increasing 10% since 2007.[230] This indicator provides information on how public forests are utilised in Victoria and a measure of the extent to which forest management is providing for the recreational needs of the Victorian community and the contribution of forests to the tourism sector. Public forests are broadly available to visitors, and promoted for tourism and recreation use (see indicator (6.3b Range and use of recreation and tourism opportunities that are available within forests), and indicator 6.3c (Number of visits per annum)).

State forests

Visitor activities in state forests include bushwalking, mountain-biking, camping, four-wheel driving, horse-riding and hunting. To help manage government objectives and these multiple uses, state forests are zoned as follows:

- Special Protection Zone (SPZ) – managed for conservation, where significant ecological values, or other values that require exclusion from timber harvesting and recreation use, are identified
- Special Management Zone (SMZ) – managed to conserve specific features while timber production is undertaken under specific conditions. The conservation targets fauna species point of localities (special management sites) or significant attributes (historic sites and isolated population patches for key threatened plant species). Recreational use is restricted
- General Management Zone (GMZ) – managed for a variety of purposes, but with timber production a high priority. Secondary priorities are providing recreational and educational opportunities, protection of landscape values, fire protection and conservation to complement adjacent zones.

The recreational activities permitted depend on different management objectives. In SPZ and SMZ, restrictions apply to recreational activities to protect natural and cultural values. By contrast, most recreational activities are allowed in GMZ areas.

Recreational activities in all management zones in state forests may be temporarily or permanently restricted for various reasons, including:

- protection of flora and fauna
- safety around prescribed burning and harvesting activities (GMZ, SMZ areas)
- protection of water catchments and infrastructure
- public events
- responses to natural disturbances, including landslips, floods and/or fire danger.

No data was found in relation to the quality of Victorian state forests for recreation and tourism uses. A visitor satisfaction survey program to monitor the quality of state forests recreation experiences is currently under consideration. Lack of data prevents meaningful reporting on this indicator.

230. Parks Victoria 2015, 'Valuing Victoria's parks', Melbourne, Victoria https://parkweb.vic.gov.au/__data/assets/pdf_file/0008/666350/Valuing-Victorias-parks.pdf Accessed 5 September 2018.

Parks and conservation reserves

Parks and conservation reserves in Victoria are categorised according to the IUCN standard. All Victorian formal reserves are assigned an IUCN protected area category based on protection status and primary land management (see indicator 1.1c (Area of forest type by growth stage distribution in protected zones)). IUCN categories assigned to areas are subject to refinement. Informal reserves are not assigned an IUCN protected area category.

As the primary management objectives of parks and conservation reserves are biodiversity and conservation outcomes, tourism and recreation activities are permitted subject to the conservation significance of the area.

In Victoria, about 97% of parks and conservation reserves, and 99% of state forest, are available for recreation purposes. However, the actual area used for tourism and recreation is significantly lower, for reasons including remoteness, safety issues (many parks and state forests have rough terrain types) and lack of infrastructure (such as roads and recreational trails).

The following zones temporarily or permanently restrict public access to public forests:

- Safety exclusion zones – these include areas where forest management operations occur, such as timber harvesting coupes
- Water catchments – these are closed to public entry, except limited areas where bushwalking is permitted
- Public safety zones – these zones include public land where high fire-danger ratings are expected when Code Red Fire Danger Rating is forecasted.

From 2004 to 2018, overall available areas for recreation and tourism activities increased by approximately 12.4%. V and VI-type areas (Protected landscape/seascape and protected area with sustainable use of natural resources respectively) were found to have the greatest increase in size (more than 200%). Meanwhile, Ia (strict nature reserve) and III (natural monument or feature type IUCN areas increased gradually.

Parks Victoria conducts visitor satisfaction surveys to monitor the quality of national parks for recreation and tourism uses in Victoria. The most recent survey results demonstrate that the overall level of visitor satisfaction across parks improved between 2010 and 2014. Visitor satisfaction for peri-urban and urban parks improved by about 10%, while overall satisfaction for non-urban parks declined by 5%.[231] Community satisfaction with management of national, state, regional and metropolitan parks and conservation reserves remained consistently high between 1997 and 2014: more than 80% of survey participants responded 'very good' or 'good'.[232]

231. Parks Victoria 2014, 'State of the Parks third edition', Melbourne, Victoria http://parkweb.vic.gov.au/park-management/environment/research-and-scientific-management/state-of-the-parks/state-of-the-parks-3rd-edition Accessed 5 September 2018.
232. Ibid

Credit: Chris M McNamara

Criterion 6: Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies

	Status				Trend	Data Quality
	UNKNOWN	POOR	FAIR	GOOD		
6.3b Range of use of recreation and tourism opportunities that are available within forests	○	○	●	○	→	DATA QUALITY Fair

Data Custodian
DELWP, Parks Victoria

Victoria's forests are managed to meet a high demand for recreation and tourism activities. To minimise potential damage to natural resources from visitor activities, recreation and tourism facilities must be carefully managed.

In state forests, facilities are managed by DELWP. Facilities in parks and conservation reserves are managed by Parks Victoria. Tour operators offer a wide range of appropriate, organised recreation activities on public land. They require a licence to operate: these are managed by Parks Victoria. The State of the Parks Third Edition[233] reported 372 licensed tour operators, who generated nearly 200,000 visits to parks.

Table 53 shows the number of sites and tracks available for recreation and tourism activities, in state forests and parks and conservation reserves, between 2003 and 2017. The number of day-visitor areas and camp grounds has been largely static in state forests, whereas the number of camp grounds in parks and conservation reserves increased dramatically.

Several changes over the past 15 years for various types of tracks include:

- a slight increase in the total kilometres of walking trails, due to improved data capture of the existing track network
- an increase in the network of mountain-biking trails, because of greater investment in the provision of mountain-bike trails in response to increased popularity in Victoria
- increases in four-wheel-driving touring routes, scenic drives, and trail-bike touring routes, largely due to better packaging and promotion of existing roads and attractions.

Note that the kilometres reported for 'driving (km of roads)' reflect promoted touring experiences, not the total kilometres of roads open and available for public use. The increase in promoted touring routes has been primarily in four-wheel-drive tours, which package existing roads and attractions into a promoted touring 'experience' - for example, 'High Country Back Road Tours'.

233. Ibid

Credit: Rachel M Dawkins

Table 53. Sites and tracks available in forests for recreation and tourism activities

Activity	State forest				Parks and conservation reserves			
	2003	2008	2013	2017	2003	2008	2013	2017
Day-visitor areas	300	227	261	250	790	668	752	757
Camp grounds	280	226	249	255	252	599	680	
Total recreational sites			398	389	1042	1267	1432	
No. short walks (<3 km)	53		113	91	811			
No. medium walks (3–8 km)	51		44	51	204			
No. day trails (8–12 km)	14		12	15	50			
No. overnight trails (>12 km)	17		11	6	35			
Walking trails (km)*	550	715	742	787		3,700	3,700	3,700
Mountain-biking trails (km)			334	423				
Horse-riding trails (km)			71	112				
Four-wheel-driving touring routes (km)			251	2128				
Scenic drives (km)			403	449				
Trail-bike touring routes (km)			58	340				
Fishing (no. of managed sites)		33	54	67				
Driving (km of roads)		1700	620	2917				
Events or festivals		152	195	170				
Climbing (no. of documented sites)								

**Note SoF 2013 made a data translation error for the total km of walking trails: the correct figure for 2013 is 742 km. (Data source: DELWP 2018 and Parks Victoria 2018)*

DELWP applies a Levels of Service (LOS) framework across public land sites and infrastructure to guide the strategic management of visitor services across the forests estate (Table 54). This framework provides a statewide context for the establishment and delivery of services and infrastructure to meet the needs of visitors, and guides management of a sustainable and diverse network.

A 'high' LOS means a highly serviced site, with high levels of supporting visitor infrastructure – for example, Steavenson Falls. A 'very basic' LOS is a site with low ranger presence and supporting visitor infrastructure, such as a remote forest camp site. Sites and tracks in state forests are typically less developed for public recreational use than those in nature conservation reserves. Parks Victoria (PV), which manages nature conservation reserves, has a different levels of service matrix, which cannot be compared directly with the state forest matrix.

Table 54. Number of sites and tracks by LOS category in state forests

LOS category	Sites	Tracks
Very High Catering for tourists and park/forest visitors seeking comfort and convenience in a popular/iconic park/forest area	0	2
High Catering for tourists and park/forest visitors seeking quality facilities in a predominantly natural setting	8	5
Mid Catering for active and passive recreationalists seeking some facilities in a predominantly natural setting	86	108
Basic Catering for independent, experienced park visitors prepared to sacrifice comfort to avoid high-use areas	237	142
Very basic Catering for self-sufficient active recreationalists, highly experienced in their preferred activity	58	10
Extremely basic	0	3

** Excludes metropolitan parks*
(Data source: DELWP 2018)

The PV's LOS matrix for parks has been shifted from general parks to visitor sites since 2015. This is mainly due to the criticism towards PV that there are lack of clearly articulated priorities and identifiable outcomes in park management.[234] To justify their investment in the management, PV has developed the visitor experience framework which provides a tool to prioritise assets to understand where to best invest visitor resources in the park network. This aims to provide the greatest overall benefit to visitors while visitor numbers and expectations are growing faster than budgets (please see Table 56 for changes in visitor numbers between 2002-03 and 2016-17).

Proportional distribution of parks by the LOS category in the table below (Table 55) shows that about a quarter of the total number of parks is categorised as 'Mild' or 'High' and more than a half of the parks have limited facilities for visitors ('Basic' and 'Very basic' categories).

234. Parks Victoria 2015, 'Visitor experience framework', Melbourne, Victoria.

Credit: Chris M McNamara

Table 55. Number of parks by LOS category in parks estate

LOS category	Number parks
Very high These sites provide a very high level of service. The sites are clearly defined with significant controls and hardening across the site to manage visitor access and use. There is an extensive range of highly developed and accessible facilities catering for intensive use	9
High These sites provide a high level of service. The sites are clearly defined with controls and hardening in the site to manage visitor access and use. There is a mix of facilities that are more developed, accessible and generally larger catering for more intensive use	195
Mild These sites provide a mild level of service. These sites are clearly defined with greater structure to control visitors and access and hardening that may include sealed surfaces around the site. There is a moderate mix of facilities that are more developed. These areas generally have a higher level of use than basic sites that is clearly evident. This category still has quite a bit of variation depending on the setting	724
Basic These sites provide a basic level of service. These sites are clearly defined with greater structure and have a basic mix of facilities although the quantity and range of facilities is limited. An established pattern of use and wear is clearly evident	669
Very basic These sites provide a very basic level of service. These sites are loosely formed and very undeveloped with no or minimal facilities. There is an established pattern of use and wear that makes the site distinct throughout the year	1,350
Not yet assessed	1,044
Total	3,991

Note: not all visitor parks are a forested area.
(Data source: Parks Victoria 2018)

Credit: Rachel M Dawkins

Criterion 6: Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies

	Status (UNKNOWN / POOR / FAIR / GOOD)	Trend	Data Quality
6.3c Number of visits per annum - state forests **Data Custodian** DELWP		?	DATA QUALITY Poor
6.3c Number of visits per annum - national parks and conservation reserves **Data Custodian** Parks Victoria		↗	DATA QUALITY Good

Victoria's forests, including state and national parks, attract millions of visitors every year. Tourists spend $1.4 billion per year associated with their visits to parks, generating about $1 billion gross value and 14,000 jobs for the state economy.[235] This section provides an indication of overall visitor use and demand, and is a key measure of the socio-economic benefits of forests.

Data for this indicator is from Parks Victoria's latest Statewide Visitor Number Monitor 2002-03 to 2016-17, which covers national and state parks in Victoria, and is conducted every two years.

Forest-visitor numbers generally fluctuate throughout the year, and are difficult to monitor due to multiple entry and exit points. Parks Victoria conducts a random telephone survey every two years, asking respondents for demographic details, and details about locations used, and number of visits to, parks and conservation reserves. This information is supplemented by vehicle counts, and data about entry fees, camping permits and surveys conducted at high-use visitor sites.

Visitation to state and national parks has increased from about 25 million to 42 million (about 70%) between 2002–03 and 2016–17 (Table 56). In 2016–17, the 42 million visits included 660,000 international visits and 1.83 million visits from New South Wales and South Australia. The greatest increase over this period was from interstate visitors (232% increase) and non-Melbourne Victorians (198% increase). More than 90% of all visitors were from Victoria, with more than 60% of those visitors coming from Melbourne.

235. Parks Victoria 2015, 'Valuing Victoria's parks', Melbourne, Victoria http://parkweb.vic.gov.au/__data/assets/pdf_file/0008/666350/Valuing-Victorias-parks.pdf Accessed 24 December 2018.
236. Australian Bureau of Statistics 2018, 'Population projections by region, 2017-2066', Canberra, Australia

Table 56. National and state park visits in Victoria, 2002–03 to 2016–17

Origin of visitors	Number of visitors (millions)									
	2002–03	2004–05	2006–07	2008–09	2010–11	2012–13	2013–14	2014–15	2015–16	2016–17
Melbourne	16.46	16.89	18.87	21.08	20.03	22.73		25.91		25.52
Rest of Victoria	7.22	9.56	9.52	9.23	10.86	9.99		9.75		14.31
Total Victorian	23.68	26.45	28.39	30.30	30.89	32.72		35.65		39.84
New South Wales and South Australia	0.79	1.54	1.17	1.98	1.50	1.35		1.4		1.83
Internationals	0.45	0.60	0.59	0.67	0.68	0.75		0.78		0.66
Total	24.92	28.58	30.16	32.95	33.07	34.8		37.84		42.33

**Note SoF 2013 made a data translation error for the total km of walking trails: the correct figure for 2013 is 742 km. (Data source: DELWP 2018 and Parks Victoria 2018)*

Criterion 6: Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies

The State of the Parks Third Edition, published in 2014, reported that 71% of the Victorian population had visited a park in the past twelve months. This proportion was constant between 2002 and 2014 – a period of significant population growth in Victoria. Visitor numbers are likely to continue to grow accordingly, with Melbourne's population projected to reach 8 million by 2047.[236] For Parks Victoria, this could present a management challenge, as increased visitation could affect cultural and heritage values, including those in Aboriginal cultural places.

There was no data for this report on visitors to state forests. Anecdotally, visits are increasing at a similar rate to visits to national and state parks. Nonetheless, lack of data means the contribution of state forests in terms of recreation cannot be evaluated. DELWP has begun a visitor monitoring program to measure and track levels of visitation to state-forest visitor sites, and is expected to provide data on levels of visitation from 2019.

Credit: Rachel M Dawkins

Criterion 6: Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies

	Status (UNKNOWN / POOR / FAIR / GOOD)	Trend	Data Quality
6.4a Area of forest to which indigenous people have access and rights that protect their cultural heritage and are recognised through formal and informal management practices **Data Custodian** DELWP	○ ○ ○ ●	↗	DATA QUALITY Good

Aboriginal existence and identity are underpinned by healthy cultural landscapes. Along with water and other natural resources, the land that is now the state of Victoria was managed for thousands of years according to traditional laws, customs and practices. Shaped by a sustainable use regime and managed with a deep understanding of natural systems and an embedded lore and culture, Country (land, water, animals, plants, people, spirits and customs) has provided for the material, cultural and spiritual needs of thousands of generations of Aboriginal people[237]

Victoria's cultural landscapes are unique. They are host to one of the oldest continuing cultures in the world, and home to a vast array of plants, animals and places that have both symbolic and practical value to Aboriginal Victorians and all other Victorians. Today's cultural landscapes are a reflection of how Aboriginal people engaged with their world and experienced their surroundings. They are the product of generations of economic activity, material culture and settlement patterns. While colonisation resulted in the landscape being broken up into different land tenures, and established different management regimes, Aboriginal people remain connected to Country, and cultural landscapes continue across these artificial boundaries.[238]

This indicator focuses on Traditional Owners' formal and informal agreements in managing their traditional land, with a specific focus on forests. Information has been sourced from datasets of Victorian Crown land that Traditional Owners have the use of and rights under the *Native Title Act 1993; Traditional Owner Settlement Act 2010*; and/or *the Aboriginal Heritage Act 2006*.

Victorian Aboriginal Cultural Heritage

Aboriginal cultural heritage in Victoria is protected under the *Aboriginal Heritage Act 2006* (the Act). The Act was established on 28 May 2007, replacing the *Archaeological and Aboriginal Relics Preservation Act 1972*. The Act establishes a framework of mechanisms for the management and protection of Aboriginal cultural heritage, through cultural heritage management plans, cultural heritage permits, Protection Declarations and Aboriginal cultural heritage land management agreements.

Registered Aboriginal Parties is a status provided under the Act to Traditional Owner organisations that hold decision-making powers under the Act for the protection and management of Aboriginal cultural heritage within a specified geographic area. Registered Aboriginal Parties are appointed by the Victorian Aboriginal Heritage Council. The Council consists of up to 11 Traditional Owners, who are appointed by the Minister for Aboriginal Affairs. All members are Victorian Traditional Owners who have extensive knowledge and relevant experience or knowledge of Aboriginal cultural heritage in Victoria. There are currently 11 Registered Aboriginal Parties covering more than 60% of Victoria.

237. Parks Victoria 2018, 'Managing Country Together', Melbourne, Victoria https://parkweb.vic.gov.au/__data/assets/pdf_file/0006/724695/Managing-Country-Together.pdf Accessed 24 December 2018.
238. Ibid

A number of Victorian Traditional Owner organisations, including Registered Aboriginal Parties, are working in partnership with government and non-government organisations in developing Country Plans, strategies and assessment frameworks. These mechanisms articulate Traditional Owner groups' aspirations to improve, care and manage the cultural landscape health of Country by integrating cultural heritage and spiritual values; self-determination and governance; health and wellbeing, and economic capacity.

Traditional Owners are formally recognised in three ways by the Victorian government: (i) through the (Commonwealth) *Native Title Act 1993*; (ii) by way of a determination of a co-operative management agreement with a Recognition and Settlement Agreement under the *Traditional Owner Settlement Act 2010* and (iii) through appointment as a Registered *Aboriginal Party under the Aboriginal Heritage Act 2006*, which provides greater responsibilities, control and decision-making for Traditional Owners over their cultural heritage. These methods of recognition establish partnerships between the state and the Traditional Owner groups, to jointly manage and share in the decision-making over determined areas of Crown land.

The Victorian Aboriginal Heritage Council (the Council) was established under the *Aboriginal Heritage Act 2006* (the Act) to ensure that Traditional Owners throughout Victoria play a central role in the protection and management of their heritage. It is the only Victorian statutory authority embodying Aboriginal self-determination. As explained above, it consists of up to 11 Traditional Owners, appointed by the Minister for Aboriginal Affairs.[239]

Aboriginal cultural heritage can include tangible and intangible archaeological, historical and anthropological Aboriginal heritage places, including landforms and land categories. The Victorian Aboriginal Heritage Register (VAHR) is maintained by the Secretary, Department of Premier and Cabinet through their delegate, the Registrar, Aboriginal Victoria. The VAHR is not an open-access register. Access is limited to persons listed in the Act, and information that is listed as sensitive has further access restrictions. Sensitive information includes information about Aboriginal ancestral remains and burials. Registered Aboriginal Parties, and the Council in non-Registered Aboriginal Party areas, have the right to determine if and how information on the VAHR can be accessed.

Traditional Owner Settlement Act 2010

This Act provides for certain Crown land sites, in the Traditional Owner agreement area, to be granted to the Traditional Owner corporation in 'Aboriginal title', and to then be jointly managed with the state. Aboriginal title is a highly modified freehold grant to the Traditional Owners, where the right to occupy, use, control and manage the land is transferred back to the state, including the authority to issue leases and licences. In all cases, the parks and reserves will continue to be managed under the same Act of Parliament by which they were reserved prior to the grant of Aboriginal title. For example, a National Park under the *National Parks Act 1975* prior to the grant of Aboriginal title is taken to be a National Park following the grant. Transfer of parks or reserves to Aboriginal title does not affect existing use and access, which will continue to be managed under the relevant land act. Neither Traditional Owners nor the state can sell or transfer the land or claim exclusive possession.

Aboriginal title is granted under a Recognition and Settlement Agreement for joint management plans, which is formalised through entering into a Traditional Owner Land Management Agreement (TOLMA) by the Traditional Owner corporation. The TOLMA establishes a process for developing joint management plans on Aboriginal Titles lands.

239. Victorian Aboriginal Heritage Council 2017, 'Annual Report 2016 -2017', Melbourne, Victoria.

The joint management plans are endorsed by the DELWP Secretary, prior to approval by the minister responsible for administrating the *Conservation, Forests and Lands Act 1987* (at the time of writing, this was the Minister for Energy, Environment and Climate Change).

The Recognition and Settlement Agreement also allows for the establishment of a Traditional Owner Land Management Board, with the objective of enabling the knowledge and culture of the Traditional Owner group to be recognised in the joint management of the Aboriginal Title lands (appointed lands). Traditional Owner Land Management Board members are appointed by the minister. The composition of membership is at least 50% Traditional Owners, the Secretary's nominee and general members. Membership can range between 7 and 11 people.

Joint management recognises the ongoing connection of Traditional Owners to their land, and enables the knowledge and culture of the Traditional Owner group to be incorporated in the management of that land. Traditional Owners and the state work together in equal partnership to manage the natural and cultural values of parks and reserves under Aboriginal title.

Joint management is supported by strong public policy values and benefits both Traditional Owners and the wider community by:

- recognising Traditional Owner culture and knowledge and enabling direct Traditional Owner influence and involvement in how Aboriginal title land is managed
- increasing the potential for employment, education and training opportunities for Traditional Owners
- providing quality tourism experiences, improving public education and conservation and enabling parks and reserves users and visitors to enjoy activities that connect them with nature and Traditional Owner culture.

Managing cultural landscapes in Victoria's parks and reserves

Parks Victoria is building on its existing reporting frameworks, which largely focus on ecology and natural systems, by adding three pertinent elements to determining the health of cultural landscapes. These are:

- social, spiritual and emotional wellbeing of Traditional Owners
- extent and condition of culturally significant species
- tangible and intangible Aboriginal cultural heritage.

Long-term monitoring is required, as changes in landscape condition can take significant time to become apparent. At the time of writing, Parks Victoria in partnership with Victorian Traditional Owners were realigning reporting frameworks, including State of the Parks reporting, to better incorporate cultural landscape management and condition.

The three key elements, listed above, for improving cultural landscapes are underpinned by the following values:

- **Land Justice and Reconciliation,** including the right to use, manage and direct what happens on Country. The Victorian Government is committed to self-determination for Aboriginal people through the *Aboriginal Heritage Act 2006, Traditional Owner Settlement Act 2010* and *Aboriginal Victorians Bill 2018*
- **Gather, record, share and use traditional and contemporary knowledge.** As the first inhabitants of Victoria, Aboriginal people have a deep knowledge of Country. Supporting Traditional Owner land management, cultural values and knowledge of Country can provide a strong basis for improving management of Country. At the same time, there are opportunities to support non-Aboriginal people to better understand Traditional Owner values and perspectives

- **Connection to Country.** Maintaining a physical connection to Country is well-recognised as a fundamental pillar of the wellbeing of Aboriginal people and the broader cultural landscape. It can provide a means of cultural and spiritual renewal, employment, improved land management outcomes and economic independence. Importantly, it can provide Traditional Owners with the opportunity to meet their cultural obligations to care for Country
- **Management.** The cultural landscapes of Victoria are mostly highly modified environments that have been adapted to suit the needs of their inhabitants, while still maintaining the core attributes that have shaped them over thousands of years. The decisions that managers and users of cultural landscapes make can have a significant impact on the natural and cultural values of those places. In many places, modern land management techniques have focused on meeting the needs of growing populations, without recognising the underlying needs and capacity of Country. By integrating traditional and modern management approaches, actively protecting and improving cultural heritage values and returning ancestors to rest in their rightful Country, Victorians can take steps to reverse some of this impact
- **Sustainable natural resources.** According to traditional laws and customs, it is imperative that natural resources are managed sustainably, to ensure they continue to provide for current and future generations. Embedding this principle into the range of ways that cultural landscapes are used – including harvesting, tourism and enterprise development – will help to bring them back to cultural and ecological health.

At the time of writing, Victoria had formal agreements with five Traditional Owner groups for joint management of their traditional lands under the *Native Title Act 1993; Traditional Owner Settlement Act 2010;* and/or the *Aboriginal Heritage Act 2006*. These agreements are unique, reflecting Native Title, self-determination and the aspirations of the Traditional Owner communities. These agreements increase the involvement of and recognition of rights of Traditional Owners to protect and manage cultural heritage in specific areas of Crown land comprising primarily of public forest.

At the time of writing this report, 375,166 hectares, or about 5%, of public forest was covered by formal Traditional Owner agreements (Table 57) with the most recent, the Taungurung Recognition and Settlement Agreement, formally accepted by the Victorian Government in 2018.

Table 57. Public forest area under Traditional Owner joint management in Victoria

Agreement name	Traditional Owner group entity	Public forest area (hectares)
Yorta Yorta Co-operative Management Agreement (2004)	Yorta Yorta Nation Aboriginal Corporation	50,000[A]
Wotjobuluk Co-operative Management Agreement (2005)	Barengi Gadjin Land Council Aboriginal Corporation	194,000
Gunditjmara Co-operative Management Agreement (2007)	Gunditj Mirring Traditional Owner Aboriginal Corporation	8,375
Yorta Yorta Traditional Owner Land Management Agreement (2010)	Yorta Yorta Traditional Owner Land Management Board (Public entity)	28,505[B]
Gunaikurnai Recognition & Settlement Agreement (2010)	Gunaikurnai Traditional Owner Land Management Board	45,463
Dja Dja Wurrung Recognition & Settlement Agreement (2012)	Dja Dja Wurrung Clans Aboriginal Corporation	48,823
Taungurung Recognition & Settlement Agreement (2018)	Taungurung Clans Aboriginal Corporation	To be determined
Total		375,166

[A] Approximately, and inclusive of Barmah National Park [B] Barmah National Park (Data source: DELWP 2018)

Traditional Owners also have access and rights that protect their cultural heritage through informal management regimes. These incorporate public and private lands in Victoria. In total, about 15 million hectares, including public and private forests, were listed as leasehold forest/Aboriginal co-managed land by Registered Aboriginal Parties (Table 58). There is a total of 11 Registered Aboriginal Parties, with the most recent addition being the Bunurong Land Council Aboriginal Corporation.

Small parts (2,830 hectares) of Victorian private forests are also informally managed by Traditional Owner groups, including 1,700 hectares of the Lake Condah Indigenous Protected Area. The area is part of the Budj Bim National Heritage Landscape, listed in 2004 due to its outstanding cultural heritage value in Victoria. The Kerrup Gunditj clan (Gunditjmara people) traditionally had an extensive and complex aquaculture system at Lake Condah, including eel and fish harvesting. Today, it is managed by the Gunditj Mirring Traditional Owners Aboriginal Corporation. Other declared Indigenous Protected Areas in Victoria include:

- Deen Marr Indigenous Protected Area, which covers 453 hectares in the South East Coastal Plain bioregion, and was declared in 1999. The land was purchased by the Framlingham Aboriginal Trust in 1993
- Kurtonitj Indigenous Protected Area, which covers 353 hectares and is in the centre of the Budj Bim National Heritage Landscape between Mount Eccles volcanic plain and the sea. Declared in 2009, Kurtonitj is owned by the Gunditj Mirring Traditional Owners Aboriginal Corporation, and managed by the Winda-Mara Aboriginal Corporation on behalf of the Gunditjmara people
- Tyrendarra Indigenous Protected Area, which covers 248 hectares on Darlot Creek, a tributary of Land Condah near Portland, and was declared in 2003. Tyrendarra is owned and managed by the Winda-Mara Aboriginal Corporation on behalf of the Gunditjmara people.

Credit: Wally Notman

Table 58. Area of Victorian forest to which Traditional Owners have access and rights that protect their cultural heritage and are recognised through formal and informal management agreements

Name of area and agreement	Area (ha)
Leasehold forest/Aboriginal co-managed land Registered Aboriginal Parties • Gunditj Mirring Traditional Owners Aboriginal Corporation • Barengi Gadjin Land Council Aboriginal Corporation • Taungurung Clans Aboriginal Corporation • Yorta Yorta Nation Aboriginal Corporation • Wurundjeri Land and Compensation Cultural Heritage Council Aboriginal Corporation • Martang Pty Ltd • Dja Dja Wurrung Clans Aboriginal Corporation • Wathaurung Aboriginal Corporation • Eastern Maar Aboriginal Corporation • Gunaikurnai Land and Waters Aboriginal Corporation* • Bunurong Land Council Aboriginal Corporation	14,862,100
Private forest • Framlingham Forest (1,130 hectares) • Lake Condah Indigenous protected area (1,700 hectares and includes the four properties of Lake Condah, Allambie, Muldoons and Vaughans) • Freehold land owned by the Gunditjmara community (Gunditj Mirring Traditional Owners Aboriginal Corporation and Winda Mara Aboriginal Corporation) and declared or intended as Indigenous Protected Areas by the Gunditjmara community owners and recognised by the Australian Government • Lake Tyres Forest (approximately 1,600 hectares)	4,430
Other Crown land/Indigenous co-managed Dja Dja Wurrung Clans The Dja Dja Wurrung People have been granted title to six parks and reserves within their native title settlement area including: • Greater Bendigo National Park • Kara Kara National Park • Hepburn Regional Park • Kooyoora State Park • Wehla Nature Conservation Reserve • Paddys Ranges State Park. These parks will be jointly managed and overseen by the Dhelkunya Dja Land Management Board.	47,502
Grampians National Park • Grampians National Park includes the very small strip of Crown land (Crown allotment 2A, Parish of William) that is reserved under section 4 of the Crown Land Reserves Act 1978 (Vic.)	167,219
Gunaikurnai Joint Management Plan Partnership between the Gunaikurnai Land and Waters Aboriginal Corporation, on behalf of the Gunaikurnai people, and the Victorian Government to jointly manage the following 9 parks and reserves in Gippsland: • Buchan Caves Reserve • Corringle Foreshore • Lake Tyers State Park • Mitchell River National Park • New Guinea Caves • Raymond Island Gippsland Lakes Reserve • Tarra-Bulga National Park • The Knob Reserve	47,070

(Data source: DELWP 2018)

Criterion 6: Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies

	Status (UNKNOWN / POOR / FAIR / GOOD)	Trend	Data Quality
6.4b Proportion of places of indigenous and non-indigenous cultural values in forests formally managed to protect these values **Data Custodian** DELWP, Parks Victoria	○ ○ ● ○	↗	DATA QUALITY Fair

Victoria's forests are not only environmentally and economically valuable, but have great cultural value too. This indicator measures and monitors management regimes in Victoria for Aboriginal and non-Aboriginal cultural heritage values, such as historical sites and aesthetic values.

The management of Aboriginal cultural heritage places is depend on the tenure of site locations, which are often jointly managed by local Aboriginal communities and DELWP or Parks Victoria. Under the *Aboriginal Heritage Act 2006*, all known Aboriginal cultural heritage places are formally protected, regardless of whether they are listed on the Victorian Aboriginal Heritage Register (VAHR). The term 'sites' in this indicator refers to sites and/or places.

There is also a range of non-Aboriginal cultural heritage sites in Victorian public forests, protected under the *Heritage Act 1995*. Sites listed on the Victorian Heritage Register have the highest level of protection and are deemed to be of state-wide significance, as reviewed and approved by the Heritage Council of Victoria.

Disturbance to both Aboriginal and non-Aboriginal cultural heritage sites cannot take place without a permit. Identified non-Aboriginal cultural heritage sites are listed in the Forest Management Plans of state forests. The identities of Aboriginal cultural heritage sites are unpublished, due to the sensitivity of these sites. Nonetheless, all known cultural heritage sites are carefully considered during forest management activities planning. Specific actions are often taken to protect individual sites from potential damage by forest management activities. For example, exclusion zones and buffers can be established around sites of particular significance to protect certain attributes.

In conserving and protecting Aboriginal cultural heritage sites, Parks Victoria has integrated objectives and prescriptions specific to Aboriginal cultural heritage management into the general management of parks and reserves. The prescriptions vary from cultural heritage assessments and heritage surveys to site-specific management plans. A case in point would be the establishment of visitor exclusion areas in the immediate vicinity of some rock art sites.

Legislations for protection of cultural heritage in public forests in Victoria

It is important to identify culturally significant places and artefacts that exist in Victorian public forests – these are protected under legislation. The protection of cultural heritage values on Victorian public forested land is provided for by specific provisions under both Commonwealth legislation; for example, *Environment Protection and Biodiversity Conservation Act 1999* and state legislation such as *Heritage Act 1995*. *The Heritage Act 1995* also established the Victorian Heritage Register, which lists all non-Aboriginal historic places of state significance. The *Planning and Environment Act 1987* and the *Mineral Resources (Sustainable Development) Act 1990* provide further protection for sites listed under the Victorian Heritage Register. Cultural heritage sites may also be protected under legislation specific to public land use categories, such as the *Forests Act 1958* and the *National Parks Act 1975*.

To identify cultural heritage places, Public Land Management layer (PLM25) was used and categorised by 1) public forests, 2) other Crown land and 3) private area. A spatial layer (MMTGEN layer) under PLM25 was used to determine the land tenure breakdown.

Places that fell within Commonwealth land, freehold, other conservation reserves, private land, and plantations attributes in the MMTGEN field, as well as the parcels with null MMTGEN values, were not considered in this report.

This report lists significantly more registered Aboriginal cultural heritage sites in Victorian public forests than SoF 2013. Prior to 2010, the registration date of Aboriginal places was not mandatory, and has many null values in DELWP's spatial layer. Since 2010, this attribute has been made mandatory and is complete from 2010 onwards.

Aboriginal cultural heritage places

Table 59 shows the total number of Aboriginal cultural heritage sites registered between 2012 and 2017. A breakdown of Aboriginal heritage sites by place type that is added in 2017 is described in Table 60.

In 2017, there were more than 12,000 Aboriginal cultural heritage sites registered in parks and conservation reserves, state forests and other Crown land (public forests). Between 2012 and 2017, there was an increase of about 5% in the total number of registered Aboriginal cultural heritage sites. More than half of the increase was contributed by parks and conservation reserves tenure type. The number of Aboriginal cultural heritage sites in parks and conservation reserves was consistently about 68% of the total number of sites. The most common place-types registered, in both parks and conservation reserves and state forests, were low-density artefact distribution, scarred trees and hearths.

Table 59. Registered Aboriginal cultural heritage places in Victorian public forests and other Crown land, 2012–17

Tenure	2012	2013	2014	2015	2016	2017
Parks and conservation reserves	7,841	7,930	8,008	8,062	8,102	8,138
State forests	1,193	1,196	1,205	1,213	1,227	1,287
Other Crown land	2,519	2,568	2,611	2,641	2,669	2,712

(Data source: DELWP 2018)

Table 60. Aboriginal cultural heritage places registered on public land, by component type, 2017

Place components	Parks and conservation reserves	State forests
Aboriginal Cultural Place	0	5
Artefact scatter	9	0
Hearth	18	1
Low-density artefact distribution	35	47
Mound	2	0
Object collection	2	11
Quarry	1	0
Rock art	2	0
Scarred tree	9	50
Shell midden	3	1
Soil deposit	1	0
Total	82	115

(Data source: DELWP 2018)

Non-Aboriginal cultural heritage places

Of non-Aboriginal cultural heritage components (artefacts that exist at a particular place), the most common are associated with mining and mineral processing (Table 61).

Table 61. Non-Aboriginal cultural heritage places

Heritage Victoria group name	Parks and conservation reserves		State forest	
	New Victorian Heritage Register since 2013	Total heritage inventory	New Victorian Heritage Register since 2013	Total heritage inventory
Cemeteries and burial sites	10	20	-	25
Collections	-	-	-	-
Commercial	-	15	-	19
Community facilities	-	3	-	-
Education	1	9	-	1
Exploration, survey and events	-	10	-	3
Farming and grazing	8	79	-	9
Forestry and timber industry	13	134	13	162
Government and administration	-	1	-	-
Health services	3	-	-	-
Heritage Inventory site type	-	45	-	36
Institutional places	-	1	-	-
Landscape – cultural	4	11	-	1
Landscape – natural	2	1	-	-
Law enforcement	1	-	-	-
Manufacturing and processing	9	33	-	7
Maritime industry	2	8	-	-
Military	4	9	-	7
Mining and mineral processing	144	1911	83	950
Monuments and memorials	4	7	-	2
National Heritage Process Group	2	-	-	-
Parks, gardens and trees	8	16	-	-
Postal and telecommunications	3	1	-	2
Recreation and entertainment	2	2	-	1
Residential buildings (private)	9	50	-	6
Retail and wholesale	-	2	-	-
Transient accommodation	3	-	-	-
Transport	25	40	4	10
Unknown item group	-	10	-	1
Urban area	-	5	-	2
Utilities – fire control	-	-	1	-
Utilities – water	4	14		
Total components	261	2437	101	1244
Total number of places	110	1220	47	609

(Data source: DELWP 2018)

While it is clear the number of Aboriginal cultural heritage sites has increased (Table 59), there is insufficient evidence to evaluate whether these sites have been managed as part of sustainable forest management. Parks Victoria (for parks and conservation reserves) regularly monitors cultural heritage sites in national and state parks to protect sites with cultural, spiritual and historical values.[232] This is an important process to manage Victorian public forests to protect culturally sensitive sites. On the other hand, state forests and other Crown land are unclear how Aboriginal cultural heritage sites are monitored and managed regularly.

There is also no system to regularly monitor the number of visitors for state forests (6.3c Number of visits per annum). In addition, many non-Aboriginal cultural values are known to exist in Victorian public forests; however, these are not formally registered, which causes a difficulty in managing and protecting these values.

As such, this report recommends that the Victorian Government create systematic management strategies for monitoring indicators related to the cultural values in forests.

Credit: DELWP Corporate Library

Criterion 6: Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies

	Status (UNKNOWN / POOR / FAIR / GOOD)	Trend	Data Quality
6.5a Direct and indirect employment in the forest sector, and forest-sector employment as a proportion of total employment **Data Custodian** ABS, ABARES, Australian Forest and Wood Products		↘	DATA QUALITY Fair

Employment status is an important measure of the extent of participation in the workforce, and the degree to which Victorian communities benefit from economic activity in forests. Employment trends need to be assessed in relation to overall employment trends in both Victoria and Australia.

All parts of the forest industry generate both direct jobs and indirect jobs. Direct jobs are those related to primary production, primary processing and secondary processing, and indirect jobs are created as a result of the activities of the forest industry. This indicator defines forest sector as production-oriented employment. Tourism-related forest employment is not included in this indicator.

Note that all information presented in this section is from studies published by Forest and Wood Products Australia. These studies use datasets from 2018 ABS and Department of Agriculture and Water Resources (ABARES) data.[240,241] These are the only regularly collected data on employment. For both type of datasets, people who are employed are asked to describe the type of work they undertake. The information is then coded to allocate industry of employment for each participant, using the Australian and New Zealand Standard Industrial Classification (ANZSIC) (ABS/SNZ 2013).

The studies have two versions, analysis of direct and indirect employment of Green Triangle region[242] and the rest of Victorian region.[243] The analysis of employment status in Green Triangle region is not used in this report because the data used in the analysis is not purely from Victoria. Green Triangle spans the border area between South Australia and Victoria.

The data provided below shows changes in direct employment. Data showing changes in indirect jobs cannot be sourced for Victoria. Indirect jobs created in the forest industry is estimated by a prediction model called 'EconSearch RISE model', using results of a 2017 industry survey by Forest and Wood Products Australia.[244]

Direct employment

Table 62 demonstrates trends in the number of people employed in each forest industry sector, and total numbers of people employed at all industry sectors, in both Victoria and Australia.

Employment in Victoria is decreasing in most categories. The total number of Victorians employed in the forest industry in 2016 was down by 28.4% from 2006.[245] Only the forestry support services and forestry and logging categories were stable during the period.

Similarly, employment in all forest industry categories except one has fallen across Australia. Most affected were the wood, pulp and paper product manufacturing sectors. The downturn in wood product manufacturing is associated mainly with decreases in wooden structural fitting and component manufacturing.

240. Australian Bureau of Statistics 2018, '6202.0 – Labour Force, Australia, August 2018', Canberra, Australia http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/6202.0August%202018?OpenDocument Accessed 24 December 2018.
241. Australian Department of Agriculture and Water Resources (ABARES) 2018, 'Australian forest and wood products statistics: September and December quarters 2017', Canberra, Australia http://www.agriculture.gov.au/abares/publications/display?url=http://143.188.17.20/anrdl/DAFFService/display.php?fid=pb_afwpsd9abfe20180524.xml Accessed 24 December 2018.
242. Schirmer J, Mylek M, Magnusson A, Yabsley B, Morison J 2017, 'Socio-economic impacts of the forest industry Green Triangle', Forest and Wood Products Australia, Melbourne, Victoria https://www.fwpa.com.au/images/Green_Triangle_Report_8Dec2017_published.pdf Accessed 13 January 2019.
243. Schirmer J, Mylek M, Magnusson A, Yabsley B, Morison J 2018, 'Socio-economic impacts of the forest industry Victoria (exc. The Green Triangle)', Forest and Wood Products Australia, Melbourne, Victoria https://www.fwpa.com.au/resources/reports/other/1631-socio-economic-impacts-of-the-forest-industry-victoria-exc-the-green-triangle.html Accessed 10 January 2019.
244. Ibid
245. Ibid

This may be explained by a shift towards aluminium or synthetic-based products for construction elements such as window frames and doors.

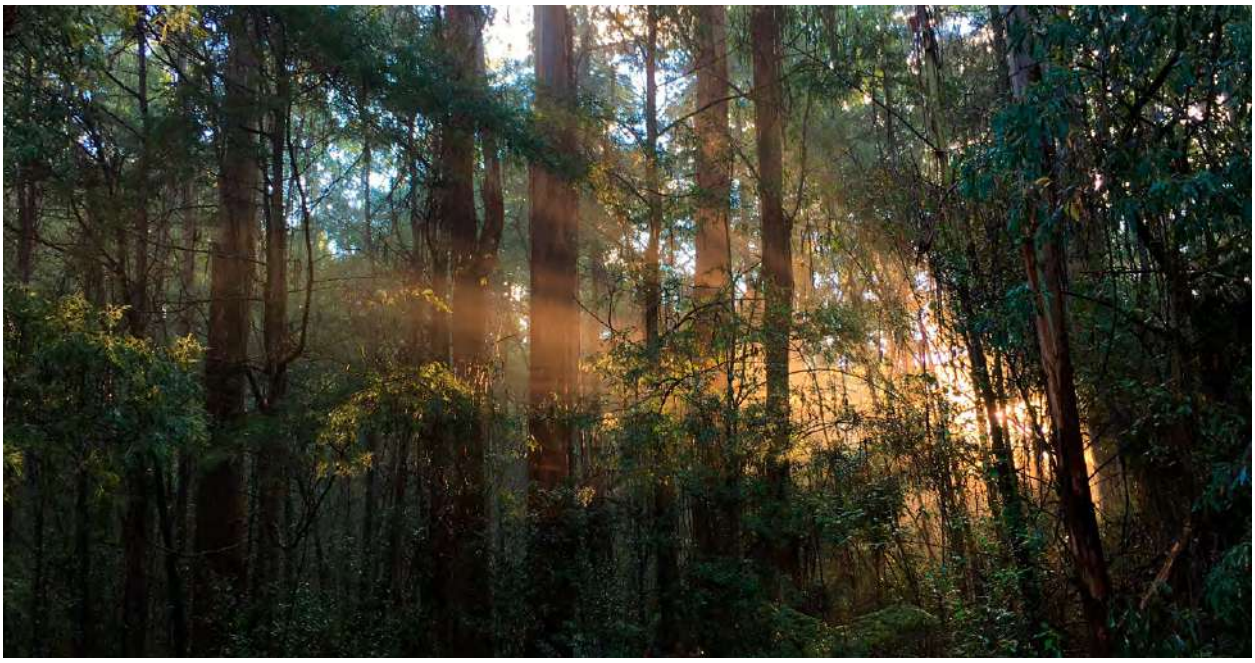
Wood product manufacturing was the largest sector of the Victorian forest industry, accounting for more than 45% of the industry's employees in 2016. This is slightly lower than the national proportion for the wood product manufacturing sector, which employs about 51% of the total employed in the forest industry. The pulp and paper product manufacturing sector also employed a significant proportion of forest industry workers (34%) in 2016.

Contribution of the forest sector to total employment decreased significantly, both in Victoria and Australia. This is due to both an increase in total employment generally, and a decrease in forest sector employment, by 27% in Victoria and 33% across Australia.

Table 62. Employment by forest industry sector in Australia and Victoria, 2006, 2011 and 2016

	Australia			Victoria			% Victoria[A]		
Year	2006	2011	2016	2006	2011	2016	2006	2011	2016
Sector									
Forestry and logging	6,866	5,403	6,028	1,177	1,065	1,371	17%	20%	23%
Forestry support services	2,050	2,171	2,956	338	418	569	16%	19%	19%
Pulp and paper product manufacturing	23,482	19,368	13,969	8,893	8,164	5,660	38%	42%	41%
Timber wholesaling	5,533	4,673	4,566	1,704	1,641	1,610	31%	35%	35%
Wood product manufacturing	47,304	41,669	29,032	10,897	10,348	7,525	23%	25%	26%
Total in forest industry sector	85,235	73,284	56,551	23,009	21,636	16,735	27%	30%	30%
Total employment of all industries	10,299,500	11,323,200	11,957,700	2,551,200	2,830,900	3,102,300	25%	25%	26%
Forestry dependency[B]	0.83%	0.65%	0.47%	0.90%	0.76%	0.54%			

[A] % Victoria is a proportion of employment in Victoria in each sector compare to the employment of each sector in Australia.
[B] Forest dependency is total in forest industry sector divided by total employment of all industries.
(Source: Australian Department of Agriculture and Water Resources and ABS)



Credit: Tom Fairman

Indirect employment

The EconSearch RISE model estimated that an average of 3.1 indirect jobs were created for every direct job in the forest industry in Victoria. This multiplier varied depending on sector. For example, every direct job in native forests created 1.9 indirect jobs, while every direct job in hardwood plantations created 3 indirect jobs.

Overall an estimated 10,581 indirect jobs were created in 2017. This estimate was not state-scale, as the 5,115 direct jobs do not include the direct jobs created in the south-western part of Victoria, including the Green Triangle area.

A 2013 study reported that there had been no recent studies estimating the indirect employment impacts of Victoria's forest industries, and there are relatively few recent Australian studies of forest industry multipliers to apply to various forest sectors.[248]

The study also compiled the proportion of full-time and part-time workers in the forestry industry in Victoria, and found that 16% of forest industry direct employees were part-time workers. This was much lower than the part-time rate across all industries in Victoria (39%), but a significant increase from 2% in 2006.[249]

The EconSearch RISE model estimate from 2018 was the first estimate of indirect forest jobs in Victoria to use an economic modelling process.

While ABS Census (Population and Housing) data is the most reliable for monitoring direct employment in the forestry industry, and for estimating indirect employment, the Census is only conducted every five years.[250] However, data collected through the Forest Industry Survey (FIS) in 2017 was found to have a reasonable consistency with the Census data,[251] indicating that there is potential to use both datasets in combination to monitor direct and indirect employment status more frequently.

Data in this indicator suggests that the decline in direct employment in the forest industry is accelerating. Robust information about employment needs to be captured more frequently to monitor this trend.

248. Schirmer J, Binks B, Kancans R, Stenekes N 2013, 'Social indicators for Australia's forest and wood products industries: discussion papaer', Australian Department of Agriculture ABARES, Canberra, Australia http://apo.org.au/system/files/165176/apo-nid165176-739616.pdf Accessed 9 December 2018.
249. Note this data does not include Melbourne, as high employment numbers in secondary processing in Melbourne reduce comparability to industry survey data.
250. Schirmer J, Mylek M, Magnusson A, Yabsley B, Morison J 2018, 'Socio-economic impacts of the forest industry Victoria (exc. The Green Triangle)', Forest and Wood Products Australia, Melbourne, Victoria https://www.fwpa.com.au/resources/reports/other/1631-socio-economic-impacts-of-the-forest-industry-victoria-exc-the-green-triangle.html Accessed 10 January 2019.
251. Ibid

Credit: Tom Fairman

Criterion 6: Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies

	Status				Trend	Data Quality
	UNKNOWN	POOR	FAIR	GOOD		
6.5b Average wage rates and injury rates in major employment categories within the forest sector **Data Custodian** ABS	○	○	○	●	↗	DATA QUALITY Good

A sustainable forest industry provides the economic benefits of income security to forest-dependent communities. It also provides safe workplaces to prevent illness and injury at work.

The available data for this indicator is national-scale datasets published by the Australian Department of Agriculture and Water Resources. This indicator provides wages and salaries in forestry industries from an analysis by Schirmer et al based on data from ABS Census conducted in 2006, 2011 and 2016. With the same reason as indicator 6.5a (Direct and indirect employment in the forest sector, and forest-sector employment as a proportion of total employment), wage rates in Green Triangle region are not included in this indicator.

For injury rates, the number of standardised injury insurance claims in the forest industry in Victoria is presented. Injury rates are reported by the ANZSIC industry categories: forestry and logging, wood product manufacturing, and pulp, paper and converted paper product manufacturing.

Wage rates

Table 63 shows income earned by workers in the forest industry, compared to all industries, except for the Green Triangle region. The Green Triangle region earned higher incomes than the average for the rest of Victoria. The table indicates that forest industry workers in Victoria generally earned greater than the average salary for the region. Forest industry workers who earned less than $649 per week (16%) were almost half of the proportion of workers who earned less than $649 per week in all industries.

A similar pattern can be found in the group of workers who earn more than $1,299 per week: 38% of workers in the forest industry compared to only 30% of the overall employed labour force. Much of this difference is due to the higher proportion of full-time workers in the forest industry, which raised the overall salary per worker on average (Table 64). When this data narrows down to only full-time workers, forest industry workers were still less likely to earn a low level of income (7% of full-time forestry workers) whereas the proportion of full-time workers earning more than $1,299 per week in the forest industry is similar to those in all industries. Overall, these two tables indicate that forestry workers are less likely to earn low incomes than workers in other industries.

252. Ibid

Table 63. Income earned by workers in Victoria (excluding Green Triangle region), in forest industry sectors and for all industries, 2006– 2016

Industry sector (ABS classification)	% of all workers earning <$600 or <$649 per week			% all workers earning >$1,299 or $1,250 per week		
	2006 ($600/wk)	2011 ($600/wk)	2016 ($649/wk)	2006 ($1299/wk)	2011 ($1250/wk)	2016 ($1250/wk)
Forestry	33	29	22	15	21	41
Logging	19	10	14	20	47	53
Forestry support services	46	31	21	4	17	30
Wood product manufacturing	42	22	14	6	15	25
Pulp and paper manufacturing	16	9	5	42	58	72
Forest industry workforce – Victoria, excluding Green Triangle/Melbourne	34	20	16	16	27	38
Employed labour force (all industries) – excluding Green Triangle/Melbourne	47	42	31	12	20	30

Note: Workers who were away from work or did not report their working hours were excluded from the analysis. Data does not include Melbourne as high numbers of employment in secondary processing in Melbourne reduce comparability to industry survey data.
(Data source: ABS Census of Population and Housing[253])

Table 64. Income earned by full-time workers, in forest industry sectors and all industries, 2006–2016

Industry sector (ABS classification)	% of all workers earning <$600 or <$649 per week			% all workers earning >$1,299 or $1,250 per week		
	2006 ($600/wk)	2011 ($600/wk)	2016 ($649/wk)	2006 ($1299/wk)	2011 ($1250/wk)	2016 ($1250/wk)
Forestry	22	11	10	20	35	48
Logging	10	3	8	22	53	57
Forestry support services	25	11	9	6	23	39
Wood product manufacturing	37	15	9	7	19	28
Pulp and paper manufacturing	9	6	2	45	48	76
Forest industry workforce – Victoria, excluding Green Triangle/Melbourne	27	12	7	18	31	43
Employed labour force (all industries) – excluding Green Triangle/Melbourne	29	16	12	17	33	43

Note: Workers who were away from work or did not report their working hours were excluded from the analysis.
(Data source: ABS Census of Population and Housing[254])

253. ABS, 'ABS Census of Population and Housing 2006, 2011, 2016, TableBuilderPro, place of usual residence database', Canberra, Australia.
254. Ibid

Injury rates

Between 2011–12 and 2016–17, the total number of injuries in the forestry industry decreased by about 23%, mainly due to a 50% reduction in injuries in the paper and product manufacturing industry. The wood product manufacturing sector had the greatest number of claims of the three sectors presented (Table 65), followed by the pulp, paper and converted paper product manufacturing sector.

With current information, it is difficult to identify that this is a sign of improvements in occupational health and safety/ employment quality. This is because there are various other factors that could influence on the data such as overall number of employments. More comprehensive data is necessary to evaluate current status and trend of injury rates in forestry industry.

Table 65. Number of injury insurance claims in the forest industry (forestry and logging, wood product manufacturing and pulp, paper and converted paper product manufacturing), 2011–12 to 2016–17

Industry sector	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17
Forestry and logging	12	18	18	18	21	18
Wood product manufacturing	381	370	280	321	368	338
Pulp, paper and converted paper product manufacturing	205	146	124	135	129	107
Total	598	534	422	478	518	463

(Data source: WorkSafe Victoria)

Credit: Stephen Colquitt

Criterion 6: Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies

	Status				Trend	Data Quality
	UNKNOWN	POOR	FAIR	GOOD		
6.5c Resilience of forest-dependent communities to changing social and economic conditions **Data Custodian** ABS	○	○	●	○	↘	DATA QUALITY Good

Communities with high economic and cultural dependence on forest and forest-related industries are more vulnerable to changes in forest industries than those with less dependence. This indicator is a measure of the extent to which communities can successfully respond and adapt to changes in the industry.

'Forest-dependent communities' are people living in local government areas (LGAs) where more than 2% of total employment is directly dependent on the forest industry, or where there are large areas of plantations or harvesting of native forests.

Measuring the resilience of forest-dependent communities is difficult. Forest-dependent communities can be found near forests and are often small. This indicator provides information on proportional contribution of the forest industry to direct employment based on ABS Census data from 2006, 2011 and 2016[255] and Australian forest and wood products statistics.[256] This is achieved by comparing the overall employment change with the 2016 Regional Wellbeing Survey data[257] to provide adaptive capacity, which includes economic diversity, community wellbeing and capital resources index (Table 66). These quantitative indices are used to represent the degree of adaptive capacity within a community.

The information presented in this indicator is only from those directly employed in the forest and wood products industries. It is difficult to determine the economic dependence on forests from non-forest products industries such the apiary, grazing and ecotourism industries. As such, these industries were not considered in this indicator.

255. Australian Bureau of Statistics 2016, '2016 Census – Australian Bureau of Statistics', Canberra, Australia.
256. Australian Department of Agriculture and Water Resources (ABARES), 'Australian forest and wood products statistics, Canberra, Australia http://www.agriculture.gov.au/abares/publications/pubs?url=http://143.188.17.20/anrdl/DAFFService/pubs.php%3FseriesName%3DAustForestStat%26sort%3Ddate%26sortOrder%3Ddesc%26showIndex%3Dtrue%26outputType%3Dlist%26indexLetter%3D Accessed 10 January 2019.
257. University of Canberra 2017, 'Data tables for Regional Development Australia (RDA) regions & Local Government Area (LGA) regions', Bruce, Australia http://www.canberra.edu.au/research/faculty-research-centres/ceraph/regional-wellbeing/survey-results/2016-survey-results/2016-results-by-rda-and-lga Accessed 24 December 2018.

Table 66. Level of adaptive capacity of communities

Economic diversity index
The economic diversity index is the measure of diversity of employment sectors in a local economy, relative to the Australian economy. High economic diversity provides alternative income sources for displaced workers, as there are various income streams in the local economy. More income sources can elevate resilience to changes in the industry on which they depend. This index is also called the Hachmann Index[258] and utilises data from the 2016 ABS CPH to evaluate scores based on the assessment of employment diversity across sectors in a location relative to that for Australia.
Community Wellbeing Index
The Community Wellbeing Index is based on the annual Regional Wellbeing Survey of residents of rural and regional Australia. The survey is conducted by the Centre for Research and Action in Public Health at the University of Canberra. Respondents are asked five questions about liveability to gauge their attachment to and attitude towards their community, and how it relates to their quality of life. Questions seek to assess how capably they cope with challenges, and their confidence in the future of their community. The index can be compared across other areas.[259]
Capital Resources Index
The Capital Resources Index is a compound index to assess the accessibility of the capital resources to residents in a community, and responsiveness of a community to changes in an industry to achieve positive wellbeing outcomes. This index is a combination of sub-components of the Regional Wellbeing Survey that measure residents' views on income and living costs (financial capital); personal health, psychological distress, and community leadership (human capital); equity and inclusion (institutional capital); volunteering rates and belonging (social capital); access to education, professional and telecommunications services (physical capital); and environmental health (natural capital).

(Data source: DELWP 2018)

In 2016, seven Victorian LGAs had 2% or more of the workforce employed in forest and wood products industries (Alpine, Latrobe, Colac-Otway, Benalla, Wellington, Glenelg and Wangaratta) (Table 67).

These LGAs experienced significant proportional fluctuation in employment conditions between 2001 and 2016. For example, Glenelg lost 55.8% of total employment in forests and wood products industries between 2006 and 2011, but had a 52% increase in the subsequent five years. This increase in forest jobs contrasted with declining employment generally in the Glenelg community, and was the largest proportional increase in Australia.

In four LGAs in Victoria, employment in forest and wood products industries increased between 2011 to 2016, although total employment declined.

Nationally, employment falls accelerated between 2001 and 2016. From 2011 to 2016, the forest and wood products industries lost approximately a quarter of overall jobs in Australia, while all industries gained 3.9%. As indicated earlier, Victoria is consistent with the national trend (see indicator 6.5a (Direct and indirect employment in the forest sector, and forest-sector employment as a proportion of total employment)).

Adaptive capacity in Victoria is mixed compared to the national average. All eight forest-dependent LGAs had a lower economic diversity index, meaning that displaced workers have less potential to find alternative income sources. Glenelg demonstrated poor variety in existing employment sectors in the community – almost half that of the national average.

However, despite lower economic diversity, some LGAs had high wellbeing scores (Table 67). This reflects the fact that other influences can affect wellbeing.

258. Moore E 2001, 'Measuring economic diversification', Oregon Employment Department, USA.
259. Schirmer J, Yabsley B, Mylek M, Peel D 2016, 'Wellbeing, resilience and liveability in rural and regional Australia: The 2015 Regional Wellbeing Survey', University of Canberra, Canberra, Australia https://www.canberra.edu.au/research/faculty-research-centres/ceraph/regional-wellbeing/survey-results/2015/RWS2015_Web-Part-1.pdf Accessed 24 December 2018.

The capital resources index in the Victorian LGAs with high employment dependence on forest and wood products industries was mostly higher than the national average. This indicates that Victorian forest-dependent communities have better accessibility to capital resources to achieve positive wellbeing outcomes.

Table 67. Employment status in forest and wood products, compared to total employment from all industries, and adaptive capacity (economic diversity, community wellbeing and capital resource index) in forest-dependent LGAs, 2001–06 to 2011–16

LGA (Local Government Area)	No. of people employed in forest and wood products industries, 2016	Proportion of workforce employed in forest and wood products industries, 2016 (%)	Change in forest and wood products industries employment (%)[A]			Change in total employment (all industries) (%)	Adaptive capacity (2016)		
			2001–06	2006–11	2011–16	2011–16	Economic diversity index [B]	Community wellbeing index [C]	Capital resources index [D]
Alpine (S)[E]	239	4.53	-20.6	-20.7	-2.4*	0.8	0.76	0.85	0.60
Latrobe (C)[F]	1189	4.19	11.0	-14.6	-4.9	-4.0	0.75	0.62	0.54
Colac-Otway (S)	378	4.14	4.6	8.8	2.4*	-1.8	0.63	0.79	0.58
Benalla (RC)[G]	178	3.29	-29.9	2.1*	-8.2	-8.2	0.77	0.72	0.58
Wellington (S)	443	2.58	43.7	3.9	9.9	-1.9	0.64	0.74	0.56
Glenelg (S)	190	2.40	-10.4	-55.8	52.0	-7.7	0.58	0.73	0.55
Wangaratta (RC)	253	2.09	-9.9	-9.1	9.5	-2.1	0.83	0.83	0.63
Australia	51983	0.51	-3.4	-14.0	-24.2	3.9	1.0	0.75	0.55

Note: LGAs are considered to be dependent on the forest and wood products industries when direct employment in the sector is at least 2% of total workforce employment.
[A] 2001, 2006 and 2011 data have been translated to 2016 LGA boundaries.
[B] The Economic Diversity Index is calculated from ABS census data and measures the variety of employment sectors in a local area on a scale between 0.0 and 1.0, with a score of 1.0 indicating the same diversity as the Australian economy (high diversity). Economic Diversity Index cannot be aggregated above LGA-scale.
[C] Community Wellbeing Index scores from 2016 Regional Wellbeing Survey datasets rescaled to between 0.0 (relatively low wellbeing) and 1.0 (relatively high wellbeing).
[D] Capital Resources Index constructed by ABARES from 2016 Regional Wellbeing Survey data by averaging the scores under financial capital, human capital, institutional capital, social capital, physical capital and natural capital. A score of 0.0 indicates relatively low capital and a score of 1.0 indicates relatively high capital. In most cases the ranking represents scores reported for a group of LGAs or region/s that includes the LGA with the main forest-sector employment. For both Community Wellbeing Index and Capital Resources Index scores, the data used is weighted to represent the distribution of people in the community in rural and regional Australia.
[E] (S) stands for shire.
[F] (C) stands for city.
[G] (RC) stands for rural city.
** Change of 10 or fewer individuals.*
(Data source: ABARES, ABS and University of Canberra 2016 Regional Wellbeing Survey data tables)

In summary, Victorian forest-dependent communities have relatively high resilience in terms of wellbeing. However, these communities have less-diverse income streams and less alternative employment for displaced workers than similar communities in Australia. Glenelg and Colac-Otway LGAs are more susceptible to economic changes than the other Victorian forest-dependent LGAs. Providing a variety of employment sectors in these communities is important to minimise the negative effects of changes in forestry employment.

260. University of Canberra, '2016 results by RDA and LGA', Bruce, Australia http://www.canberra.edu.au/research/faculty-research-centres/ceraph/regional-wellbeing/survey-results/2016-survey-results/2016-results-by-rda-and-lga Accessed 10 January 2019.

Criterion 6: Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies

	Status				Trend	Data Quality
	UNKNOWN	POOR	FAIR	GOOD		
6.5d Resilience of forest-dependent Indigenous communities to changing social and economic conditions	○	●	○	○	↘	DATA QUALITY Good

Data Custodian
The National Centre for Vocational Education Research, ABS

Understanding and monitoring participation of the Aboriginal community in the forestry industry is important for their viability, maintenance of their traditional values and cultural use. This indicator provides a measure of the extent to which Aboriginal communities are involved in the forestry industry to identify social or economic community transitions. The definition of forest-dependent Aboriginal communities in this report is Aboriginal people living in local government areas (LGAs) with a higher-than-state-average of Aboriginal employment in the forestry industry, as a subset of total Aboriginal employment in all industries.

It is difficult to measure and quantify the resilience of Aboriginal communities to changing social and economic conditions. This indicator provides three types of information regarding the current and future involvement of Aboriginal communities in the forestry industry:

- student enrolments and completions in forestry programs between 2014 and 2017, from the National Vocational Education Training Provider Collection for Government-funded students and courses (not fee-for-services courses)[261]
- proportion of Aboriginal employment among employees in the forestry industry by state, derived from ABS Census data (2006, 2011 and 2016)
- Aboriginal employment compared to overall Aboriginal employment across all industries by several LGAs in Victoria.

In 2018, the Victorian Aboriginal Affairs Framework was developed to provide specific objectives and goals against key domains – specifically Country and Culture. The critical goal is that Aboriginal Land, water and cultural rights are realised, with a number of specific measurements to be captured over a five-year period (2018–23). This framework could be used to report on this indicator in future SoF reporting.

In 2016, about 2% of total Australian employment was in the forest industry. This was an increase from 1.17% in 2006 (Table 68). However, there was a dramatic reduction in the **numbers** of people employed, down 48% among non-Aboriginal people, while total Aboriginal employment also decreased during the period.

Among all states, Victoria's forest industry had the lowest Aboriginal employment rate. In 2016, Victoria was the only state with lower than 1% Aboriginal employment in the forest industry. This means that Aboriginal communities in Victoria were less reliant on the forestry industry than communities in other states and territories.

Table 69 also supports the conclusion that the Aboriginal community in Victoria became less dependent on the forestry industry between 2006 and 2016. Total Aboriginal employment in all industries in Victoria more than doubled during the same period – but Aboriginal employment in the forestry industry only slightly increased during the decade.

261. The National Centre for Vocational Education Research 2018, 'National VET provider collection, 2013-2017 (with duplicate activity from National VET in Schools Collection removed for 2014-17 for total VET activity); National Apprentice and Trainee Collection, March 2018 estimates', Adelaide, South Australia.

Table 68. Proportion (and total numbers) of Aboriginal employment in forestry industry by state, 2006–2016

State	2006	2011	2016
Victoria	0.41%	0.42%	0.63%
New South Wales	1.19%	1.63%	2.41%
South Australia	0.57%	1.14%	1.60%
Western Australia	0.84%	1.05%	2.02%
Northern Territory	5.14%	18.85%	49.75%
Queensland	1.74%	1.88%	2.87%
Tasmania	3.14%	4.04%	5.01%
Australian Capital Territory	1.60%	2.16%	2.61%
Average	1.17%	1.40%	2.12%
Total no. employed – non-Aboriginal	106,729	99,445	55,375
Total no. employed – Aboriginal and/or Torres Strait	1,248	1,391	1,176

(Data source: ABS Census)

Table 69. Forestry industry dependency in the Aboriginal community in Victoria, 2006–2016

	2006	2011	2016
Number of Aboriginal/Torres Strait Islanders in forestry industry	118	120	145
Overall employment of Aboriginal/Torres Strait Islanders	7718	10657	15364
Forestry industry dependency in Aboriginal community	1.53%	1.13%	0.94%

(Data source: ABS Census)

In Victoria, nine LGAs were found to have a higher rate of Aboriginal employment in the forestry industry than the state average in 2016 (Table 70). This indicates that Aboriginal communities in these regions are less resilient to changes in the forestry industry than those in other Victorian regions. Between 2006 and 2016, almost all these regions experienced a gradual decrease in Aboriginal involvement in the forestry industry.

Table 70. Proportion of Aboriginal employment in the forestry industry, compared to total Aboriginal employment in all industries, in nine LGAs where higher proportion than state average was found (based on 2016 data)

Local government area	2006	2011	2016
East Gippsland (S)[A]	7.49%	5.54%	4.11%
Knox (C)[B]	4.96%	2.80%	3.45%
Glenelg (S)	8.20%	7.84%	3.20%
Greater Dandenong (C)	1.78%	1.30%	3.14%
Hume (C)	4.02%	3.89%	1.97%
Wodonga (RC) [C]	2.68%	2.67%	1.95%
Monash (C)	1.88%	2.12%	1.49%
Greater Shepparton (C)	0.78%	0.70%	1.39%
Kingston (C)	5.13%	2.07%	1.31%
Total employment all industries	1.53%	1.13%	0.94%

[A] (S) stands for shire. [B] (C) stands for city. [C] (RC) stands for rural city.
(Data source: ABS Census)

Table 71 shows that total Aboriginal students enrolled in government-funded VET programs (related to the forest and wood industries) decreased by more than 50% between 2013 and 2017. The proportion of Aboriginal students was steady at 9%. This reflects the general decrease in enrolments, of both Aboriginal and non-Aboriginal people, in forest and wood industry VET programs.

Table 71. Aboriginal enrolments in forest and wood industry government-funded VET programs, 2013–17

Year	Certificate II	Certificate III	Certificate IV	Diploma	Total Aboriginal students	Total students	Proportion
2013	97	90	0	0	187	2,144	9%
2014	44	65	0	0	109	1,294	8%
2015	16	24	0	0	40	1,123	4%
2016	38	37	0	0	75	1,254	6%
2017	39	36	0	0	75	838	9%

(Data source: National Vocational Education Training Provider Collection)

In 2013, the Victorian Government developed the Victorian Aboriginal Economic Strategy 2013–2020[262] to build on efforts across government and the private sector towards delivering strong outcomes in education, training, employment and business enterprise.

A significant increase in Aboriginal employment in all industries may be a result of the government's effort; however, the forestry industry did not produce any improvements in Aboriginal involvement. Mitigation strategies to reverse the trend found in this indicator are required.

262. Minister for Aboriginal Affairs 2013, 'Victorian Aboriginal Economic Strategy 2013-2020', Melbourne, Victoria https://w.www.vic.gov.au/aboriginalvictoria/policy/victorian-aboriginal-economic-development.html Accessed 24 December 2018.

Criterion 6:
Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies

	Status UNKNOWN	POOR	FAIR	GOOD	Trend	Data Quality
6.5e Area of forest available and accessible for indigenous people to exercise their inherent rights to meet subsistence or individual and family cultural and spiritual needs **Data Custodian** None	●	○	○	○	?	DATA QUALITY Poor

See Indicator 6.4a (Area of forest to which Indigenous people have access and rights that protect their cultural heritage and are recognised through formal and informal management regimes) for details. No relevant information was found for this indicator.

Credit: Faye Bedford

Criterion 6: Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies

	Status (UNKNOWN / POOR / FAIR / GOOD)	Trend	Data Quality
6.6a Extent to which the management framework includes the exercise of customary, custodial, traditional and native title rights as an essential component in achieving sustainable forest management **Data Custodian** DELWP	○ ○ ○ ●	→	DATA QUALITY Good

This indicator measures the extent to which Aboriginal people can actively participate in forest management. Aboriginal Victorians have distinct knowledge, skills, perspectives and experiences for managing land and cultural heritage values.

In Victoria, the *Traditional Owner Settlement Act 2010* gives Traditional Owners the option to undertake settlement determination through state legislation. It establishes a formal partnership with Victoria's Traditional Owner groups and the state of Victoria in managing natural resources, continuing cultural practices and achieving long-term economic development and employment outcomes, through jointly managed land agreements and negotiated native title settlement determinations. DELWP and Parks Victoria are identified as key partner agencies within native title settlement determinations.

The Ngootyoong Gunditj Ngootyoong Mara South West Management Plan (the Plan) is a multi-park management plan, developed in a unique partnership between Parks Victoria, the Gunditjmara Traditional Owners, Budj Bim Council and DELWP. The plan was released in May 2014 and covers nine parks managed or co-managed by Parks Victoria, Cobboboonee Forest Park managed by DELWP, 132 reserves and a regional park managed by Parks Victoria, and six properties owned by the Gunditjmara community, including three Indigenous protection areas. The Plan integrates the knowledge of the Gunditjmara traditional owners into park management. Cooperative management is one outcome from the 2007 Native Title settlement determination (under the *Native Title Act 1993*) between the Gunditjmara Traditional Owners and the state of Victoria.[263,264]

The Aboriginal Heritage Act 2006 (the Act) recognises Aboriginal people 'as the primary guardians, keepers and knowledge holders of Aboriginal cultural heritage'. Registered Aboriginal parties (RAPs) have important roles and functions in managing and protecting Aboriginal cultural heritage in Victoria. Key functions of RAPs in the protection of Aboriginal cultural heritage are approving cultural heritage permits, acting as a party to a cultural heritage agreement, and evaluating Cultural Heritage Management Plans.

Aboriginal Cultural Heritage Land Management Agreements (ACHLMAs) are voluntary agreements, made between RAPs and public land managers, to manage and protect cultural heritage in a specific area to conduct land management activities. These agreements are prepared as set out in Schedule 4 of the Aboriginal Heritage Regulations 2018. Conditions can be included, and amendments made, with consent from all parties to the agreement.

263. Parks Victoria 2015, 'Annual Report 2014-15', Melbourne, Victoria http://parkweb.vic.gov.au/about-us/publications-list/annual-reports Accessed 24 December 2018.
264. Victorian National Parks Association 2015, 'Exploring Victoria's national parks', Carlton, Victoria https://vnpa.org.au/publications/exploring-victorias-national-parks/ Accessed 24 December 2018.

Table 72. Mechanisms that support Aboriginal participation in sustainable forest management

Mechanism	Public Land Tenure	Forest activity	Participation level
Aboriginal Heritage Act 2006	All and private	All	Registered Aboriginal parties formally participate in approvals for cultural heritage management plans and cultural heritage permits
Native Title Act 1993	All	Activities considered to be future acts under this legislation	Future acts referred to registered Native Title claimants as required
Traditional Owner Settlement Agreement Act 2010	All	All	Confers rights to Traditional Owners to participate in public land management decision-making in areas under agreement
Dja Dja Wurrung agreement 2013, under the *Traditional Owner Settlement Act 2010*	Parks and conservation reserves		First comprehensive native title settlement under the Act; formally recognises the Dja Dja Wurrung people as the Traditional Owners for part of Central Victoria
Joint management arrangements under the *Conservation, Forests and Lands Act 1987* or co-operative management agreements	Any within scope of agreement	Any within scope of agreement	Traditional Owners formally and actively participate in decision-making about management of specific areas of public land
Code of Practice for Timber Production 2007	All	Timber production planning	Traditional Owners and other relevant Aboriginal groups consulted in regards to mitigation of impacts on Aboriginal cultural heritage values
Fire Operations Plan Guidelines	All	All	N/A
Aboriginal Inclusion Plan Munganin – Gadhaba[265]	All	All	Aims to increase Aboriginal employment and cultural wellbeing while bringing knowledge of Country to resource management
Forest Management Plans	State forests	All	Specifies strategies to conserve Aboriginal heritage in partnership with communities and comply with Native Title Act 1994
District Action Plan Guidelines	State forests	Forest management activities (except timber production, fire and burning)	Cultural heritage management plans and cultural heritage permits referred to registered Aboriginal Parties under the Aboriginal Heritage Act 2006, as required
Indigenous Partnership Strategy and Action Plan 2005	Parks and conservation reserves	All	Policy applicable between 2005–2012 promoting Traditional Owner and Aboriginal participation in Parks Victoria's activities

(Data source: DELWP 2018)

265. DELWP 2015, 'Munganin – Gadhaba 'Achieve Together': DELWP Aboriginal inclusion plan', Melbourne, Victoria https://www2.delwp.vic.gov.au/__data/assets/pdf_file/0017/4418/DELWP-Aboriginal-Inclusion-Plan.pdf Accessed 9 December 2018.

Criterion 7: Legal, institutional and economic framework for forest conservation and sustainable management

Commissioner *for* Environmental Sustainability Victoria

Credit: Stephen Colquitt

VICTORIA State Government

Criterion 7: Legal, institutional and economic framework for forest conservation and sustainable management

	Status (UNKNOWN / POOR / FAIR / GOOD)	Trend	Data Quality
7.1 Extent to which the legal framework (laws, regulations, guidelines) supports the conservation and sustainable management of forests **Data Custodian** DELWP	FAIR	↗	DATA QUALITY Fair

A legal framework with laws, regulations and guidelines is necessary to support continuous improvements in sustainable forest management. Such a system assists to establish transparency and public participation in policy and decision-making processes.

There are currently 33 legislations that regulate forest management in Victoria, which creates legislative complexity. Table 73 summarises the legislation, the tenure to which they apply, and lists key amendments made during the reporting period. VEAC seeks to address the problem of legislative complexity in the final report of its Statewide *Assessment of Public Land,* released in May 2017. The report includes several recommendations to reform the public land legislative framework, in particular changes to the:

- *Land Act 1958*
- *Forests Act 1958*
- *National Parks Act 1975*
- *Crown Land (Reserves) Act 1978*.

The rationale for legislative reform is to strengthen, modernise and simplify Crown land legislation to ensure it is responsive to modern challenges and demands. The Victorian Government has accepted, in principle or in part, all recommendations made by VEAC, including committing to rewriting the Crown land legislation over the next four years.

Beekeeping

Between 2013 and 2018, the regulation of beekeeping in Victoria was changed. In March 2016, primary Land Acts were amended to allow for bee-site licences to apply for a longer period of up to 10 years.[266] Administrative processes were altered to enable the revision of licence terms and conditions and the streamlining of licence expiration. These regulatory changes include greater protections between bee sites and other public land boundaries through the requirement of an 800-metre buffer from the centre of a bee site to the boundary of wilderness parks, wilderness zones, reference areas and natural catchment areas.[267]

266. Victorian Government 2016, 'Authorised version No.128, Land Act 1958. No 6284 of 1958: Authorised version incorporating amendments as at 19 September 2016', Melbourne, Victoria, p.309.
267. Crown Land Legislation Amendment (Canadian Regional Park and Other Matters) Act 2016. http://www.legislation.vic.gov.au/Domino/Web_Notes/LDMS/PubStatbook.nsf/51dea49770555ea6ca256da4001b90cd/21CF72B25E443BA2CA257F8C0019032A/$FILE/16-012aa%20authorised.pdf Accessed 4 December 2018.

Table 73. Main legislation relevant to sustainable forest management in Victoria

Agency	Legislation	Summary of legislation purpose	Applicable tenure	Key amendments, 2013-17
DELWP	*Conservation, Forests and Lands Act 1987*	To provide a framework for a land management system, to make necessary administrative, financial and enforcement provisions, and to establish a system of land management co-operative agreements	Public/ Private (where applicable)	Streamlining of provisions relating to the making of codes of Practice
DELWP, DEDJTR	*Sustainable Forests (Timber) Act 2004*	To provide a framework for sustainable forest management and sustainable timber harvesting in state forests	State forests	Key amendments during this period are listed below. In 2013: • streamline AO process by vesting timber with VicForests • responsibility for Timber Release Plan approval transferred to VicForests • removal of timber-harvesting operator licences. In 2014: • Establish Timber Harvesting Safety Zones
Victorian Plantations Corporation	*Victorian Plantations Corporation Act 2003*	To establish the Victorian Plantations Corporation to manage state plantations and to require that timber harvesting comply with a code of practice	State forests	No amendments made since 7 June 2012
DELWP	*Forests Act 1958*	To provide for the management and protection of state forests, including timber harvesting and fire management	State forests and all public land for fire matters	Allowance for collection of domestic firewood without a permit, in certain areas, at specified times
DELWP	*Forests (Fire Protection) Regulations 2014*	To provide for the protection of state forests, national parks and protected public land from damage by fire	National parks (including state parks), state forests and protected public land	No amendments
DELWP	*Forests (Recreation) Regulations 2010*	To regulate camping and other activities in certain public land tenures including forests reserves and forest parks	Public land	No amendments

Table 73. Main legislation relevant to sustainable forest management in Victoria Cont'd

Agency	Legislation	Summary of legislation purpose	Applicable tenure	Key amendments, 2013-17
DELWP	*Flora and Fauna Guarantee Act 1988*	To establish a legal and administrative structure to enable and promote the conservation of Victoria's native flora and fauna, and to provide for a choice of procedures which can be used for the conservation, management or control of flora and fauna and the management of potentially threatening processes	All	No amendments
DELWP	*Catchment and Land Protection Act 1994*	To set up a framework for the integrated management and protection of catchments, to encourage community participation in the management of land and water resources, and to set up a system of controls on noxious weeds and pest animals	All	No amendments
DELWP	*Land Act 1958*	To set out the law relating to the sale and occupation of Crown lands, including provision for a range of licences	Public land	Provision for uniform licensing of bee sites on most Crown land
Parks Victoria	*National Parks Act 1975*	To provide a framework for establishment and management of national parks and other parks	Public national parks and other parks and reserves referred to in the Act	• establishment of new park areas including Lake Tyers Park (8,680 ha) • additional areas added to Great Otway National Park • introduction and removal of power for Minister to grant leases of up to 99 years over certain areas • introduction of total prohibition on cattle grazing in alpine national parks and in the six river redgum national parks.

Table 73. Main legislation relevant to sustainable forest management in Victoria Cont'd

Agency	Legislation	Summary of legislation purpose	Applicable tenure	Key amendments, 2013-17
Parks Victoria	*Parks Victoria Act 2018*	To establish Parks Victoria. There were major changes to the legislative framework, which resulted in having a broad range of direct powers to manage Victoria's parks and waterways	National parks and other conservation reserves	No amendments
Environment Protection Authority Victoria	*Environment Protection Act 1970*	To establish an Environment Protection Authority and to provide a framework for preventing pollution and environmental damage by setting environmental quality objectives and establishing programs to meet them	All	In 2017, a new Environment Protection Act was passed by the Parliament of Victoria.[268] The Environment Protection Act 2017 also has the function of establishing the Environment Protection Authority. The two Acts are operating together currently, in the transitional period for the reforms.
Environment Protection Authority Victoria	*Environment Effects Act 1974*	To provide a framework for preparation of an Environmental Effects Statement for public works that the Minister considers capable of having a significant effect on the environment	All	No amendments
DELWP	*Heritage Rivers Act 1992*	To make provision for Victorian heritage rivers by providing for the protection of public land, in particular parts of rivers and river catchment areas in Victoria that have significant nature conservation, recreation, scenic or cultural heritage attributes	Public land	No amendments
DELWP	*Crown Land (Reserves) Act 1978*	To provide for the reservation of Crown lands for certain purposes and for the management of such reserved lands	Reserved Crown land	Key amendments are creation of two new regional parks

268. The Parliament of Victoria 2017, 'Environment Protection Act 2017: No. 51 of 2017', Melbourne, Victoria http://www.legislation.vic.gov.au/Domino/Web_Notes/LDMS/PubStatbook.nsf/51dea49770555ea6ca256da4001b90cd/ABB3C4D755B99F3BCA2581C30009DE28/$FILE/17-051aa%20authorised.pdf Accessed 4 December 2018.

Table 73. Main legislation relevant to sustainable forest management in Victoria Cont'd

Agency	Legislation	Summary of legislation purpose	Applicable tenure	Key amendments, 2013-17
DELWP	*Reference Areas Act 1978*	Provides for the protection, control and management of certain special areas of Crown land to be preserved in their natural state, as far as is possible, due to their ecological interest and significance	Public	No amendments
DELWP, local government	*Planning and Environment Act 1987*	To establish a framework for planning the use, development and protection of land in Victoria in the present and long-term interests of all Victorians. Provides for the protection of natural processes and genetic diversity, and conservation of places of scientific, aesthetic or special conservation value. Requires administration and enforcement of planning schemes that specify appropriate controls on the use, development and protection of land, including timber production on private land	All	No amendments
CFA	*Country Fire Authority Act 1958*	To confer on the authority a responsibility to prevent and suppress fire on all land (urban and rural) outside the Melbourne Metropolitan Fire District, but does not include any forest, national park or protected public land	Private	No amendments
DEDJTR	*Climate Change Act 2017*	To separate ownership of the land from ownership of the trees on the land, and provide legal security to the 'Forest Property Owner'. Recognises carbon sequestration rights and enables ownership of these rights separately from the trees and the land	All forested land	No amendments

Table 73. Main legislation relevant to sustainable forest management in Victoria Cont'd

Agency	Legislation	Summary of legislation purpose	Applicable tenure	Key amendments, 2013-17
DELWP	*Road Management Act 2004*	To establish a coordinated management system for public roads to promote safe and efficient state and local public road networks and the responsible use of roads	Public land	No amendments
DELWP	*Safety on Public Land Act 2004*	Provides for public safety in state forests by providing for the establishment and enforcement of public safety zones	State forests	No amendments
DELWP	*Forests (Wood Pulp Agreement) Act 1996*	To ratify an agreement between the Minister administering the Forests Act 1958 and AMCOR Limited with respect to the supply of pulpwood for the manufacture of wood pulp and for other purposes	Public	No amendments
DELWP	*Land Conservation (Vehicle Control) Act 1972*	To makes provisions for vehicular traffic on public land, as well as the prevention of soil erosion on, and damage to, public land	Public	Increases in maximum penalties for offences
Department of Premier and Cabinet; DELWP	*Aboriginal Lands Act 1991*	To authorise the granting of the reservations and Crown Grants of certain lands for Aboriginal cultural and burial purposes	Public	No amendments
Department of Premier and Cabinet	*Aboriginal Heritage Act 2006*	To provide for the protection of Aboriginal cultural heritage in Victoria.	All	Major amendments were made to the Act between 2013 and 2018 including changes to: • determine whether a mandatory cultural heritage management plan (CHMP) is required • Change CHMP from a guidance document to an approval document • require involvement of Traditional Owners where there is no Registered Aboriginal Party (RAP) • expand liability for offences and civil penalty provisions • allow for disclosure of Aboriginal heritage surveys.

Table 73. Main legislation relevant to sustainable forest management in Victoria Cont'd

Agency	Legislation	Summary of legislation purpose	Applicable tenure	Key amendments, 2013-17
Department of Justice and Regulation	*Traditional Owner Settlement Act 2010*	To provide for the making of negotiated agreements for land claims between Traditional Owner groups and government	All	No amendments
DELWP	*Catchment and Land Protection Act 1994*	To set up a framework for the integrated management and protection of catchments and to encourage community participation in the management of land and water resources	All	No amendments
DELWP	*Climate Change Act 2010*	To support climate policy, including the state's adaptation planning framework.	All	No amendments
DELWP	*Marine and Coastal Act 2018*	To provide for coordinated strategic planning and management for the Victorian coast	All	No amendments
DELWP	*Water Act 1989*	To provide for the integrated management of all elements of the terrestrial phase of the water cycle and to promote the orderly, equitable and efficient use of water resources	All	No amendments
DELWP	*Wildlife Act 1975*	To establish procedures, and provide for banning notices and exclusion orders in order to promote the protection and conservation of wildlife, and the prevention of taxa of wildlife from becoming extinct	All	No amendments

(Data source: DELWP 2018)

Criterion 7: Legal, institutional and economic framework for forest conservation and sustainable management

	Status (UNKNOWN / POOR / FAIR / GOOD)	Trend	Data Quality
7.2 Extent to which the institutional framework supports the conservation and sustainable management of forests **Data Custodian** DELWP	FAIR	↘	DATA QUALITY Fair

Institutional frameworks aim to encourage certain activities or behaviours within a sector. The processes, resources and activities provided through institutional frameworks create an environment that influences how effectively and efficiently the aims of the framework are delivered. The level of commitment and ability of the framework to produce outcomes can be monitored through the extent to which current conservation and sustainable forest management aims are being supported.

This indicator provides data on the governance framework to support conservation and sustainable forest management of public and private forests. The framework includes laws, plans, policies, public engagement and participation. Table 75 is an overview of the institutional framework elements in Victoria for conservation and sustainable forest management, in both public and private forests. Table 74 outlines key institutions involved in each element of the framework, and key activities undertaken during the reporting period.

Table 74. Institutional framework elements in Victoria for conservation and sustainable forest management, 2013–17

Element	Public[A]	Private[A]	Responsible organisation	Key activities in period
Administrative arrangements	Yes	Yes	DELWP, local government, Parks Victoria, VicForests, Catchment Management Authorities	Tenure transfer – state forest to Park
Public engagement and participation	Yes	Yes	DELWP, local government	
Periodic forest-related planning	Yes	No	DELWP	
Periodic assessment of forest values	Yes	No	DELWP, VicForests	Victorian Forest Monitoring Program
Periodic review of forest-related policy	Yes	Yes	DELWP	RFA review
Relevant skills development and maintenance	Yes	Yes	Universities, Registered Training Organisations, DELWP	
Infrastructure	Yes	Part	DELWP, Parks Victoria, local government	Access roads; recreation and fire management; infrastructure
Law enforcement	Yes	Yes	DELWP, Parks Victoria; local government	Timber-harvesting compliance; general forest and park compliance
Law enforcement	Yes	Yes	DELWP, Parks Victoria; local government	Timber-harvesting compliance; general forest and park compliance

[A] *'Yes' or 'no' indicates whether the relevant element has been conducted. 'Part' indicates partial completion. (Data source: DELWP 2018)*

The Victorian Government is responsible for ensuring that commercial timber harvesting activities comply with Victoria's environmental regulatory framework. Harvest coupes are assessed by auditors, and if non-compliance is found, the magnitude of impact is determined based on the following categories: severe, major, moderate, minor, negligible and no impact. More information is available on the DELWP website.[269]

Table 75 demonstrates the overall assessment results of compliant and non-compliant audit elements, by different environmental impact categories, between 2007 and 2017. Audits since 2014 have targeted elements of the regulatory framework that have been assessed as having a 'high risk' of causing environmental harm. While the high-risk elements have been targeted, VicForests has indicated a high level of compliance with prescriptions for timber production harvesting and coupe closure activities throughout the reporting period. Four environmental impacts arising from non-compliances were assessed based on the environmental impact assessment (EIS) tool. The assessment method is provided in the audit report.[270] The majority of non-compliances have been found to have no impact, or to be negligible or to have minor environmental impact.

However, it is important to note that the major environmental impact category has shown an increase. The reason for this must be investigated and identified.

Table 75. Audit results for harvesting and coupe completion operations in Victoria, 2007 to 2016–17

Audit report year	2007	2011	2013	2014	2015–16	2016–17
Harvesting year	2006–07	2008–09	2010–11 & 2011–12	2013–14	2014–15	2015–16
No. coupes assessed	43	27	40	24	83	30
Compliant elements (%)	94	95	96	90	86	91
Severe	0	0	0	0	0	0
Major	16	2	16	6	25	37
Moderate	30	31	21	14	53	35
Minor	43	28	51	70	100	14
Negligible	55	49	34	23	106	9
No impact	25	40	36	19	3	0
Areas with <90% compliance	• Rainforest boundary tracks • Camp maintenance areas • Log landings and dumps	• Major – rainforest • Moderate – waterway, filters	• Major – roading, coupe planning	• Water and soils Roading	• Planning for crossings • Design and construction of crossings • Removal and rehabilitation of crossings • Water-quality, river-health and soil protection • Planning and design of in-coupe roads • Construction of in-coupe roads	• Soils • Water • Roading design • Roading construction • Roading maintenance and closure

(Data source: FAP reports and SoF 2013)

269. DELWP, 'Forest audits', Melbourne, Victoria https://www.forestsandreserves.vic.gov.au/forest-management/forest-audits Accessed 4 December 2018.

270. Jacobs 2016, 'Forest Audit Program 2015: audit of in-coupe roads: environmental audit of the construction and maintenance of in-coupe roads', Jacobs Group (Australia) Pty Limited, Bendigo, Victoria https://www.forestsandreserves.vic.gov.au/__data/assets/pdf_file/0026/118367/fap2015-in-coupe-roads-final-020320161.pdf Accessed 4 December 2018.

Furthermore, relevant to this indicator is the current focus on the definition of 'old-growth forests'. For example, 'old growth' in mountain ash in the Central Highlands has been defined in two ways. One definition suggests old growth is determined by age structure of the individual tree (between 120 and 150 years old), its senescence and its ability to bear hollows.[271] Another definition uses only age structure (over 250 years, late mature and senescent growth stage) with height and trunk diameter.[272] Old growth in mountain ash can also be determined by the understorey; for example, tree ferns that are greater than 350 years.[273]

These variations in old-growth definitions highlight that each vegetation type has its own ecological characteristics and age structures that need to be considered in determining an ecologically meaningful definition of old growth, rather than applying a one-size-fits-all approach.

In addition, the number of species listed on the IUCN Red List categories in the Central Highlands is expected to increase dramatically within the next 25 years (see indicator 1.2a (The status of forest dependent species at risk of not maintaining viable breeding populations, as determined by legislation or scientific assessment)). This demonstrates that the current framework needs to improve to better support biodiversity conservation in Victorian public forests.

Credit: Stephen Colquitt

271. Lindenmayer DB, Blair D, McBurney L, Banks SC 2015, 'Mountain Ash: Fire, Logging and the Future of Victoria's Giant Forests', CSIRO Publishing, Clayton South, Victoria.
272. VicForests 2015, 'Ecologically sustainable forest management plan: working plan Version 1.0', Melbourne, Victoria http://www.vicforests.com.au/static/uploads/files/ecologically-sustainable-forest-management-plan-v1-0-wfctkbfzjkxi.pdf Accessed 4 December 2018.
273. Lindenmayer DB, Blair D, McBurney L, Banks SC 2015, 'Mountain Ash: Fire, Logging and the Future of Victoria's Giant Forests', CSIRO Publishing, Clayton South, Victoria.

Criterion 7: Legal, institutional and economic framework for forest conservation and sustainable management

	Status (UNKNOWN / POOR / FAIR / GOOD)	Trend	Data Quality
7.3 Extent to which the economic framework supports the conservation and sustainable management of forests **Data Custodian** DELWP	FAIR	?	DATA QUALITY Fair

This indicator assesses whether the current economic framework supports sustainable forest management. It lists the economic framework elements considered important for supporting conservation and sustainable management of both public and private forests. The indicator includes assessment of new policies and key developments.

This indicator is assessed using the best available state and national data – but note that state-scale datasets are extremely limited. This makes assessment of this indicator, including comparison of past and present economic frameworks, difficult.

A recent report from Forest and Wood Products Australia indicates that the forest industry contributed about $7.3 billion to the Victorian economy in 2017–18.[274] This consisted of $1.9 billion in direct sales of wood and fibre and $5.4 billion in flow-on effects from other industries involving forest products (socio-economic activities).

Since SoE 2013, several state and federal government investments have contributed to progress for Victorian native forests. As part of Victoria's Regional Tourism Strategy from 2013 to 2016, the 2013–14 state budget committed $13 million to improve tourism in national parks, state forests and on public land.[275] This facilitated upgrades and continual management of Victorian regions containing forests, such as Gippsland, the Macedon Ranges and Daylesford.[276] (A drawback of this is the potential for ecological damage from the removal of prohibitions against private-sector development in national parks. While sustainable environmental outcomes are encouraged in the tourism development guidelines,[277] there are no current assessments for ecological affects due to private-sector development.)

In 2013–14, DEDJTR made grants of $620,000 to a number of wood-processing enterprises, as a part of the Regional Growth Fund.[278] However, limited benchmarks and targets meant the only quantifiable outcomes were in relation to financial returns or employment.[279]

From 2014 to 2017, the Australian Government provided $3 million to enhance the environmental and cultural values of the Dandenong Ranges.[280] The initiative, delivered through the National Landcare Program, funded community groups to undertake activities to strengthen wildlife habitat, regulate weeds and decrease bushfire fuel-loads. As this was a sub-program, outcomes of the fund have not been examined in detail, but will be reviewed as part of the National Landcare Program.[281]

274. Forest and Wood Products Australia 2018, 'Media release: Forest industry adds 7.3 billion to Victorian economy: research', Melbourne, Victoria https://www.fwpa.com.au/news/1632-forest-industry-adds-7-3-billion-to-victorian-economy-research.html Accessed 4 December 2018.
275. State of Victoria 2013, 'Victoria's regional tourism strategy 2013-2016', Melbourne, Victoria https://corp.rdp.tourismnortheast.com.au/wp-content/uploads/sites/54/6588_victoria_-regional_tourism_strategy_2013-16_WEB-1.pdf Accessed 4 December 2018.
276. Ibid
277. DELWP 2015, 'Tourism lease in National Parks: guidance note', Melbourne, Victoria https://www.ecotourism.org.au/assets/Resources-Hub-Protected-Area-Management/tourism-leases-in-national-parks.pdf Accessed 4 December 2018.
278. Department of State Development Business and Innovation 2014, 'Annual report 2013-14', Melbourne, Victoria https://web.archive.org/web/20150301094836/http:/dsdbi.vic.gov.au/__data/assets/pdf_file/0018/1006353/DSDBI-ANNUAL-REPORT-2013-14-FINAL_web.pdf Accessed 4 December 2018.
279. VAGO 2015, 'Regional growth fund: outcomes and learnings', Melbourne, Victoria https://www.audit.vic.gov.au/report/regional-growth-fund-outcomes-and-learnings Accessed 4 December 2018.
280. Australian Government, 'Dandenong Ranges', Canberra, Australia http://www.nrm.gov.au/national/local/dandenong-ranges Accessed 4 December 2018.
281. Australian Department of the Environment and Energy & Australian Department of Agriculture and Water Resources 2017, 'Report on the review of the national landcare program', Canberra, Australia http://www.nrm.gov.au/system/files/resources/fb8af1b3-f8fc-4b07-9334-4ae013da9188/files/nlp-review-final-report.pdf Accessed 4 December 2018.

Information to evaluate this indicator is scant. However, a regional set of environmental–economic accounts for the Central Highlands[282,283] has been developed to assess ecosystem assets and their benefits for human wellbeing, including a framework to measure conservation and sustainable forest management. This assessment of native forest management uses the United Nations System of Environmental and Economic Accounting (SEEA) framework, which has been adopted in more than 45 countries.[284] In the Central Highlands, the results show that the economic value of water, tourism and plantation industries on private land is greater than the economic value of the native timber harvesting industry. (This excludes 2009–10, due to the 2009 Black Saturday bushfires.) The value of plantation forestry was found to be greater than that for native forestry, even though the size of the area managed for plantations is only 14% of the area of native forest available for harvest.[285]

Results from the trade-off analysis show that ceasing native forest timber harvesting could increase the economic value of ecosystem assets such as carbon. This trade-off analysis provides an opportunity to systematically and regularly assess the costs and benefits of changing ecosystem assets and services. However, the analysis in this study focuses only on the Central Highlands and does not include a state-scale assessment. A rigorous and scientific state-scale approach to assess the economic framework for sustainable forest management, following the international SEEA standard, is critical for policy development and implementation. This environmental economic accounts approach has been discussed in 6.1c (Value ($) of forest derived ecosystem services).

With the exception of 2006–07, 2008–09 and 2011–12, VicForests has made a net profit since its inception in 2004 and up until 2015–16. Its profitability was significantly undermined by the 2006–07 and 2009 bushfires[286] VAGO has indicated that VicForests had a loan facility of $26.8 million in 2013 from the Treasury Corporation of Victoria to cover cashflow problems resulting from the impacts of catastrophic bushfires and some delays in payments from mills.[287] This needs to be repaid.

There are different opinions relating to the economic sustainability and profitability of native forest harvesting in Victoria. Those who believe the harvesting is unprofitable cite evidence of the declining number of people directly employed in state forest industries: total employment in the forest industry has decreased by 28.4% between 2006 and 2016.[288] Others cite profit-loss and Victorian Government loans to VicForests as further evidence of the lack of profitability.[289,290]

282. Keith H, Vardon M, Stein JA, Stein JL, Lindenmayer DB 2017, 'Ecosystem accounts define explicit and spatial trade-offs for managing natural resources', Nature Ecology and Evolution, 1, pp. 1683-1692.
283. Keith H, Vardon M, Stein JA, Stein JL, Lindenmayer DB 2017, 'Experimental ecosystem accounts for the Central Highlands of Victoria. Summary Report', Australian National University and the Threatened Species Recovery Hub, Canberra, Australia.
284. United Nations 2012, 'System of Environmental-Economic Accounting Central Framework', New York, USA http://www.un.org/en/contact-us/ Accessed 4 December 2018.
285. Keith H, Vardon M, Stein JA, Stein JL, Lindenmayer DB 2017, 'Ecosystem accounts define explicit and spatial trade-offs for managing natural resources', Nature Ecology and Evolution, 1, pp. 1683-1692, figure 3.b.
286. VAGO 2013, 'Managing Victoria's native forest timber resources', Melbourne, Victoria http://www.vicforests.com.au/static/uploads/files/20131211-timber-resources-wfsdlrklejjj.pdf Accessed 4 December 2018.
287. Ibid
288. Schirmer J, Mylek M, Magnusson A, Yabsley B, Morison J 2018, 'Socio-economic impacts of the forest industry Victoria (exc. The Green Triangle)', Forest and Wood Products Australia, Melbourne, Victoria https://www.fwpa.com.au/resources/reports/other/1631-socio-economic-impacts-of-the-forest-industry-victoria-exc-the-green-triangle.html Accessed 4 December 2018.
289. VicForests 2013, 'Corporate and business plans, 2013-2014 to 2015-2016', Melbourne, Victoria.
290. Lindenmayer D 2017, 'Halting natural resource depletion: engaging with economic and political power', The Economic and Labour Relations Review, 28(1), pp. 41-56.

Criterion 7:
Legal, institutional and economic framework for forest conservation and sustainable management

	Status (UNKNOWN / POOR / FAIR / GOOD)	Trend	Data Quality
7.4 Capacity to measure and monitor changes in the conservation and sustainable management of forests **Data Custodian** N/A		unavailable	DATA QUALITY Fair

A monitoring, evaluating and reporting system is essential to ensure the effectiveness of sustainable forest management of public forests in Victoria. An open and transparent monitoring and reporting system that provides up-to-date and reliable information helps decision-makers to evaluate the status of Victorian forests and decide strategic directions to mitigate emerging concerns.

This indicator provides an assessment of each indicator in SoF 2018. The assessment has three categories: status, trend and data quality. Rating criteria for this assessment is described in Figure 61.

This analysis uses a different method from that used in SoF 2008 and SoF 2013, so the overall results are not compared with previous assessment results.

Assessment results (Table 76) show that:

- approximately 50% of the indicators had sufficient data coverage to assess trend and status. About one-fourth had partial datasets to assess trend or status only. One-fifth had 'poor' data quality, with no data to make an assessment

Legend

Status

N/A **Not Applicable**
The indicator assessment is based on future projections or the change in environmental condition and providing a status assessment is not applicable. Only a trend assessment is provided.

Unknown
Data is insufficient to make an assessment of status and trends.

Poor
Environmental condition is under significant stress, OR pressure is likely to have significant impact on environmental condition/ human health, OR inadequate protection of natural ecosystems and biodiversity is evident.

Fair
Environmental condition is neither positive or negative and may be variable across Victoria, OR pressure is likely to have limited impact on environmental condition/human health, OR moderate protection of natural ecosystems and biodiversity is evident.

Good
Environmental condition is healthy across Victoria, OR pressure is likely to have negligible impact on environmental condition/ human health, OR comprehensive protection of natural ecosystems and biodiversity is evident.

Trend

N/A **Not applicable**
This indicator assessment is based on current environmental condition only and it is not applicable to provide a trend assessment. Only a status assessment is provided.

? **Unclear**

↘ **Deteriorating**

→ **Stable**

↗ **Improving**

Data quality

Poor
Evidence and consensus too low to make an assessment

Fair
Limited evidence or limited consensus

Good
Adequate high-quality evidence and high level of consensus

Figure 61. Indicator assessment matrix

- about one-third of indicators had status assessments indicating significant stress or pressure. This could mean significant impact on environmental conditions, or insufficient data to make an assessment of status and trends. Two indicators had a poor status and deteriorating trend with high confidence (that is, 'good' data quality): indicator 2.1 (Area and percentage of forest and net area of forest available and suitable for wood production) and indicator 6.5d (Resilience of forest dependent Indigenous communities to changing social and economic conditions)
- trend assessment was not possible for more than one-third of the indicators, due to lack of time-series data. This was mainly due to methodological changes in data collection and interpretation. The Victorian State of Environment 2018 report recommends avoiding amendments to the VFMP that would disrupt future trend analysis
- Victoria's capacity to monitor and measure social, economic and environmental conditions and governance in relation to forests is improving, but knowledge gaps remain. This report highlights gaps in relation to:
  - information on the effect of an increase in IUCN protected areas (indicator 1.1c)
  - formal agreed list of forest-dependent species (indicator 1.2a)
  - state-scale information on the number of forest-dependent species at risk from isolation that may lead to a loss of genetic variation (indicator 1.3a)
  - time-series information on annual production of non-wood forest products (indicator 2.4)
  - value and yield of non-wood forest products, except for game-hunting information (indicator 6.1b)
  - area and quality of forest actively utilised for recreation and tourism in state forests (indicator 6.3b)
  - number of visits (indicator 6.3c)
  - monitoring and management of Aboriginal cultural heritage sites in state forests (indicator 6.4b).

Note that indicator 6.5e could not be assessed at all, as the data was difficult to obtain. In addition, there was little distinction between indicator 6.5e and 6.4a. It would be more effective for future reports to combine these two indicators.

The Victorian Government has been improving monitoring methods, to better capture data and to improve data accuracy for the indicators. However, cost-effective and suitable monitoring programs have not yet been developed or established for some indicators – including socio-economic indicators for state forests.

Another gap is data about private native forests – important to several indicators, including indicator 1.2a (the status of forest-dependent species at risk of not maintaining viable breeding populations), as determined by legislation or scientific assessment.

Legislation, prescriptions and planning frameworks should be consistently reviewed and updated according to Victoria's needs.

Table 76. Indicator assessment

Indicator	Status	Trend	Data quality	Description	Region	Measure	Data custodian
Criterion 1: Conservation of biological diversity							
1.1a Area of forest by type and tenure - forest canopy cover and canopy height classes	Unknown	Unclear	Poor	Maps of forest cover in Victoria are based on satellite data. Although the 2008–13 data can provide the change in forest cover, the trends have not been demonstrated for this report, but will be included in future reports.	Victoria	Forest canopy cover	DELWP
1.1a Area of forest by type and tenure - forest type	Fair	Improving	Good	Forest extent in Victoria was heavily affected by the 2009 'Black Saturday' bushfires. But a decrease in the areas where classified as 'Forest unclassified (burnt)' demonstrates tree regrowth from previously burnt forest, largely concentrated in the Mallee.	Victoria	Forest area on public lands	DELWP
1.1a Area of forest by type and tenure - plantation forest in private land	Fair	Stable	Good	Plantation area in private land had little change since 2009–10. This is due to a significant decline in establishment of new plantations in Victoria (none since 2012– 13).	Victoria	Plantation area (hectares)	ABS
1.1b Area of forest type by growth stage	Fair	Improving	Good	This indicator reports the growth stage by broad forest type, which provides an indication of diversity and balance of growth stages across Victoria's forest estate. Comparison of two datasets captured in different years indicates that forest area in different types increased both in state forest parks and reserves.	Victoria	Forest area by growth stage	DELWP
1.1c Area of forest type by growth stage distribution in protected zones	Fair	Improving	Fair	Overall IUCN protected area increased between 2004-2016, and PV managed formal protected area (parks and reserves) also increased between 1956-2016. While this is anecdotally a positive outcome for conservation of forest systems, there is limited evaluation of the effectiveness of the protected area network in providing better protection of biodiversity assets such as threatened species.	Victoria	IUCN and Parks Victoria protected area;	DELWP, Parks Victoria
1.1d Fragmentation of native forest cover	Poor	Unclear	Fair	The presented data demonstrates a map of forest fragmentation in Victoria. As this is a snapshot of forest fragmentation in 2018, no trend analysis is available. Peer-reviewed journal papers have found that several threatened species are at risk due to forest fragmentation.	Victoria and regional locations	Forest fragmentation: edge, interior, patch, perforated and transitional area by bioregion	DELWP

Indicator	Status	Trend	Data quality	Description	Region	Measure	Data custodian
Criterion 1: Conservation of biological diversity							
1.2a The status of forest-dependent species at risk of not maintaining viable breeding populations, as determined by legislation or scientific assessment	Fair	Deteriorating	Good	Since 2013, the only species group to be updated is vascular plants, which occurred in 2014. However, assessing changes in DELWP's advisory list related to plants can be misleading due to the frequent changes in botanical nomenclature. Except for the 36 species that were added, the status of the other 461 species has not been changed. Vascular plants represent by far the greatest proportion of these species. This might be due to greater knowledge and awareness of vascular plants within the scientific community, and their relative ease of detection. Since 2007–08, no changes have been observed in the number of rare or threatened amphibians.	Victoria	Conservation status: numbers of rare or threatened forest-dependent species	DELWP
1.2b Area of habitat available for forest-dependent indicator species	Fair	Unclear	Poor	The datasets presented provide some useful information for understanding the current status of forests. However, there is a lack of information to evaluate the current status and estimate future conditions of available habitats for forest-dependent indicator species. In particular: • sufficient time-series data is not available. SoF 2003 and SoF 2008 presented no data against this indicator, and the data in SoF 2013 is not comparable with the current dataset. • it is difficult to evaluate current status, as there are no thresholds for habitat requirements at landscape-scale. This means that land managers are currently unable to determine relevant management actions based on this data. Studies that are more targeted are required in some areas.	Victoria	Vascular species richness, relative abundance of plant functional types, volume of dead tree and coarse woody debris	DELWP
1.2c Representative indicator species from a range of habitats monitored at scales relevant to regional forest management	Good	Unclear	Fair	A total of 361 projects distributed throughout the state observed 813 fauna species across various types of tenure. The Victorian Government has a well-established structure to monitor fauna species.	Victoria	Field survey results	DELWP

Indicator	Status	Trend	Data quality	Description	Region	Measure	Data custodian
Criterion 1: Conservation of biological diversity							
1.2d Degree of disturbance to native-forest species caused by invasive species	Fair	Deteriorating	Good	For most identified pathogens and insect agents in Victoria, damage during the reporting period has stabilised or decreased. However, a few species, including Red Gum basket lerp, Dothistroma needle blight, Mycosphaerella leaf disease, Cypress canker and Phytophthora cinnamomi have expanded their distribution and impact.	Victoria	Scale and impact of invasive species on native forests, plantations and urban/farm forests	DELWP
1.3a The number of forest dependent species at risk from isolation that may lead to loss of genetic variation	Unknown	Unclear	Poor	There is no comprehensive information about the number of forest-dependent species at risk from isolation at state-scale to evaluate this indicator. Therefore, this indicator presents scientific evidence focused on particular forest-dependent species in Victoria.	Central Victoria and Central Highlands	Habitat distribution of some fauna species	Deakin University, Australian National University
1.3b Number of in-situ and ex-situ conservation efforts for forest-dependent species	Unknown	Unclear	Poor	In 2013, a method change occurred, making it difficult to determine benefits from management activities and making trend analysis unachievable. The data presented has been provided by on-ground managers.	Victoria	In-situ and ex-situ conservation activities on forest-dependent threatened species Quantifiable conservation efforts	DELWP
Criterion 2: Maintenance of productive capacity of forest ecosystems							
2.1 Area and percentage of forest and net area of forest available and suitable for wood production	Poor	Deteriorating	Good	The Resource Outlook from VicForests has reduced the available timber production area in state forests. The Resource Outlook defines the volume of hardwood timber products from native forests made available to the market, separating the species groups of timber supply into two groups: ash and mixed-species. The reduction in availability of sawlog resource in areas such as the Central Highlands of Victoria can be attributed to the effects of fire in estimates of sustained yield. The trend indicates that less timber production in state forests will occur in the future and more emphasis will be on other values including species conservation and carbon sequestration issues.	Victoria	Area and percentage of forest and net area of forest available and suitable for wood production	VicForests, DELWP
2.2 Volume of wood by forest type in State forest that is available and suitable for timber production	Fair	Stable	Good	Allocation Order shows that the area available to harvest for ash timber will decrease dramatically; whereas, that for mixed species will increase. The overall area available for timber harvesting is stable.	Victoria	Area available for native timber harvesting	DELWP, DEDJTR, VicForests

Indicator	Status	Trend	Data quality	Description	Region	Measure	Data custodian
Criterion 2: Maintenance of productive capacity of forest ecosystems							
2.3 Annual production of wood products from state forests compared to sustainable harvest levels	Fair	Deteriorating	Good	Total timber annual production from state forests has been gradually decreasing. Decreasing sawlog production, seen over the past 20 years, has continued. Production fell by more than 50% between 1996-97 and 2016-17. Pulpwood has followed a similar trend. This will deteriorate further, as age class distribution of ash forests are highly imbalanced.	Victoria	Annual production of wood products from state forest	VicForests, DELWP
2.4 Annual production of non-wood forest products	Unknown	Unclear	Poor	The processing of non-wood forest products data has been inconsistent. SoF 2008 provided data about tree ferns, seed harvest, grazing, deer-hunting and sand/gravel extraction between 2000–01 and 2005–06. However, SoF 2013 provides information on eucalyptus oil; duck, quail and deer-hunting; mineral extractions; and seed harvest. These inconsistencies could cause issues in projecting long-term trends and changes in value, leading to difficulties in developing any management actions. In addition, it is important to compare harvest trends to known sustainable levels to evaluate the status and to develop management strategies.	Victoria	Annual production rate of non-wood forest products	DELWP, DEDJTR
2.5 Proportion of timber harvest area successfully regenerated, by forest type	Fair	Stable	Good	Between 2011–17, 2,059 hectares more have been harvested than regenerated. This does not indicate that sustainable harvest has not been achieved, according to DEDJTR. The figures show the area harvested in a specified five-year period, and the area regenerated in the same five-year period. This needs to be carefully monitored to ensure successful post-harvest timber harvest is fully achieved. A VAGO 2013 audit report found that the harvest manager, VicForests, was meeting the required regeneration standards, but recommended better alignment of harvesting and regeneration reports.	East Victoria	Net native forest area regenerated	VicForests, DEDJTR

Indicator	Status	Trend	Data quality	Description	Region	Measure	Data custodian
Criterion 3: Maintenance of ecosystem health and vitality							
3.1 Scale and impact of agents and processes affecting forest health and vitality – mortality, dieback, canopy health	Fair	Unclear	Fair	Robustness of previous datasets is weaker than the current dataset, preventing comparison of current and past data. Across all Victorian bioregions, the average percentage of areas showing mortality, crown dieback and canopy health impacted are 14.3%, 20.3% and 23.3%, respectively.	Victoria	Degree of leaf damage based on mortality, crown dieback and crown defoliation	DELWP
3.1 Scale and impact of agents and processes affecting forest health and vitality – bushfire affected area and climate	Fair	Deteriorating	Good	Between 2013 and 2018, the most damaging bushfire on record is the Wye River-Jamieson Track fire, which was instigated by lightning on 19 December 2015. The fire exceeded control lines on Christmas Day under extreme weather conditions, burning 2,520 hectares of national park and private properties along with an estimated 160 houses. Between 2013 and 2014, Victoria experienced its most significant fire season since 2008, which challenged emergency services and Victorian communities. Across the season, Victoria had 19 days of Extreme and Severe Fire Danger Rating, and 16 days of Total Fire Ban. More than 463,000 hectares of public and private land were burnt, and 80 residences were destroyed. Bushfire-affected area has been decreasing since 2003. Annual mean temperature and the number of unusually warm days are increasing. This could reverse this trend in decreasing bushfire-affected area in the future.	Victoria	Bushfire-affected area (hectares), annual mean temperature by year, and number of unusually warm days by year	DELWP, BoM
3.2 Area and type of human-induced disturbance – planned burns	Fair	Unclear	Good	Following the 2010 final report by the 2009 Victorian Bushfires Royal Commission, the Victorian Government committed to expand its planned-burning approach by aiming to reduce fuel hazards and protect human life. However, in 2016, based on recommendations by the Inspector-General for Emergency Management, the government began to shift from a hectare-based approach to a risk-based approach to bushfire management. This focuses on areas where the likelihood of a bushfire starting, spreading and impacting on people, property and the environment is greatest, based on fire-modelling results. The government is developing a system of bushfire management strategies to reduce risk, which will be delivered by 2020. A strategic change in planned-burning targets prevents trend analysis.	Victoria	Annual planned burn area	DELWP

Indicator	Status	Trend	Data quality	Description	Region	Measure	Data custodian
Criterion 3: Maintenance of ecosystem health and vitality							
3.2 Area and type of human-induced disturbance – grazing	Unknown	Stable	Poor	Licence numbers and payments for rent or other activities on Crown land in the reporting period were stable. However, it is difficult to assess status, as the relationship between licence numbers and environmental impact is unknown. No information on the size of grazing area has been identified.	Victoria	Number of licences issued for grazing activities	DELWP
Criterion 4: Conservation and maintenance of soil and water resources							
4.1 Area and percentage of forest by activity type, systematically assessed for risk to soil attributes	Good	Improving	Good	This indicator provides up-to-date legal and non-legal binding regulatory frameworks that address forest-related soil attributes. This includes timber production and bushfire management instruments to assess risk to soil attributes. As demonstrated by the forest audit program for assessing soil risks after timber harvesting, the audited coupes fully complied with 86% of the applicable environmental and roading criteria, with the average level of compliance for individual coupes varying between 71% and 100%. The Bushfire rapid risk assessment team responsible for post emergency risks was deployed to highlight erosion risks and mitigation options. The annual deployment areas have significantly decreased since 2015. Sufficient information on the assessment results is provided.	Victoria	Regulatory frameworks to systematically assess for risk to soil attributes in forests	DELWP
4.2 Change in forested catchment water yield characteristics through time	Fair	Deteriorating	Good	This indicator presents the current status of forest catchment areas and highlights water-yield issues and risks to be addressed based on the 'EnSym – Environmental Systems Modelling platform'. The statistical prediction model demonstrates that there are several catchment areas in ash forests at risk of dramatic decrease in water yield due to timber harvesting and bushfires.	Areas where ash-type forests exist	Estimated annual change in forested catchment water yield due to timber harvesting and fire	DELWP

Indicator	Status	Trend	Data quality	Description	Region	Measure	Data custodian
Criterion 4: Conservation and maintenance of soil and water resources							
4.3 Change in forested catchment river health characteristics through time	Unclear	Unclear	Poor	River health is monitored through the Index of Stream Condition (ISC). The ISC provides a snapshot of river health for 29,000 km of major rivers and tributaries at six-year intervals from 1999. The last ISC report indicated that 66% of Victoria's river reaches were in moderate, good or excellent condition, 32% were in poor or very poor condition, and 2% were not assessable due to insufficient data. However, the last ISC report was prepared with data up to 2010 after a second report was released in 2004, and no update has been made. This leads to a difficulty in evaluating current status and trend of stream conditions.	Victoria	Index of Stream Condition	DELWP
Criterion 5: Maintenance of forest contribution to global carbon cycles							
5.1 Total forest ecosystem biomass and carbon pool by forest type, age class and successional stages	Fair	Unclear	Fair	The amount of carbon mass is presented by bioregion, tenure and type. Relevant information for a single period is presented as provided from the VFMP. Trend analysis will be possible from 2020, once the five-year panel system is fully implemented.	Victoria	Total carbon distribution per bioregion, tenure and type	DELWP
5.2 Contribution of forest ecosystems to the global greenhouse gas balance	Poor	Improving	Good	Since 2011, sequestration from forest management activities has increased, driven by 20 vegetation projects funded by the Emissions Reduction Fund over the past five years. This trend is observed through an upsurge in the Kyoto Australian carbon credit unit (KACCU), representing abatement from activities that contribute to the nation's emission targets under the Kyoto protocol. Estimated net contribution of the fund to the sequestration in land use, land-use change, and forestry (LULUCF) is minimal. Compared to other sectors, including waste and agriculture, proportional contribution of forest-related activities to state-scale greenhouse gas balance is minimal.	Victoria	Carbon dioxide emissions by sector	DELWP

Indicator	Status	Trend	Data quality	Description	Region	Measure	Data custodian
Criterion 6: Maintenance and enhancement of long term multiple socio-economic benefits to meet the needs of societies							
6.1a Value of wood products	Fair	Deteriorating	Good	Value of wood products from state forests declined between 2007–08 and 2016–17, while value of pulpwood productions from plantations increased significantly. All available data indicates that the supply of wood and wood products is likely to decline in Victoria, while demand for wood and wood products is likely to continue to grow in-line with strong population growth.	Victoria	Value and volume of wood products from state forests; value and volume of pulplog productions from plantations; value and volume of Victorian forest products exports	VicForests; Australian Government
6.1b Value and yield of non-wood forest products - game-hunting and apiary business	Unknown	Improving	Fair	Number of game-hunting participants increased steadily. Duck harvest gradually increased, stubble quail harvest was stable and deer harvest increased threefold compared to 2009 figures. Sustainable levels have not been established for game-hunting. Data on apiary licences and revenue is the only other information available for this indicator. The number of licences, and revenue generated from licences, has increased, suggesting increased demand for the apiary business.	Victoria	The number of duck, stubble quail and deer harvested in Victoria; the number of game-hunting licences; apiary licences and revenue	Game Management Authority
6.1b Value and yield of non-wood forest products - the other non-wood forest products	Unknown	Unclear	Poor	Other than the information on game-hunting and apiary business, no information for other non-wood forest products was updated since SoF 2013.	None	Value and yield of non-wood forest products	DELWP
6.1c Value ($) of forest-derived ecosystem services	Fair	Unclear	Fair	Forest ecosystems provide a suite of ecosystem services, including climate regulation, water supply, and filtration and habitat services. There is no state-scale approach that quantifies the value ($) of forest-derived ecosystem services in Victoria. Existing regional-scale approaches could be expanded to work on a state-scale.	Victoria	Value ($) of forest derived ecosystem services	DELWP
6.1d Degree of reuse and recycling of wood products	Good	Improving	Good	Between 2008–09 and 2015–16, the quantity of forest-derived products recycled increased by 35%. This upward trend is expected to continue. The waste recovery rate in Victoria for the same period was slightly above the national average rate. The rate in Victoria is likely to trend upwards. The most up-to-date information is the data from 2016-17, however; relevant data for SoF2018 report could not be retrieved as recovery rate of wood products were aggregated in 'organics' section.	Victoria	Amount forest-derived products recycled; waste recovery rates of forest-derived products	Sustainability Victoria

Indicator	Status	Trend	Data quality	Description	Region	Measure	Data custodian
Criterion 6: Maintenance and enhancement of long term multiple socio-economic benefits to meet the needs of societies							
6.2a Investment and expenditure in forest management	Fair	Stable	Good	xpenditure for forest fire management was reduced to $269.9 million in 2016–17. Prior to this, it fluctuated, including up to $396.5 million in 2015–16. Reported expenditure on conservation and recreation increased significantly between 2014-15 and 2016-17 to $369.8 million. This may reflect increased Victorian Government focus on conservation and recreational values in state forests, parks and reserves.	Victoria	Expenditure on forest management	DELWP
6.2b Investment in research and development, and education	Fair	Deteriorating	Fair	Government has invested about $39 million in forest-related R&D and education (an average of about $5.6 million per year between 2010–11 and 2016–17). Data demonstrate that the number of tertiary and VET students in the forest product sector is declining. A lack of tertiary graduates has meant employers have sought to employ overseas candidates. A 2014 report suggested that declining VET enrolments would lead to skill shortages. There are now many more tertiary pathways for training and employment in forests than what current information provides. Better datasets are needed for this indicator, to better assess status and trends in education for the forests industry.	Victoria	Government investment in forest management and education; enrolment/ graduate figures	DELWP, ForestWorks, Forest and Wood Products Australia
6.2c Extension and use of new and improved technologies	Good	Not applicable	Good	Several new technologies are identified – the Forest Climate Risk Tool; a mobile platform for public forest visitors; a web application to assist bushfire and planned-burning personnel to better interpret forecast bushfire weather; and the use of Light Detection and Ranging (LiDAR) technology to map Leadbeater's Possum habitat.	Victoria	Application of new and improved technologies for sustainable forest management	DELWP, CSIRO, University of Melbourne
6.3a Area and quality of forest actively utilised for recreation and tourism – quality of state forests	Unknown	Unclear	Poor	No data was found in relation to the quality of Victorian state forests for recreation and tourism. A visitor satisfaction survey program to monitor quality of state forests recreation experiences is being considered.	Victoria	Survey of state forest visitors	DELWP

Indicator	Status	Trend	Data quality	Description	Region	Measure	Data custodian
Criterion 6: Maintenance and enhancement of long term multiple socio-economic benefits to meet the needs of societies							
6.3a Area and quality of forest actively utilised for recreation and tourism – parks and conservation reserves and area for state forests	Good	Improving	Good	Area for recreation and tourism in state forests and parks and reserves is increasing. Parks Victoria conducts visitor satisfaction surveys to monitor quality of national parks for recreation and tourism uses in Victoria. The most recent survey shows improved visitor satisfaction across parks between 2010 and 2014. Visitor satisfaction for peri-urban and urban parks improved by about 10%; overall satisfaction for non-urban parks declined by 5%. Community satisfaction with management of national, state, regional and metropolitan parks and conservation reserves was consistently high between 1997 and 2014.	Victoria	IUCN protected areas	DELWP, Parks Victoria
6.3b Range and use of recreation and tourism opportunities that are available within forests	Fair	Stable	Fair	This indicator provides data on the number of sites and tracks available for recreation and tourism activities in state forests and parks and conservation reserves between 2003 and 2017. The number of day visitor areas and camp grounds has been largely static in state forests, whereas the number of camp grounds in parks and conservation reserves has increased dramatically. Sites and tracks within state forests typically provide less developed sites and tracks for public recreational use.	Victoria	Number of sites and tracks within forests	DELWP, Parks Victoria
6.3c Number of visits per annum - state forests	Unknown	Unclear	Poor	There was no formal data for state forest visitors available for this report. (Anecdotally, visits to state forest visitor sites have increased considerably, at a similar rate to visits to national and state parks in Victoria.) DELWP's visitor monitoring program, to measure and track levels of visitation to state forest visitor sites, is expected to provide data on levels of visitation from 2019.	Victoria	Number of visits	DELWP
6.3c Number of visits per annum – national parks and conservation reserves	Good	Improving	Good	Visitation to state and national parks has increased considerably, from about 25 million to 42 million between 2002–03 and 2016–17.	Victoria	Number of visits	Parks Victoria
6.4a Area of forest to which Indigenous people have access and rights that protect their cultural heritage and are recognised through formal and informal management practices	Good	Improving	Good	Total public forest area under Traditional Owner joint management in Victoria increased by 76,166 hectares, compared to the data in SoF 2013 report.	Victoria	Total public forest area under joint management agreement	DELWP

Indicator	Status	Trend	Data quality	Description	Region	Measure	Data custodian
Criterion 6: Maintenance and enhancement of long term multiple socio-economic benefits to meet the needs of societies							
6.4b Proportion of places of Indigenous and non-Indigenous cultural values in forests formally managed to protect those values	Fair	Improving	Fair	Between 2012 and 2017, there was an increase of about 5% in the total number of registered Aboriginal cultural heritage sites. The number of non-Aboriginal cultural heritage places also increased.	Victoria	Change in Aboriginal and non-Aboriginal cultural heritage sites	DELWP, Parks Victoria
6.5a Direct and indirect employment in the forest sector, and forest-sector employment as a proportion of total employment	Poor	Deteriorating	Fair	Data shows a substantial decline in employment in most parts of forest industry, with the exception of harvesting and haulage associated with harvest of hardwood plantations, which has expanded since 2012. There are considerable limitations to assessing information about indirect forest sector jobs in Victoria.	Victoria	Change in number of indirect and direct jobs in forest sector	ABS, ABARES, Australian Forest and Wood Products
6.5b Average wage rates and injury rates in major employment categories within the forest sector	Good	Improving	Good	Forest industry wages in Victoria were generally higher than the average salary of overall industries for particular regions. Injury rates in the forestry industry declined between 2011–12 and 2016–17.	Victoria	Income earned by workers; number of injury insurance claims	ABS
6.5c Resilience of forest-dependent communities to changing social and economic conditions	Fair	Deteriorating	Good	Victorian forest-dependent communities (with more than 2% of employment in forest and wood products industries) have relatively high resilience in terms of wellbeing outcomes. However, these communities have less diverse income streams than similar communities elsewhere in Australia, meaning less potential alternative employment for displaced workers. Glenelg and Colac-Otway LGAs are particularly susceptible, in terms of this measure of economic resilience.	Victoria	Economic Diversity Index; Community Wellbeing Index; Capital Resources Index; and employment status in forest and wood products compared to total employment from all industries	ABS

Indicator	Status	Trend	Data quality	Description	Region	Measure	Data custodian
Criterion 6: Maintenance and enhancement of long term multiple socio-economic benefits to meet the needs of societies							
6.5d Resilience of forest-dependent Indigenous communities to changing social and economic conditions	Poor	Deteriorating	Good	Total Aboriginal students enrolled in government-funded VET programs decreased more than 50% between 2013 and 2017, in-line with decreasing enrolments among all students. In Victoria, nine LGAs were found to have a higher rate of Aboriginal employment in the forestry industry than the state average in 2016, indicating that Aboriginal communities in these regions may be less resilient to changes in the forestry industry than in other Victorian regions. Between 2006 and 2016, all but a few of these regions experienced a gradual decrease of Aboriginal involvement in the forestry industry.	Victoria	Student enrolments and completions in forestry programs between 2014 and 2017 from National Vocational Education Training Provider Collection for government-funded students and courses (not fee-for-services courses), proportion of Aboriginal employment among total number of employees in forestry industry by state	The National Centre for Vocational Education Research, ABS
6.5e Area of forest available and accessible for Indigenous people to exercise their inherent rights to meet subsistence or individual and family cultural and spiritual needs	Unknown	Unclear	Poor	Due to difficulties in obtaining information, this indicator could not be assessed. We suggest combining it with indicator 6.4a.	N/A	Details of accessibility and area in forests for Indigenous people to exercise their inherent rights to meet subsistence or individual and family cultural and spiritual needs	None
6.6a Extent to which the management framework includes the exercise of customary, custodial, traditional and native title rights as an essential component in achieving sustainable forest management	Good	Stable	Good	This indicator describes the several mechanisms that support Aboriginal participation in sustainable forest management for various public land tenure.	Victoria	Management framework that provides Aboriginal participation opportunities to achieve sustainable forest management	DELWP

Criterion 7: Legal, institutional and economic framework for forest conservation and sustainable management

Indicator	Status	Trend	Data quality	Description	Region	Measure	Data custodian
Criterion 7: Legal, institutional and economic framework for forest conservation and sustainable management							
7.1 Extent to which the legal framework (laws, regulations, guidelines) supports the conservation and sustainable management of forests	Fair	Improving	Fair	There are currently 33 legislations that regulate forest management in Victoria. VEAC provided its Statewide Assessment of Public Land Final Report to government in May 2017, including several recommendations to reform the complex public land legislative framework. The Victorian Government has accepted, or accepted in principle or in part, all recommendations made by VEAC, including committing to rewriting the Crown land legislation over the next four years.	Victoria	Impact of legislations on conservation and sustainable management of forests	DELWP
7.2 Extent to which the institutional framework supports the conservation and sustainable management of forests	Fair	Deteriorating	Fair	The overall assessment result of compliant and non-compliant audit elements by different environmental impact categories since 2014 for native timber harvesting activities is described in this indicator. VicForests has indicated a high level of compliance with lower risk prescriptions for timber production harvesting and coupe closure activities throughout the reporting period. Some coupes that were harvested between 2014-15 and 2015-16 were assessed to have major environmental risk. A number of these coupes have been increasing, which must be identified and investigated in the future.	Victoria	The overall assessment result of compliant and non-compliant audit	DELWP
7.3 Extent to which the economic framework supports the conservation and sustainable management of forests	Fair	Unclear	Fair	Although there are several economic frameworks to support the conservation and sustainable management of forests, limited datasets at the state-scale make it difficult to assess this indicator and detect trends.	Victoria	Description of economic frameworks in Victoria to quantify and evaluate all relevant aspects for the conservation and sustainable management of forests	DELWP
7.4 Capacity to measure and monitor changes in the conservation and sustainable management of forests	Fair	Unavailable	Fair	Approximately 50% of the indicators had sufficient data coverage to assess trend and status. Status assessments for about one-third of indicators show significant stress or pressure, either due to significant impact on environmental conditions, or insufficient data to make an assessment of status and trends. Trend assessment was not possible for about one-third of indicators due to a lack of time-series data. Extensive knowledge gaps were identified. This overall trend in assessment summary cannot be compared with the results in previous SoF reports due to differences in assessment methodology.	Victoria	Summary of indicator assessment results, and knowledge gaps	N/A

Indicator	Status	Trend	Data quality	Description	Region	Measure	Data custodian
Criterion 7: Legal, institutional and economic framework for forest conservation and sustainable management							
7.5 Capacity to conduct and apply research and development aimed at improving forest management, including development of scientific understanding of forest ecosystem characteristics and functions	Good	Stable	Good	Although the overall number of Full-time equivalent (FTE) employees remained unchanged, FTE employees in academia increased by around 4 FTE in fire behaviour and forest hydrology when comparing 2011-17. Conversely, the FTEs in government agencies decreased the same amount in fire and flora ecology. For both years, topics related to fire, ecology and hydrology accounted for 80% of overall FTE employees. DELWP indicates that current budget allocation for R&D is based on identification and prioritisation of research directions. The organisation also explained that the expected impact of the research activities on management actions or policy change has been documented.	Victoria	Number of full-time-equivalent employees by research activity for government agencies, private companies and academia	DELWP

Criterion 7: Legal, institutional and economic framework for forest conservation and sustainable management

	Status (UNKNOWN / POOR / FAIR / GOOD)	Trend	Data Quality
7.5 Capacity to conduct and apply research and development aimed at improving forest management, including development or scientific understanding of forest ecosystem characteristics and functions **Data Custodian** DELWP	GOOD	→	DATA QUALITY Good

Forest ecosystems in Victoria are highly diverse and complex in terms of ecosystem diversity and health, carbon sequestration, and genetic diversity. This indicator assesses Victoria's capacity to conduct and apply research and development to improve sustainable forest management.

The number of forest researchers employed by the Victorian Government has declined slightly from 21.9 to 17.9 full-time-equivalent (FTE) workers between 2011–12 and 2015–16. All research personnel have focused on native forest, with a significant proportion working on fire ecology (6.8 FTE), fauna ecology (5.8 FTE) and sustainable forest management (1.5 FTE) in 2015–16.

The data on FTE forest researchers in government agencies, shown in Table 77 and Table 78, include employees of DELWP, VicForests and Arthur Rylah Institute.

In addition, there were 26.3 FTE academics working in forest research and development in Victoria. This figure includes those funded by DELWP through the Integrated Forest and Ecosystem Research (IFER) program at the University of Melbourne, and through the Bushfire and Natural Hazards Co-operative Research Centre (BNHCRC).

These personnel all focused on native forests, and for 2015–16 included 5.2 FTE working on forest hydrology, 12.9 FTE on fire behaviour, 4.5 FTE on fire ecology, 0.9 FTE on sustainable forest management and 2.8 FTE on forest health.

Table 77. Numbers of FTE government staff engaged in forest-related research and development, by state, 2010–11 and 2015–16

State	FTE staff					
	Plantations		Native forest		Total	
	2010–11	2015–16	2010–11	2015–16	2010–11	2015–16
ACT	0.0	0.0	7.0	7.0	7.0	7.0
NSW	12.5	8.0	12.5	8.0	25.0	16.0
NT	3.2	0.9	0.0	0.2	3.2	1.1
QLD	31.6	20.5	0.9	1.2	32.5	21.7
SA	15.8	0.0	0.8	0.0	16.6	0.0
TAS	52.5	2.1	62.8	5.3	115.3	7.3
VIC	0.0	0.0	21.9	17.8	21.9	17.8
WA	0.0	0.0	22.0	15.6	22.0	15.6
Total	115.6	31.5	127.9	55	243.5	86.5

Note: This table shows the numbers of research personnel reported by each state and territory for 2011–12 and 2015–16. NSW total staff numbers have been split equally between plantations and native forest.
(Data source: Australia's State of the Forests 2018)

Table 78 demonstrates trends in research focuses in Victoria, in government agencies and academia, between 2011–12 and 2016–17. The data on FTEs in government agencies includes DELWP employees (policy leads for IFER and BNHCRC projects), VicForests employees, and ARI employees. Academic FTEs include those funded by DELWP through the IFER program and BNHCRC, who represent a subset of the total number of researchers in Victoria.

The overall number of FTE employees is unchanged. FTE employees in academia increased by about 4 FTE in total in fire behaviour and forest hydrology, and decreased by about 4 FTE in government agencies (in fire and flora ecology). For both years, topics related to fire, ecology and hydrology accounted for 80% of overall FTE employees.

Table 78. Numbers of FTE employees engaged in forest-related research and development, by research focus, 2011–12 and 2016–17

Research and development activity	Government agencies		Academia	
	Native forest			
	2011–12	2016–17	2011–12	2016–17
Silvicultural research	0.50	0.50		
Tree breeding (not horticultural)				
Forest hydrology	0.23	0.28	4.00	5.20
Timber use				
Fire behaviour	0.20	0.85	9.78	12.91
Forest pathology				
Agroforestry				
Fauna ecology	5.68	5.79		
Fire ecology	10.12	6.84	5.25	4.50
Forest entomology				
Flora ecology	0.63	0.00		
Non-timber forest products				
Climate change				
Statistical analysis				
Other (aquatic biota)	2.00	1.00		
Other (forest biotechnology)				
Other (forest industries)				
Other (sustainable forest management)	1.51	1.51	0.90	0.90
Other (plantations & health)	1.02	1.02	2.80	2.80
Total number of research FTEs	21.89	17.79	22.73	26.31

Note: Only includes the time-fraction of researchers, technicians and other staff directly involved with research and development activity. Does not include the time fraction of overhead staff (for example, administrative and general service employees, personnel officers and janitors).
Note: Nobody engaged in research in plantations and private companies; therefore, these were excluded in the table.
Note: While FTE data was mostly available, it was derived for BNHCRC by dividing the annual cost of a researcher (approximately $180,000). ARI and academic FTE data was taken from DELWP internal spreadsheets.
(Data source: DELWP 2018)

The two main research head agreements (with the University of Melbourne and BNHCRC) are the major providers involved in forestry research and development in Victoria.

University of Melbourne – IFER

IFER[291] is a research agreement between the School of Ecosystem and Forest Sciences at the University of Melbourne, and DELWP. It aims to enhance the evidence base for managing the impacts of fire, climate and management regimes on multiple forest values in Victoria's forest ecosystems. The IFER program investigates forest ecosystems in Victoria under six main landscape-level themes: biodiversity, carbon, integration, social and economic values, vulnerability and water.

BNHCRC (successor of the Bushfire CRC)

As a consequence of Victoria's Black Saturday bushfires in February 2009, the Commonwealth Government granted the Bushfire CRC an extension of funding to examine national issues arising from the tragedy. This led to a new three-year research program for the Bushfire CRC from 2010 to 2013. The research built on outputs from the CRC's first seven years of research to give communities and fire managers a solid basis to better prepare for, manage and respond to severe bushfires. The research focused on understanding the risks associated with bushfires, how to better communicate these risks to the public, and how to better manage direct threats of bushfire.

BNHCRC[292] established in 2013, builds on the work of the Bushfire CRC and is conducting coordinated and interdisciplinary research. This includes working with communities to improve disaster resilience and reduce the human, social, economic and environmental costs of bushfires and other natural hazards. Research undertaken by BNHCRC supports the development of cohesive, evidence-based policies, strategies, programs and tools to build a more disaster-resilient Australia. The BNHCRC provides long-term research that directly supports emergency services and other government and non-government agencies as they work to prevent, prepare for, respond to and recover from natural disasters.

The BNHCRC, like the Bushfire CRC before it, is 'end-user driven'. This means its partners, including various emergency service agencies, departments and non-government organisations around the country, have a significant say in the development and use of the research program.

DELWP's current budget allocation for research and development is based on identification and prioritisation of research directions. For trends in financial investment in research and development, see indicators 6.2b Investment in research and development, and education and 6.2c Extension and use of new and improved technologies.

291. University of Melbourne, 'Integrated forest ecosystem research (iFER)', Parkville, Victoria https://ecosystemforest.unimelb.edu.au/research/research-programs/integrated-forest-ecosystem-research-ifer Accessed 4 December 2018.
292. Bushfire & Natural Hazards CRC, East Melbourne, Victoria https://www.bnhcrc.com.au/ Accessed 4 December 2018.

UN Sustainable Development Goals

There are 27 SDG targets that align with SoF indicators (Table 79). It is important to note that the current list of selected SDG targets may change over time, as the sophistication of the operating framework improves and the narrative becomes more precise. This is intended as the beginning, not the end, of the journey of applying the SDGs to SoF reporting.

Table 79. SDG Targets by category

SDG Targets	
Biophysical targets aligned with SoF	10
Socio-economic targets aligned with SoF	17
Out-of-scope	142
Total	169

Credit: Faye Bedford

Table 80. Aligning the SoF indicators with SDG targets

Within established (biophysical) SoF scope		New and emerging (socio-economic) SoF scope		
SDG Goals	SDG Target	Status	Trend	Data quality
2 ZERO HUNGER	2.4 By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality	Good	Improving	Good
	2.5 By 2020, maintain the genetic diversity of seeds, cultivated plants and farmed and domesticated animals and their related wild species, including through soundly managed and diversified seed and plant banks at the national, regional and international levels, and promote access to and fair and equitable sharing of benefits arising from the utilization of genetic resources and associated traditional knowledge, as internationally agreed	Unknown	Unclear	Poor
4 QUALITY EDUCATION	4.7 By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development	Poor	Deteriorating	Fair
6 CLEAN WATER AND SANITATION	6.4 By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity	Fair	Deteriorating	Good
	6.6 By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes	Fair	Deteriorating	Good
8 DECENT WORK AND ECONOMIC GROWTH	8.4 Improve progressively, through 2030, global resource efficiency in consumption and production and endeavour to decouple economic growth from environmental degradation, in accordance with the 10-Year Framework of Programmes on Sustainable Consumption and Production, with developed countries taking the lead	Fair	Improving	Good
	8.8 Protect labour rights and promote safe and secure working environments for all workers, including migrant workers, in particular women migrants, and those in precarious employment	Fair	Unclear	Fair

Within established (biophysical) SoF scope		New and emerging (socio-economic) SoF scope		
SDG Goals	SDG Target	Status	Trend	Data quality
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE	9.4 By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities	Good	Improving	Good
11 SUSTAINABLE CITIES AND COMMUNITIES	11.4 Strengthen efforts to protect and safeguard the world's cultural and natural heritage	Fair	Improving	Fair
12 RESPONSIBLE CONSUMPTION AND PRODUCTION	12.2 By 2030, achieve the sustainable management and efficient use of natural resources	Fair	Improving	Good
	12.5 By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse	Good	Improving	Good
	12.6 Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle	Fair	Stable	Good
	12.b Develop and implement tools to monitor sustainable development impacts for sustainable tourism that creates jobs and promotes local culture and products	Fair	Unclear	Fair
13 CLIMATE ACTION	13.1 Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries	Poor	Unclear	Fair
	13.2 Integrate climate change measures into national policies, strategies and planning	Poor	Unclear	Fair
	13.3 Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning	Fair	Deteriorating	Fair

Within established (biophysical) SoF scope		New and emerging (socio-economic) SoF scope		
SDG Goals	SDG Target	Status	Trend	Data quality
14 LIFE BELOW WATER	14.4 By 2020, effectively regulate harvesting and end overfishing, illegal, unreported and unregulated fishing and destructive fishing practices and implement science-based management plans, in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield as determined by their biological characteristics	Poor	Deteriorating	Good
15 LIFE ON LAND	15.1 By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements	Fair	Deteriorating	Good
	15.2 By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally	Fair	Stable	Good
	15.3 By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world	Fair	Stable	Good
	15.4 By 2030, ensure the conservation of mountain ecosystems, including their biodiversity, in order to enhance their capacity to provide benefits that are essential for sustainable development	Fair	Unclear	Fair
	15.5 Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species	Fair	Unclear	Fair
	15.6 Promote fair and equitable sharing of the benefits arising from the utilization of genetic resources and promote appropriate access to such resources, as internationally agreed	Fair	Deteriorating	Good
	15.8 By 2020, introduce measures to prevent the introduction and significantly reduce the impact of invasive alien species on land and water ecosystems and control or eradicate the priority species	Fair	Unclear	Fair
	15.9 By 2020, integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts	Fair	Deteriorating	Good

Within established (biophysical) SoF scope		New and emerging (socio-economic) SoF scope		
SDG Goals	SDG Target	Status	Trend	Data quality
	17.14 Enhance policy coherence for sustainable development	Good	Stable	Good
	17.19 By 2030, build on existing initiatives to develop measurements of progress on sustainable development that complement gross domestic product, and support statistical capacity-building in developing countries	Fair	Improving	Fair

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