



Department of Planning, Industry and Environment

NSW Fire and the Environment 2019–20 Summary

Biodiversity and landscape data and analyses to understand the effects of the fire events



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Cover photo: Drone photograph of National Parks and Wildlife Service staff inspecting burnt forest in Kangaroo Valley, New South Wales (G Pickford/DPIE); **Contents:** Drone photograph of burnt forest in Kangaroo Valley, New South Wales (G Pickford/DPIE); **P.6:** Fallen burnt tree in forest of Kangaroo Valley, New South Wales (G Pickford/DPIE); **P.8:** Oxley Wild Rivers National Park (J Spencer/DPIE); **P.9:** Gospers Mountain Fire, Wollemi NP, near Hartley Vale (J Spencer/DPIE); **P.11:** Burnt forest floor in Kangaroo Valley, New South Wales (G Pickford/DPIE); **P.13:** Cobark picnic area, Barrington Tops National Park (J Spencer/DPIE); **P.14:** *Leiopactus incanescens* on *Persoonia pauciflora* (N Emery/RBG); **P.15:** Kosciuszko National Park (J Spencer/DPIE); **P.16:** Wollemi pine rescue (J Spencer/DPIE); Regeneration in Crowdy Bay (A Marshall/DPIE); **P.18:** Fire injured koala released near Numeralla in the Snowy Monaro region of NSW (L Morrell/DPIE); **P.19:** Bundjalung National Park (D Egan/DPIE); **P.20:** Brush-tailed rock-wallaby (J Spencer/DPIE).

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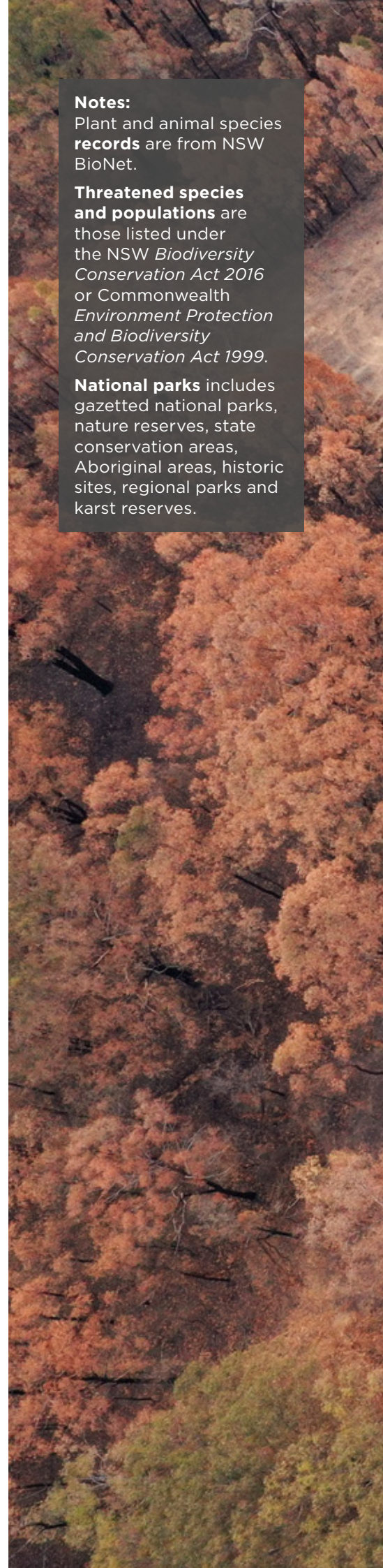
March 2020

Notes:

Plant and animal species records are from NSW BioNet.

Threatened species and populations are those listed under the NSW *Biodiversity Conservation Act 2016* or Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

National parks includes gazetted national parks, nature reserves, state conservation areas, Aboriginal areas, historic sites, regional parks and karst reserves.

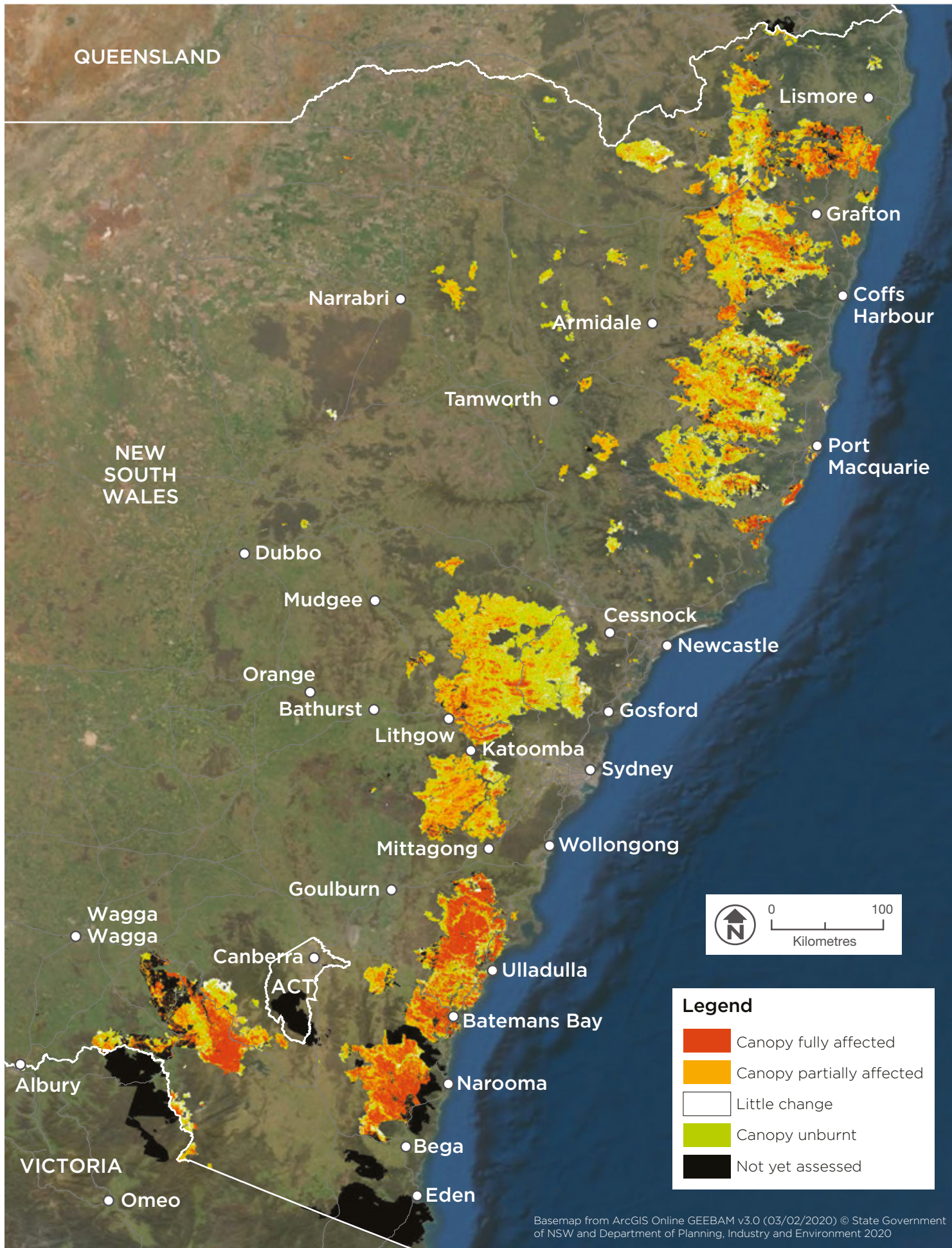




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NSW Fire and the Environment 2019-20: At a glance



Key facts about the 2019–20 fires in New South Wales

The fire ground includes:



5.4 million

hectares of land
in NSW



37% of all
NSW national park estate



42% of all
NSW state forest



4% of all
NSW freehold land



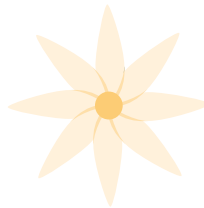
81% of the
Greater Blue Mountains
World Heritage Area



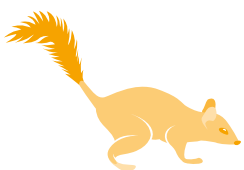
54% of Gondwana
Rainforests of
Australia World
Heritage Area in NSW



25% of
suitable koala habitat
in eastern NSW



52% of
heathlands in NSW



293 threatened
animal species have
sightings recorded
in the fire ground



680 threatened
plant species have
sightings recorded in
the fire ground

Changes in biodiversity indicators in the fire ground since 2013



39% reduction in
ecological condition
in the fire ground



4% reduction in
ecosystem persistence
in the fire ground



39% reduction in
ecological carrying capacity
in the fire ground



Assessing the effects of the 2019–20 fires

New South Wales has experienced extensive bushfires throughout spring and summer 2019–20. The Environment, Energy and Science Group has assessed the effects of the bushfires on a range of biodiversity and landscape values.

This Summary provides an outline of the biodiversity and landscape data and analyses that can assist governments, businesses and communities to understand the broad environmental effects of the extraordinary fire events of 2019–20. This information also aims to support fire research and recovery efforts.

The methods used to compile the information in this Summary are detailed in a technical report, [NSW Fire and the Environment 2019–20 Technical Report](#) (DPIE 2020).

Mapping and spatial analysis is based on best available information (Figure 1). This includes information on the extent of the fires and relative fire severity as of 3 February 2020. As improved information becomes available over time it will be used to refine and recalculate the results.

Three indicators developed for the first [NSW Biodiversity Outlook Report](#) (DPIE 2020) have been recalculated, post fire, and are reported here as ‘report cards’ (see ‘Reporting on biodiversity indicators’). These will be included in future biodiversity outlook reports.

Extensive, peer-reviewed long-term research and mapping undertaken by the Environment, Energy and Science Group and other NSW Government agencies have enabled the development of rapid assessment tools and comprehensive insights into the effects of recent fires on the environment.

This Summary will be accompanied by a technical report to enable users to explore the information presented more thoroughly.

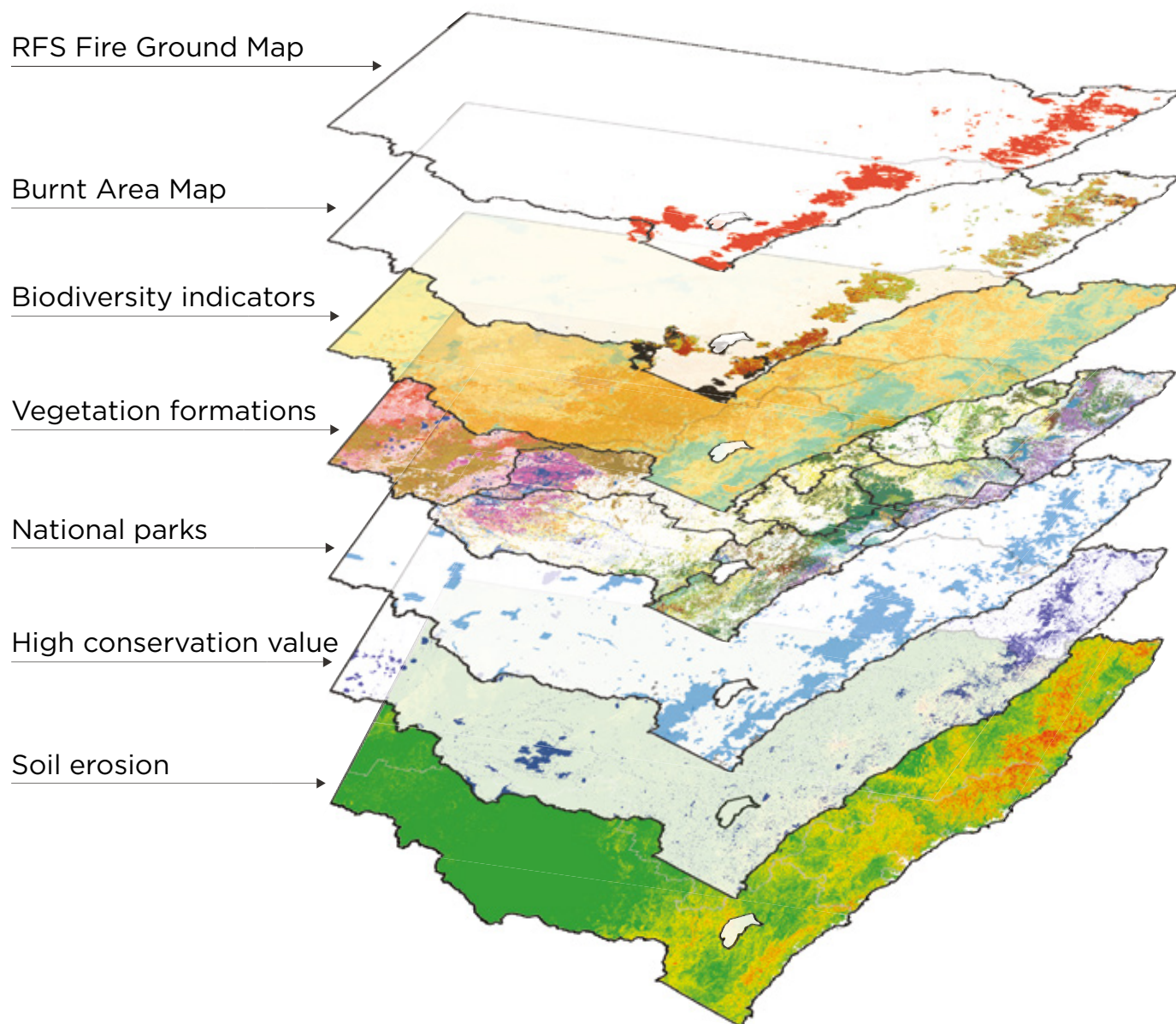


Figure 1 Spatial analysis schematic showing the various data sets used in this analysis of post-fire impacts. Data layers not shown in this schematic include: koala habitat suitability, World Heritage Areas, state forests, NSW bioregions



Mapping fire areas

At the time of undertaking this analysis, there were two different maps available for the recent NSW bushfires. The RFS Fire Ground Map shows fire extent and the Burnt Area Map shows relative fire severity.

- **RFS Fire Ground Map:** A map from the NSW Rural Fire Service (RFS) Incident Control Online (ICON) system depicting the fire ground perimeter for 2019–20. This provides the outer perimeter of the fire extent and contains both burnt and unburnt areas. Note the RFS refer to this layer as 'Burn Area'. The timeframe covered by the RFS Fire Ground Map is 15 July 2019 to 3 February 2020.
- **Burnt Area Map:** A map of relative fire severity based on how much of the **canopy** appears to have been affected by fire. It covers the same extent as the RFS Fire Ground Map and is based on Google Earth satellite imagery.

The Burnt Area Map helps to show the patchy, mosaic pattern of burning within the fire ground and the way that relative fire intensity is not uniform across the landscape.

Understanding the mosaic of relative fire intensity on the ground can help guide post-fire research and recovery. Research is ongoing into the impacts of the fire events on biodiversity and landscapes. This research will help governments, businesses and communities work through the recovery process.

Canopy

in the Burnt Area Map is the tallest vegetation at any location. For example, for forests and woodlands, this will be trees. In heathland, it will be heath and shrubs. In grassland, it will be grass.



The extent and severity of the NSW fires

RFS Fire Ground Map

The fires of spring and summer 2019–20 covered extensive areas of the eastern seaboard as shown in the RFS Fire Ground Map (Figure 2). Approximately 7% (**5.37 million hectares**) of land in New South Wales is within the RFS fire ground (at 3 February 2020).

In New South Wales, 37% of the national park estate (i.e. all categories of parks), 42% of state forests and 4% of freehold land is within the fire ground (Table 1).

Of the land in the fire ground, 50% is national park, 17% is state forest and 29% is freehold land (Figure 3).

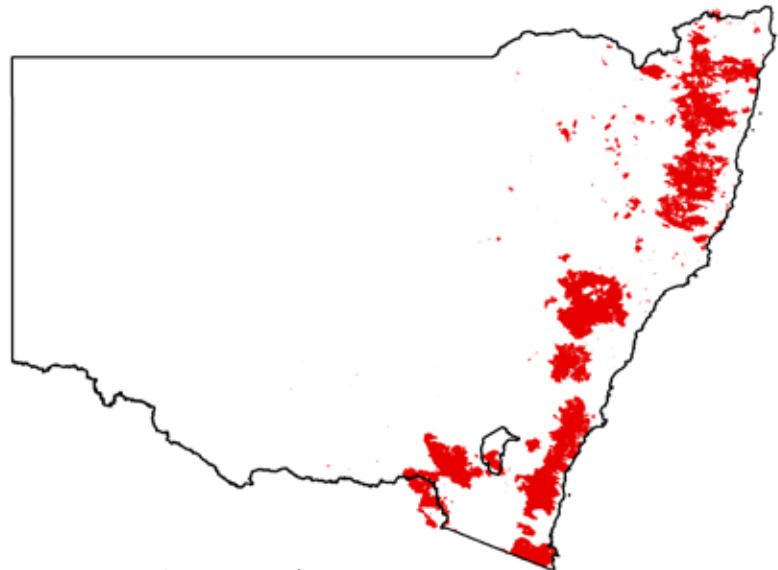
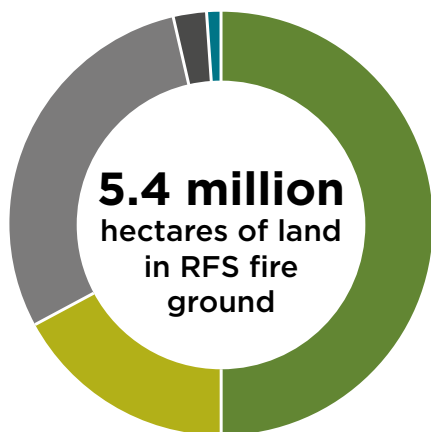


Figure 2 RFS Fire Ground Map

Table 1 Tenure summary for New South Wales and the RFS fire ground

Tenure	Number in fire ground	Total area in NSW (million ha)	Area in RFS fire ground (million ha)	% in RFS fire ground
National parks (total 878)	245	7.26	2.70	37
State forests (total 522)	208	2.16	0.91	42
Other Crown land		2.34	0.14	6
Freehold		37.01	1.57	4
Other		31.39	0.06	<1
Total			5.37	



50%

National parks
245 of 878 in NSW
2.7 million ha

17%

State forests
208 of 522 in NSW
0.9 million ha

29%

Freehold
1.6 million ha

3%

Other Crown land
0.14 million ha

1%

Other
0.06 million ha

Figure 3 Land within the RFS fire ground by tenure

Fire area extent classes

Fire area extent is reported in classes which describe the percentage of a park or state forest which is within the fire ground:

- near complete where > 99% of the area is in the fire ground
- majority where 75–99% of the area is in the fire ground
- extensive where 50–74% of the area is in the fire ground
- partial where < 50% of the area is in fire the ground.

In terms of the extent of the parks and state forests that were within the fire ground (Figure 4):

- 57 national parks had more than 99% of their area in the fire ground
- 73 national parks had 75–99% of their area in the fire ground.

For state forests:

- 43 had more than 99% of their area in the fire ground
- 72 had 75–99% of their area in the fire ground.

National parks

Of the 878 national parks in the State, 245 (or 28%) are wholly or partially within the RFS fire ground (Table 1). The Wollemi, Kosciuszko and Blue Mountains national parks had the largest fires by extent.

State forests

Of the 522 state forests in the State, 208 (or 40%) are within the RFS fire ground.

Fire area extent classes

- Near complete > 99% of area in fire ground
- Majority 75–99% of area in fire ground
- Extensive 50–74% of area in fire ground
- Partial < 50% of area in fire ground

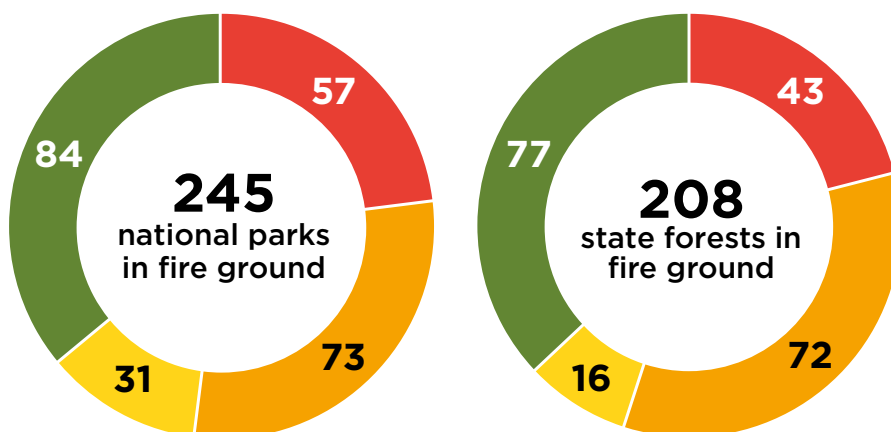


Figure 4 Fire area extent classes for national parks and state forests

Burnt Area Map

The Burnt Area Map shows the relative fire severity of areas within the RFS fire ground based on how much of the canopy appears to have been affected by fire. There is a complex mosaic of burn patterns and fire severity illustrated in the Burnt Area Map (Figure 5).

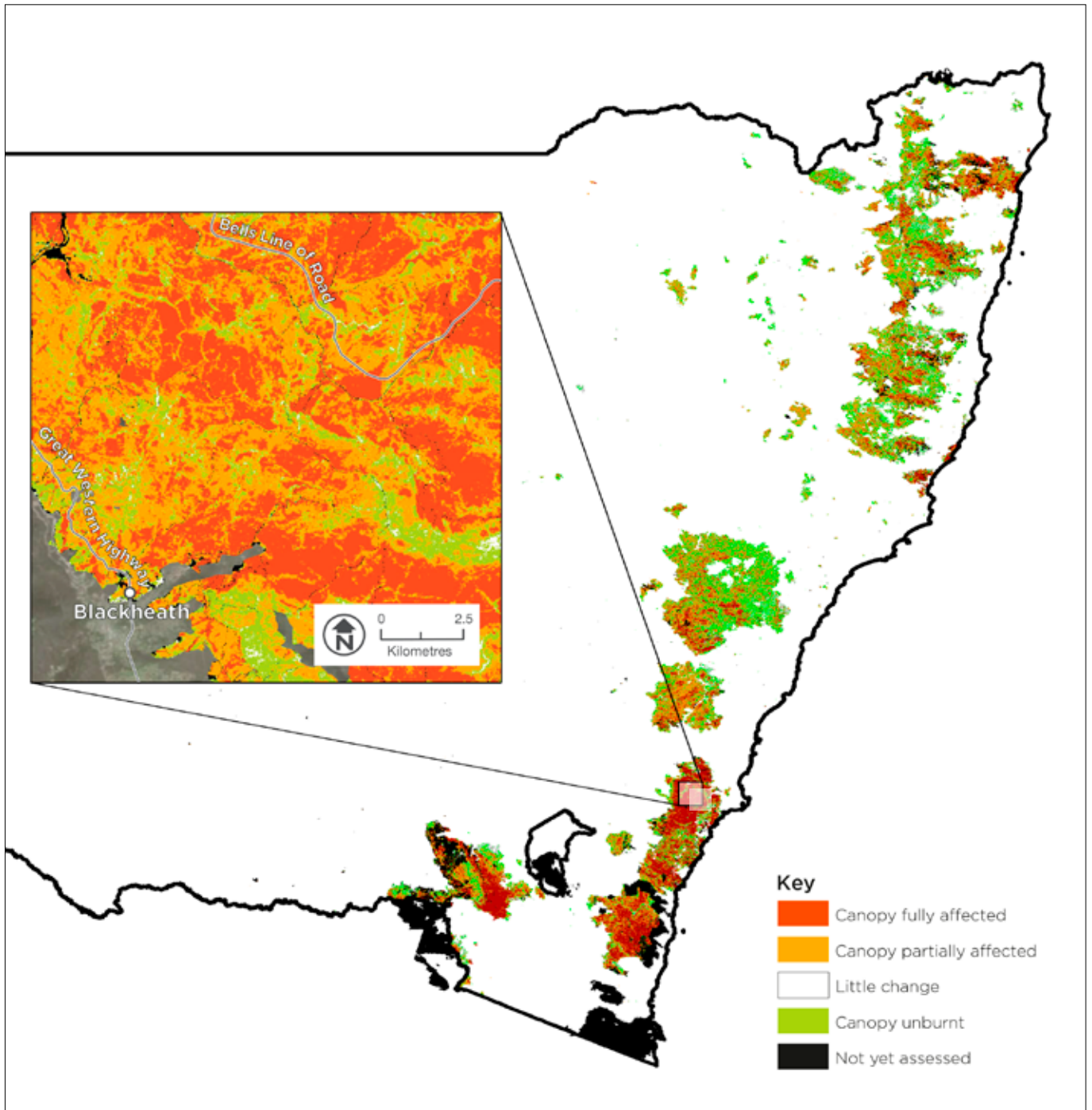
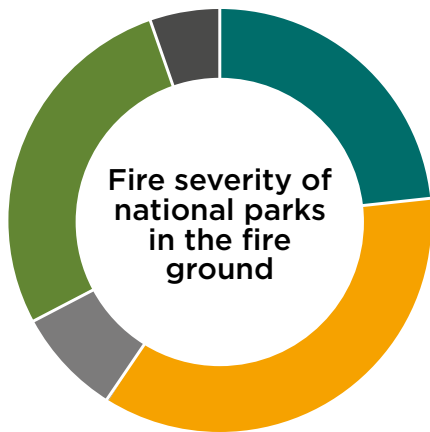


Figure 5 Burnt Area Map with inset showing fire severity in the Blue Mountains



23%
Canopy fully affected

36%
Canopy partially affected

8%
Little change

27%
Canopy unburnt

6%
Not yet assessed

Figure 6 Fire severity in national parks (% of total national park in RFS fire ground)

Fire severity classes

Relative fire severity is reported in classes which describe levels of change to the tallest vegetation:

- canopy fully affected
- canopy partially affected
- little change (pre-fire to post-fire)
- canopy unburnt
- not yet assessed.

Table 2 shows the percentage of the total area of each tenure within the fire ground that falls within each fire severity class.

Of the national park lands within the fire ground, 23% show full canopy damage and a further 36% show partial canopy damage (Figure 6).

The Burnt Area Map does not reflect the occurrence of fires in the understorey. So, a 'canopy unburnt' area may include areas where the understorey below the tallest vegetation has been burnt. As such, caution is needed when using the Burnt Area Map to infer potential impacts on understorey plants or ground-dwelling animals.

Table 2 Fire severity in major NSW tenures within the RFS fire ground

Tenure	Fire severity class (percentage of tenure area within the RFS fire ground)				
	Percent canopy fully affected	Percent canopy partially affected	Percent little change	Percent canopy unburnt	Percent not yet assessed
National park	23	36	8	27	6
State forest	17	32	7	21	24
Other Crown land	19	32	10	27	12
Freehold	13	35	7	24	12
Other	12	30	12	23	24



The Biodiversity Indicator Program

The Biodiversity Indicator Program aims to collect, monitor and assess the status and trends in biodiversity in New South Wales as required under the *Biodiversity Conservation Act 2016*.

As part of the Biodiversity Indicator Program, a range of indicators have been designed to track the status and trends in **biodiversity** and **ecological integrity** and how we manage our landscapes and protect natural areas. These indicators will, over time, provide a record of status and trends, the management actions we take, and the effectiveness of those actions in improving the habitats that support biodiversity.

A technical report, [Measuring Biodiversity and Ecological Integrity in NSW: Method for the Biodiversity Indicator Program](#), describes the biodiversity indicators required to do this. The first *NSW Biodiversity Outlook Report* presented 'first assessment' indicators which had been implemented.

Changes in the landscape

New South Wales is home to an amazing diversity of native species and ecosystems. Species and ecosystems vary across NSW's different landscapes and occur naturally in all places.

Changes to our landscapes create living environments for people and provide food and materials to sustain us. These changes also alter habitats and may make them less suitable for biodiversity.

Fires in the landscape change environments and impact species and ecosystems. In some cases, these changes benefit future biodiversity, but in other instances where fires are particularly intense or too frequent, the impact on biodiversity can be severe. Events like the bushfires over spring and summer 2019–20 have altered large areas of habitat for species and ecosystems in the State. In some places where bushfires were very extensive, there is a scarcity of unburnt areas to provide refuge for wildlife as burnt areas recover.

The combination of fire and follow-up rains can trigger major erosion events which cause lasting damage to ecosystems. This is because the capacity of landscapes to maintain soil stability changes when vegetation is burnt. This report includes information about hillslope erosion potential for all fire affected areas.

Biodiversity

is the variety of living animal and plant life (including fungi, lichen and microorganisms), including diversity within and between species and diversity of ecosystems

Ecological integrity

is the ability to maintain the diversity and quality of ecosystems and enhance their capacity to adapt to change and provide for the needs of future generations



Reporting on biodiversity indicators

The *NSW Biodiversity Outlook Report* presented results for the first assessment indicators in 'report cards'.

Each report card includes an infographic that summarises the indicator results. Results are reported in percentages, with an arrow showing the status of the indicator along a band. The level of confidence for each result is expressed by the parts of a circle.

In this Summary and the technical report, the indicator is reported for multiple years: the first assessment (2013) and the post-fire analysis (2020). An example report card infographic for multiple year reporting is shown in Figure 7. This allows trends over time to be assessed.

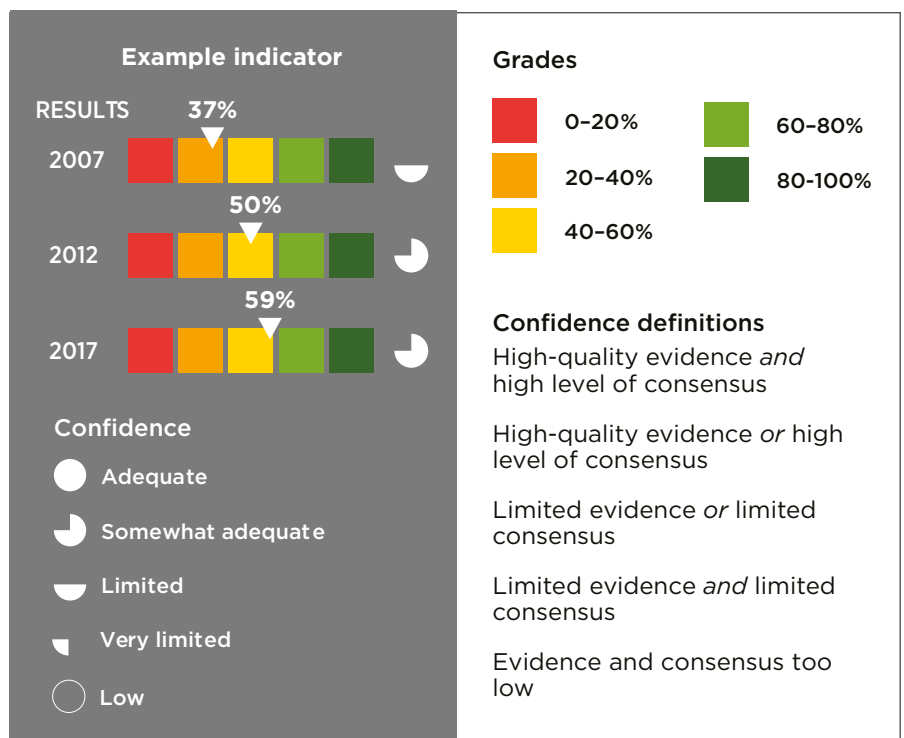


Figure 7 An example of a report card with an explanation of terms and symbols. In the example, the indicator shifted from 37% in 2007 to 50% in 2012 and 59% in 2017. For the 2007 reporting timeframe, the level of confidence in the result was 'limited' in terms of evidence or consensus; and for 2012 and 2017 the level of confidence was 'somewhat adequate'.

Information on fire extent and severity from spring and summer 2019–20 has been used to recalculate three biodiversity indicators from the first assessment. Results assessing fire impact, not linked to the indicators, are also presented under 'Natural values affected by the fires' in this document.



Biodiversity indicators: post-fire analysis

The 2020 post-fire analysis of key biodiversity indicators shows the status of ecological condition, ecological carrying capacity and persistence of ecosystems across the State has decreased since the first assessment in 2013.

These statewide reductions are due to the impact of bushfires in the 7% of the State within the fire ground.

The post-fire analysis used the Burnt Area Map to update the ecological condition model. Differences between pre-fire and post-fire extent and severity have been coupled with the modelled consequences of burning for different vegetation formations. This updated model was then used to assess the biodiversity indicators. This analysis is a statewide assessment at a single point in time. Changes in the value of an indicator help us understand the immediate effect of the fires on habitats and ecosystems.

With sufficient rainfall, post-fire regeneration and regrowth can be rapid in the first six months, then continue slowly over subsequent years. The indicators can also be recalculated in the future to incorporate natural regeneration and regrowth following fire.

Ecological condition

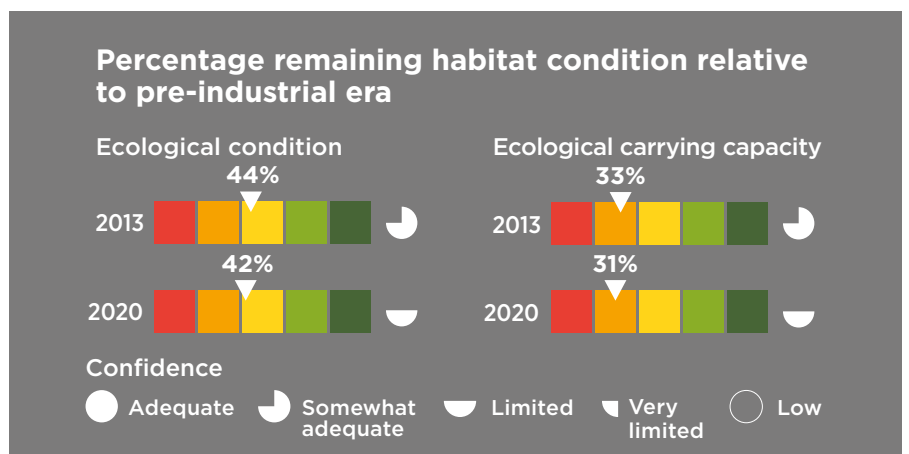
The ecological condition indicator shows the quality of terrestrial habitat at each location, estimating its intactness and naturalness without considering the indirect effects of surrounding habitat loss and fragmentation.

In 2013, 44% of the original ecological condition in New South Wales was estimated as remaining. In 2020, this decreased to 42%.

Within the RFS fire ground, ecological condition has decreased from 72% in 2013 to 44% in 2020, representing a 39% reduction. This assessment reflects the immediate effects post-fire on vegetation condition. The effects of regeneration and regrowth will be captured in future assessments.



Ecological condition in the fire ground has reduced by 39% since 2013





Ecological carrying capacity

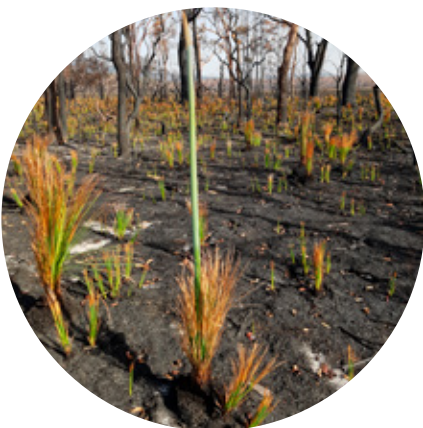
The ecological carrying capacity indicator shows the effectiveness of habitat at each location to support native species and ecosystems, considering its ecological condition and the effect of surrounding habitat loss and fragmentation on biological movement such as foraging, dispersal and migration.

In 2013, 33% of the original ecological carrying capacity was estimated as remaining in New South Wales. In 2020, this decreased to 31%.

Within the RFS fire ground, ecological carrying capacity decreased from 62% in 2013 to 38% in 2020, representing a 39% reduction. This assessment reflects the immediate effects post-fire on ecological carrying capacity. The effects of regeneration and regrowth will be captured in future assessments.



Ecological carrying capacity in the fire ground has reduced by 39% since 2013



Persistence of ecosystems

The persistence of ecosystems indicator reflects the expected persistence of species diversity based on the proportion of habitat remaining in ecosystems, using a classification representing known and undiscovered species. This indicator is a metric for diversity across ecosystems, species and genetics. Plant species are used as a surrogate for all biodiversity.

In 2013, 84% of the original diversity of NSW plants were estimated as likely to persist. In 2020, this decreased to 82%.

In areas within the fire ground, the diversity of NSW plants likely to persist was reduced by 4%. This decline represents a loss of unique diversity. This is not equivalent to extinction of individual plant species. Field studies have demonstrated that floristic diversity can increase in a post-fire environment.

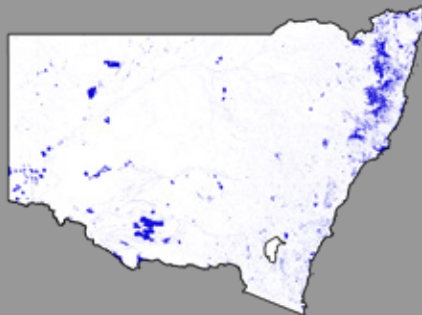


Ecosystem persistence in the fire ground has reduced by 4% since 2013

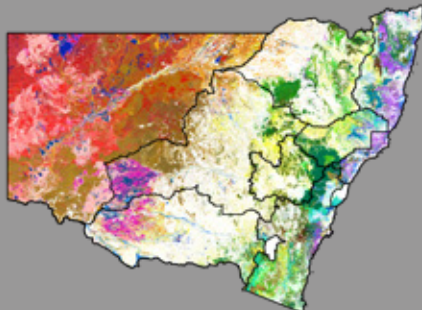
Natural values affected by the fires



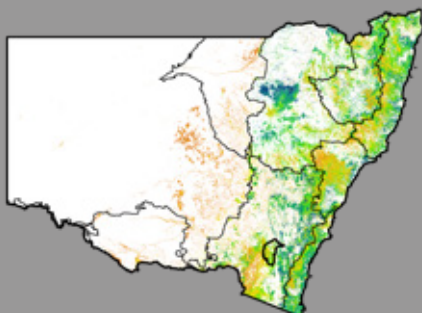
NSW World Heritage Areas



Biodiversity values map



Vegetation formations



Koala habitat suitability

World Heritage Areas

Two natural World Heritage Areas in New South Wales have been affected by the 2019–20 bushfires (i.e. are in the fire ground):

- 81% of the Greater Blue Mountains World Heritage Area
- 54% of the NSW sections of the Gondwana Rainforests of Australia, World Heritage Area

Areas of high biodiversity value

The NSW Biodiversity Values Map identifies land with high biodiversity value across New South Wales in accordance with Part 7 of the Biodiversity Conservation Act. It includes high conservation value wetlands, littoral rainforest, koala habitat, old-growth forest and threatened species habitat.

The fires have affected 26% of the area with mapped biodiversity values.

Vegetation formations

Vegetation formations are broad vegetation types which have been mapped across the State. A number of these vegetations formations have been extensively burnt in the recent fires.

For example:

- 52% of all heathlands in New South Wales has been affected by fire (i.e. are within the fire ground)
- 50% of wet sclerophyll forests has been affected
- 37% of the State's rainforests has been affected.

Koala habitat

Over 3.5 million hectares, or 25%, of the most suitable koala habitat in eastern New South Wales is in the RFS fire ground. This includes moderate, high and very high suitability habitat.

Over 1.9 million hectares of high or very high suitability koala habitat in eastern New South Wales are within the fire ground. This represents 22% of the best koala habitat in eastern New South Wales.

Koala model regions with the greatest percentage of the best koala habitat in the fire ground are the North Coast, Central and Southern Tablelands, Central Coast and the South Coast (Figure 8).

Only three koala model regions have little or no areas in the fire ground: Darling Riverine Plains, Riverina and Far West.



Koala model region

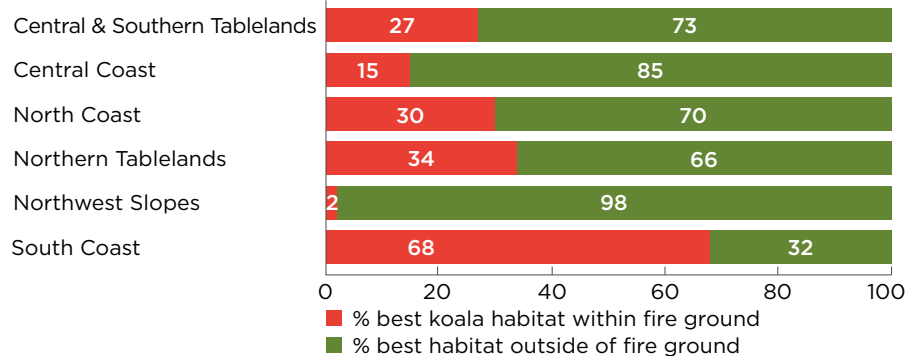
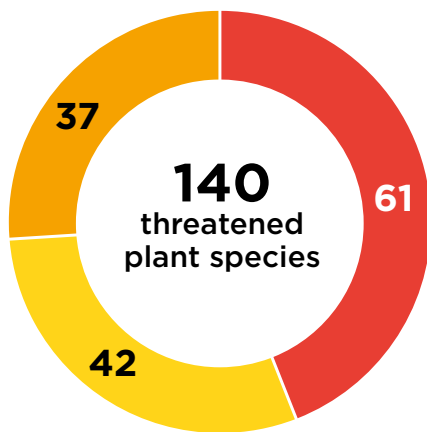


Figure 8 Percentage of high and very high suitability koala habitat inside and outside of the RFS fire ground in each koala model region



Percentage of records within fire ground

- 80-100%
- 50-80%
- 30-50%

Figure 9 Threatened plant records in the fire ground

Threatened plants

Of the 680 threatened plant species with sighting records within the RFS fire ground (Figure 9):

- 61 species have more than 80% of their records within the fire ground, including 19 with more than 30% of records in areas where the canopy has been fully affected
- 37 species have 50-80% of records within the fire ground.

Threatened animals

Of the 293 threatened animal species or populations with records in the RFS fire ground:

- all 413 records of the yellow-bellied glider endangered population on Bago Plateau are within the fire ground and more than 55% of records are in areas where the canopy has been partially or fully affected
- four other species or populations have more than 80% of their records within the fire ground:
 - the critically endangered long-nosed potoroo (97% of records, although fire severity has yet to be assessed in these areas)
 - the endangered frog *Philora pughii* (85% of records)
 - the greater glider endangered population in Eurobodalla (81% of records and more than 25% of records in areas where the canopy has been fully affected)
 - the endangered Hastings River mouse (84% of records)
- 99 species have more than 10% of their records within the fire ground.



Non-threatened plants

Of the 6587 plant species with records in New South Wales:

- 21 have more than 80% of their records within the fire ground and 50% of records within areas where the canopy has been fully affected
- 53 have more than 80% of records in the fire ground and 30% of records within areas where the canopy has been fully affected
- 123 have more than 80% of records in the fire ground
- 3209 have more than 10% of records in the fire ground.

Non-threatened animals

Of the 1074 animal species with records in New South Wales:

- 18 have more than 50% of records in the fire ground
- 73 have more than 30% of records in the fire ground
- 270 have more than 10% of records in the fire ground.

Erosion risk

Comparing modelled soil erosion across tenures, the largest percentage change in erosion after fires was predicted for state forests (143% change), followed by national parks (Table 3). Across bioregions, the largest percentage changes in erosion after fires were predicted for the South East Corner, Australian Alps, Sydney Basin and NSW North Coast bioregions.

For absolute values, the highest average erosion rates were predicted in national parks, which reflects the more rugged terrain in those areas. The highest average post-fire erosion rates were predicted for the NSW North Coast followed by the South East Corner bioregions.

Table 3 Modelled hillslope erosion in tonnes per hectare per year (t/ha/year) by tenure in average rainfall

Tenure	Average Cover 2000–19	Pre-fire cover	Post-fire cover	Change (%)
National park	3.7	10.9	23.1	113
State forest	3.4	7.7	18.7	143
Other Crown land	1.1	4.4	6.9	59
Freehold	1.1	4.9	7.1	45
Other	0.9	2.9	3.8	30

Where to from here?

This report is an assessment of the status of biodiversity in New South Wales following the 2019–20 bushfires. Further and ongoing assessment will be required as new data and information on the impacts of the fires to biodiversity become available. Collecting data and monitoring results enables us to better understand changes in the environment and manage biodiversity into the future.

Refer to the [Understanding the impacts of the 2019–20 fires website](#) for detailed information and analyses on the effects of the bushfires.

