Indicator 1.2b: The status of forest dwelling species at risk of not maintaining viable breeding populations, as determined by legislation or scientific assessment (2024)

This indicator measures the conservation status of nationally listed threatened forest-dwelling species. Documentation of this information over time allows analysis of changes to species conservation status, indicating the extent to which forest species biodiversity is being maintained.

Context and definitions

Together with information describing existing forest-dwelling species susceptible to threats that affect their ability to maintain viable breeding populations and therefore long-term persistence, this indicator also outlines the threats and key threatening processes relevant to these species. Information on threatened forest ecological communities is also included.

Forest-dwelling species: extant (not extinct) native species that use a forest habitat for at least part of its life cycle. Forest-dwelling species include only **vertebrate fauna and vascular flora**. Invertebrates and non-vascular flora are not reported because there are a lack of reliable data (many of species are yet to be described) and potentially uneven representation across taxon groups.

Nationally threatened species: listed under the *Environment Protection and Biodiversity Conservation Act 1999*, they are not limited to species but can include infraspecific-level taxa such as subspecies, ecotypes, varieties, and hybrids. Threatened forest-dwelling 'species' in this Indicator, therefore, also covers those listed at infraspecific levels.

Native: species with natural distribution (including naturalised) within Australia's National Forest Inventory (NFI) boundaries. Species endemic to Australia's outer islands and territories such as Christmas Island, Lord Howe Island and Norfolk Island are not reported as these regions are beyond NFI boundaries.

Forest ecological community: an ecological community that naturally, and to various degrees, contains forest ecosystems.

Other terms used can be found in Australia's forests and forestry glossary.

Key points

- A total of 1,227 native forest-dwelling species were listed as threatened (as at December 2021) under the *Environment Protection and Biodiversity Conservation Act 1999*, comprising:
  - 244 forest-dwelling vertebrate fauna
  - 983 forest-dwelling vascular flora.
- The most common of 11 specified threat categories for listed threatened forest-dwelling fauna and flora are: land-use change and/or forest loss, unsuitable fire regimes, predation and competition by introduced fauna and flora, small or localised population, and mortality agents.
- Forestry operations is the least commonly cited threat category for both fauna and flora, comprising 5% of total threats to threatened forest-dwelling fauna and 2% of total threats to threatened forest-dwelling flora.

- Threat categories for disease and/or pathogens and (especially) for climatic effects were substantially more prevalent for fauna and flora taxa listed between 2016 and 2021, compared to taxa listed prior to 2016.
- For all species listed for the first time between August 2016 and December 2021, forestry operations was not specified as a primary threat.

Protecting listed threatened forest-dwelling species and ecological communities

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Australian Government's principal environmental legislation. Among other things, it is designed to protect Australia's native species and ecological communities by providing for:
- listing of species and ecological communities that are threatened
- development of conservation advice and, where appropriate, recovery plans for listed species and ecological communities
- development of a register of critical habitat
- identification and listing of key threatening processes
- development of threat abatement plans to reduce the impacts of threatening processes where appropriate.

The listing of species, ecological communities and threatening processes is administered through a scientific assessment process undertaken by the Threatened Species Scientific Committee, an independent, statutory committee under the EPBC Act. Species listed as threatened can be listed in any one of the following EPBC Act categories: Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable, or Conservation Dependent. Ecological communities can be listed as threatened in any one of the following EPBC Act categories: Critically endangered, Endangered or Vulnerable.

After being listed under the EPBC Act, the recovery of a species or ecological community is promoted using a published Conservation Advice or, if deemed necessary, a Recovery Plan (collectively referred to here as conservation planning documents). Conservation Advice and Recovery Plans are statutory documents under the EPBC Act that provide guidelines for conservation planning, and identify management actions and research deemed necessary to prevent further decline and support the recovery of the threatened species or ecological community. Threat abatement plans for key threatening processes may also be developed to assist the long-term survival of threatened species and ecological communities in the wild. Furthermore, the Threatened Species Action Plan 2022-2032 provides a framework of action to protect and recover 110 priority threatened species (DCCEEW 2022).

Under the EPBC Act, a key threatening process is one that threatens or may threaten the survival, abundance or evolutionary development of a native species or ecological community. As at the end of December 2021, the EPBC Act listed 21 key threatening processes, 18 of which (86%) are directly relevant to forest-dwelling species and forest ecological communities (see Table 1.2b-10 in Supporting information for Indicator 1.2b). These are the same 18 key threatening processes listed in Criterion 1, Australia's State of the Forest Report 2018. A new key threatening process important for forest biodiversity, 'Fire regimes that cause declines in biodiversity', is in place effective from April 2022, and is therefore not included in this update of Indicator 1.2b. However, Indicator 1.2b has reported against the threat category of 'Unsuitable fire regimes' since 2008 (MIG 2008) (see Davey 2018 for a full description of the threat categories addressed in this Indicator).

All states and territories also maintain legislation to protect native species of fauna and flora. However, this Indicator only reports on species and communities that are listed under the EPBC Act. Forest-related legislation is reported in Indicator 7.1a.

Regional Forest Agreements (RFAs) are alternative (substitute) mechanisms for providing for protection of environmental values and matters of national environmental significance, including listed threatened species and ecological communities, in RFA regions. The agreements recognise that the states with RFAs provide for the protection of listed threatened species and communities in RFA regions through their forest management systems.

Threatened forest-dwelling species

As at 31 December 2021, there were 1,227 forest-dwelling species listed as threatened (Critically Endangered, Endangered, and Vulnerable) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), comprising 244 forest-dwelling vertebrate fauna and 983 forest-dwelling vascular flora (Table 1.2b-1).

These species lists were generated by intersecting the compilation of threatened species listed under the EPBC Act as at 31 December 2021 with forest-dwelling species lists from Indicator 1.2a (see Supporting information for Indicator 1.2b for methods). Forest-dwelling species listed as Extinct and Extinct in the Wild are not included in the analysis for this Indicator, and none of the eight species listed as Conservation Dependent are forest-dwelling.

The taxonomic groups containing the greatest number of listed forest-dwelling vertebrate fauna species are:
- mammals: 76 species, including iconic species such as koala (*Phascolarctos cinereus*) and Leadbeater's possum (*Gymnobelideus leadbeateri*)
- birds: 66 species, including Swift Parrot (*Lathamus discolor*) and Carnaby's Black-cockatoo (*Zanda latirostris*).

The threatened forest-dwelling vascular flora are predominantly angiosperms (flowering plants), with Orchidaceae (185 species) and Myrtaceae (128 species) the families with the greatest number of listed threatened species.

The Threatened species action plan 2022-2032 identifies 110 species for priority conservation actions.
- Of the 69 threatened priority vertebrate fauna, 49 (71%) are forest-dwelling, including koala, Swift Parrot, stocky galaxias (*Galaxias tantangara*), adorned delma (*Delma torquata*) and mountain frog (*Philoria kundagungan*).
- Of the 30 threatened priority vascular flora, 19 (63%) are forest-dwelling, including Wollemi pine (*Wollemia nobilis*), native guava (*Rhodomyrtus psidioides*), smooth davidsonia (*Davidsonia johnsonii*) and Bulberin nut tree (*Macadamia jansenii*).

Forest-dwelling species distributions were modelled against species indicative presence, capturing the habitat that represents observed locations of the species (known to occur) and habitat occurring in proximity to these locations (likely to occur) (Figures 1.2b-1 and 1.2b-2).

The modelled number of listed forest-dwelling fauna species per hectare of forest is highest in the coastal regions of eastern Australia, the Great Dividing Range, and the West Arnhem Land region of Northern Territory (Figure 1.2b-1).

The modelled number of listed forest-dwelling flora species per hectare of forest is highest in wetter coastal and hinterland areas in northern New South Wales, south-east Queensland and north Queensland (Figure 1.2b-2). These are all areas where species diversity is also high.

The number of threatened forest-dwelling fauna and flora species reported here is lower than that reported in [Indicator 1.2b in Australia's State of the Forest Report 2018](). This is because the list reported in this update excludes extinct species, species recorded only outside Australia's states and mainland territories and their close offshore islands, invertebrate fauna and non-vascular flora, and some species that were reassessed as not forest-dwelling.

Table 1.2b-1: Listed threatened native forest-dwelling species, by taxonomic group, as at December 2021

| Taxonomic group | Threatened (EPBC Act)[a] | | | | Not threatened[b] | All species[c] | Proportion of species that are threatened[b] |
	Critically Endangered	Endangered	Vulnerable	Total			
Fish	5	14	11	30	192	222	14%
Amphibians	17	8	14	39	162	201	19%
Reptiles	5	11	17	33	570	603	5%
Birds	7	33	26	66	454	520	13%
Mammals	6	32	38	76	166	242	31%
All vertebrate fauna	**40**	**98**	**106**	**244**	**1,544**	**1,788**	**14%**
Lycophytes	1	3	4	8	25	33	24%
Ferns	2	7	9	18	276	294	6%
Gymnosperms	1	8	9	18	72	90	20%
Angiosperms	127	361	451	939	12,432	13,371	7%
All vascular flora	**131**	**379**	**473**	**983**	**12,805**	**13,788**	**7%**
All species	**171**	**477**	**579**	**1,227**	**14,349**	**15,576**	
Proportion of all threatened forest-dwelling species	**14%**	**39%**	**47%**	**100%**			

[a] Threatened forest-dwelling species reported here include native forest-dwelling vertebrate fauna and vascular flora, including infraspecific taxa (subspecies, ecotypes, varieties and hybrids) listed as Critically Endangered, Endangered, or Vulnerable under the EPBC Act as at 31 December 2021. Invertebrate fauna and non-vascular flora were not considered for inclusion in the forest-dwelling species lists for both Indicators 1.2a and 1.2b.

[b] Figures are an approximation, noting that the forest-dwelling species list underpinning Indicator 1.2a (ABARES 2024) reports to species level only, while threatened forest-dwelling species included in this indicator contain species and infraspecific taxa consistent with the listing convention under the EPBC Act.

[c] Number of forest-dwelling species, at species level, as reported in [Indicator 1.2a]().

Lycophytes comprise clubmosses and quillworts.

Source: Australian Government Department of Climate Change, Energy, the Environment and Water (DCCEEW) Species Profile and Threats (SPRAT) Database; native forest-dwelling species underpinning Indicator 1.2a (ABARES 2024).

[Click here for a Microsoft Excel workbook of the data for Table 1.2b-1]().

Figure 1.2b-1: Modelled distribution of listed threatened forest-dwelling vertebrate fauna species
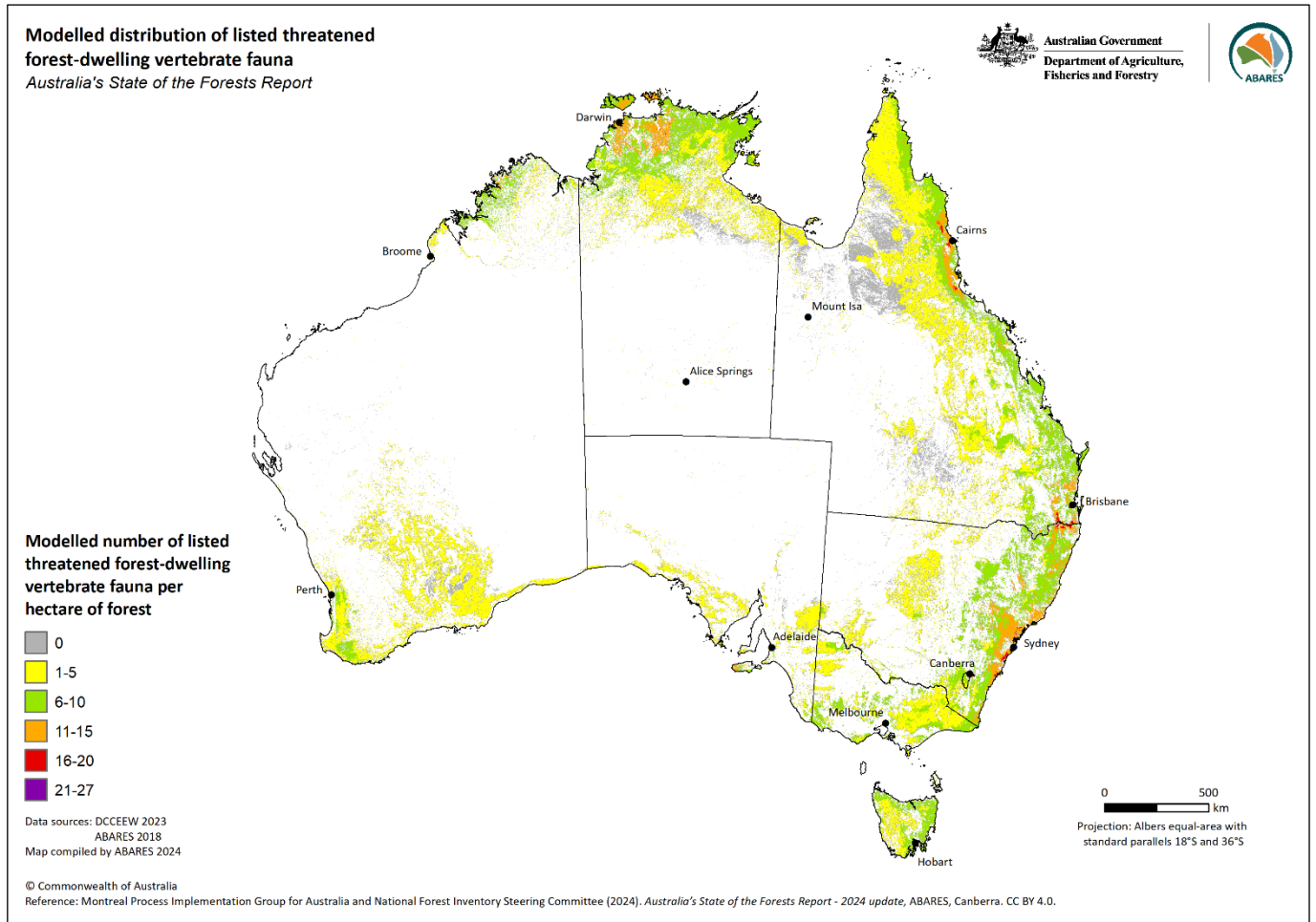
This map intersects the modelled potential extent (areas where species are known to occur plus areas where species are likely to occur) of threatened forest-dwelling vertebrate fauna listed under the EPBC Act, and the Forests of Australia (2018) dataset. Modelling was undertaken by the Australian Government Department of the Climate Change, Energy, the Environment and Water (DCCEEW).

Source: Australian Government Department of the Climate Change, Energy, the Environment and Water; ABARES (2018).

Click here for high-definition copy of Figure 1.2b-1.

Figure 1.2b-2: Modelled distribution of listed threatened forest-dwelling vascular flora species
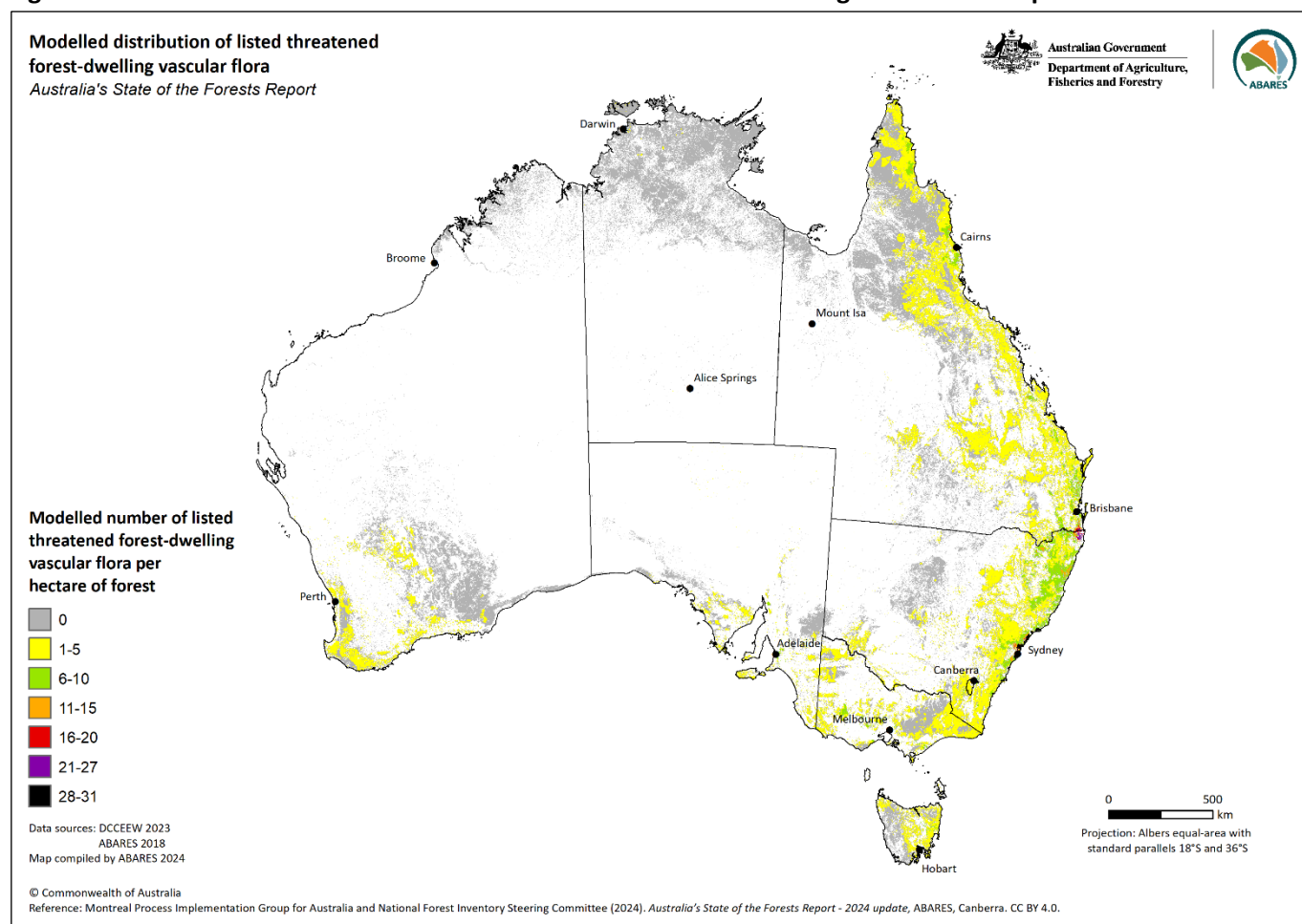
This map intersects the modelled potential extent (areas where species are known to occur plus areas where species are likely to occur) of threatened forest-dwelling vascular flora listed under the EPBC Act, and the Forests of Australia (2018) dataset. Modelling was undertaken by the Australian Government Department of the Climate Change, Energy, the Environment and Water (DCCEEW).
Source: Australian Government Department of the Climate Change, Energy, the Environment and Water; ABARES (2018).
Click here for high-definition copy of Figure 1.2b-2.

The full list of threatened forest-dwelling vertebrate fauna and vascular flora, including priority threatened forest-dwelling species, is available for download from forest species and ecological communities data.

Changes in the conservation status of threatened forest-dwelling species

During the current reporting period (August 2016 to December 2021), a number of forest-dwelling species were listed for the first time, transferred between categories, delisted, and/or had their conservation documents updated, as follows:

- 99 forest-dwelling species (31 vertebrate fauna and 68 vascular flora) were added to the national list of threatened species (Table 1.2b-2)
- 13 forest-dwelling species (6 vertebrate fauna and 7 vascular flora) were removed (delisted) from the national list of threatened species
- 6 forest-dwelling vertebrate fauna (all mammals) were listed as Extinct, noting that extinctions likely occurred around the early 1900s (no vascular flora were listed as Extinct)

- 31 forest-dwelling species (19 vertebrate fauna and 12 vascular flora) were uplisted
- 7 forest-dwelling vertebrate fauna were downlisted (no forest-dwelling vascular flora were downlisted).

Most of the vertebrate fauna listed between August 2016 to December 2021 were listed as Endangered (45%), while most of the vascular flora listed in this same period were listed as Critically Endangered (54%) (Table 1.2b-2).

Table 1.2b-2: Threatened forest-dwelling species added to the threatened species list between August 2016 and December 2021, by taxonomic group

Taxonomic group	Conservation status (EPBC Act)			
	Critically Endangered	Endangered	Vulnerable	Total
Fish	1	3	1	5
Amphibians	6	5	1	12
Reptiles	1	0	0	1
Birds	0	4	5	9
Mammals	0	2	2	4
All vertebrate fauna	**8**	**14**	**9**	**31**
Lycophytes	0	0	0	0
Ferns	1	0	0	1
Gymnosperms	0	0	0	0
Angiosperms	36	25	6	67
All vascular flora	**37**	**25**	**6**	**68**
All forest-dwelling taxa	**45**	**39**	**15**	**99**
Proportion of all threatened forest-dwelling taxa	**45%**	**39%**	**15%**	**100%**

This table reports native forest-dwelling vertebrate fauna and vascular flora listed as threatened (Critically Endangered, Endangered, Vulnerable) under the EPBC Act that were initially listed between August 2016 to December 2021.

Lycophytes comprise clubmosses and quillworts.

Source: Australian Government Department of Climate Change, Energy, the Environment and Water (DCCEEW) Species Profile and Threats (SPRAT) Database; forest-dwelling species list underpinning Indicator 1.2a (ABARES 2024).

Click here for a Microsoft Excel workbook of the data for Table 1.2b-2.

Of the 31 newly listed fauna, one species, the western trout minnow (*Galaxias truttaceus*) (Western Australian population) was initially listed as Critically Endangered in 2018 but subsequently downlisted to Endangered in 2019.

During the period August 2016 to December 2021, six forest-dwelling mammal species were listed as Extinct under the EPBC Act, however, these six species are presumed to have become extinct around the early 1900s due to habitat loss and fragmentation, change in fire regimes, and predation by introduced animals following European settlement in Australia. These species are Capricorn rabbit-rat (*Conilurus capricornensis*), marl (*Perameles myosurus*), south-eastern striped bandicoot (*Perameles notina*), long-eared mouse (*Pseudomys auritus*), blue-grey mouse (*Pseudomys glaucus*), and Percy Island flying-fox (*Pteropus brunneus*). During this period, no forest-dwelling species listed as Extinct were transferred to Critically Endangered, Endangered or Vulnerable category.

As new information on population status, threats and management scenarios for a threatened species become available, the conservation planning documents and conservation status of the species can be reviewed and updated accordingly. Between August 2016 to December 2021, conservation planning documents were updated for 72 forest-dwelling vertebrate fauna originally listed before August 2016. The conservation status of 26 of these species were also updated (19 were uplisted and 7 were downlisted). In the same period, conservation

planning documents for 133 forest-dwelling vascular flora originally listed before August 2016 were updated, and the conservation status of 12 of these species were updated (all 12 were uplisted). See Figures 1.2b-4 and 1.2b-5 in Supporting information for Indicator 1.2b.

These changes are reflected in the list of forest-dwelling species available for download from forest species and ecological communities data.

Threats to threatened forest-dwelling species

The threats to individual threatened forest-dwelling fauna and flora were categorised into 11 threat categories, with threats being classified as primary, secondary or tertiary (see Supporting information for Indicator 1.2b for methods).

The threats most commonly cited in the conservation planning documents for listed threatened forest-dwelling fauna are land-use change and/or forest loss, unsuitable fire regimes, predation by introduced fauna, small or localised population, indirect invasive species impacts, and mortality agents (Table 1.2b-3). Each of these threat categories was identified for more than half the threatened forest-dwelling fauna species, and together they comprised 69% of total threats.

Similarly, the most common threat categories for listed threatened forest-dwelling flora are small or localised population, unsuitable fire regime, mortality agents, competition from introduced flora, land-use change and/or forest loss, and predation and grazing (Table 1.2b-3). Each of these threat categories was identified for half or more of the threatened forest-dwelling flora species, and together they comprised 78% of total threats.

Table 1.2b-3: Threat categories and threat ratings for threatened forest-dwelling species, as at December 2021

Threat category	Number of species with a threat in that category				Proportion of species with a threat in that category	Proportion of total threats
	Primary threat	Secondary threat	Tertiary threat	Total		
Vertebrate fauna						
Land-use change and/or forest loss	144	26	10	180	74%	14%
Unsuitable fire regime	85	52	13	150	61%	12%
Predation by introduced fauna	68	49	28	145	59%	11%
Small or localised population	79	49	17	145	59%	11%
Indirect invasive species impacts	56	68	16	140	57%	11%
Mortality agents	52	54	21	127	52%	10%
Climatic effects	57	44	17	118	48%	9%
Competition from introduced fauna	28	41	9	78	32%	6%
Disease and/or pathogens	25	20	28	73	30%	6%
Hydrological change	41	23	10	74	30%	6%
Forestry operations	22	23	13	58	24%	5%
Vascular flora						
Small or localised population	485	152	81	711	72%	15%
Unsuitable fire regime	391	250	53	694	71%	15%
Mortality agents	419	201	31	651	66%	14%
Competition from introduced flora	389	152	31	572	58%	12%
Land-use change and/or forest loss	425	123	15	563	57%	12%
Predation and grazing	335	128	26	489	50%	10%
Indirect invasive species impacts	251	136	15	402	41%	9%
Hydrological change	92	68	18	178	18%	4%
Disease and/or pathogens	58	80	25	163	17%	3%
Climatic effects	49	71	28	148	15%	3%
Forestry operations	54	40	22	116	12%	2%

Data are for forest-dwelling species listed as threatened under the EPBC Act as at 31 December 2021.

Threats in up to six separate categories were included for each species; the total number of threat categories containing threats is thus larger than the total number of threatened species. Detailed description of threat categories can be found in Davey (2018), with modifications (see Supporting Information for Indicator 1.2b).

Assessments of threats were based on available conservation planning documents (conservation advice, recovery plans and/or listing advice). Classification of threats into primary, secondary and tertiary threats is based on the emphasis given in the documents and on the assessed likelihood and consequence of each threat (Davey 2018).

Source: Australian Government Department of Climate Change, Energy, the Environment and Water (DCCEEW) Species Profile and Threats (SPRAT) Database, with threats categorised by ABARES; species as on Table 1.2b-1.

Click here for a Microsoft Excel workbook of the data for Table 1.2b-3.

Forestry operations is the least commonly cited threat category for both fauna and flora, comprising 5% of total threats to threatened forest-dwelling fauna and 2% of total threats to threatened forest-dwelling flora (Table 1.2b-3). Forestry operations is specified as a primary threat for 22 threatened fauna and 54 threatened flora, which comprise 6% of all threatened forest-dwelling species. This is consistent with other work that shows that other threat categories, including invasive species, unsuitable fire regimes, and habitat loss and fragmentation for agriculture and urban development, are more commonly cited threats to threatened species than forestry operations (Venn 2023; Ward et al. 2021). For all species listed for the first time between August 2016 and December 2021, forestry operations was not specified as a primary threat for any of these species but was

specified as a secondary or tertiary threat for six flora species, and as a threat of lesser importance for one fauna species.

Over time, there has been a shift in the most common threat categories for listed threatened forest-dwelling fauna, and to a lesser extent listed threatened forest-dwelling flora. The increase in proportion of threatened species with threats in the climatic effects threat category is most notable. Possible drivers for this observation include increasing direct threats from climate change, increasing awareness of existing threats from climate change, and increasing knowledge of species biology.

For forest-dwelling fauna:
- climatic effects are specified as a threat category for 26 of 31 species (84%) listed between August 2016 and December 2021, a substantial proportional increase compared to 92 of 213 species (43%) listed prior to 2016
- threats due to disease and/or pathogens, and hydrological change (16 and 14 of 31 species; 52% and 45%, respectively), are also more commonly cited for fauna listed between August 2016 and December 2021, compared to 57 and 60 of 213 species (27% and 28%, respectively) listed prior to this period
- threats due to mortality agents (factors that contribute to the death of individuals), and predation by introduced fauna (10 and 14 of 31 species: 32% and 45%, respectively) are less cited for fauna listed between August 2016 and December 2021, compared to 117 and 131 of 213 species (54% and 62%, respectively) listed prior to this period (Tables 1.2b-6 and 1.2b-7 in Supporting information for Indicator 1.2b).

For forest-dwelling flora:
- climatic effects is specified as a threat category for 32 of 68 species (47%) listed between August 2016 and December 2021, a substantial proportional increase compared to 116 of 915 species (13%) listed prior to this period
- disease and/or pathogens became a more commonly cited threat for flora listed between August 2016 and December 2021 (17 of 68 taxa, 25%) compared to species listed prior to this period (146 of 915, 16%)
- small or localised population was more commonly cited as a threat for species listed between August 2016 and December 2021 (59 of 68 species, 87%), compared to those listed prior to this period (652 of 915 species, 71%).

Threatened forest ecological communities

As at December 2021, 57 forest ecological communities were listed as threatened under the EPBC Act (Table 1.2b-4), which is 62% of the total number of threatened ecological communities (forest and non-forest communities). Of the 57 listed forest ecological communities, 33 are Critically Endangered, 23 are Endangered and 1 is Vulnerable.

Between August 2016 to December 2021, 15 forest ecological communities were listed for the first time. In the same period, conservation planning documents were updated for 7 threatened forest ecological communities originally listed before August 2016, with 1 forest ecological community uplisted from Endangered to Critically Endangered. No threatened forest ecological communities were delisted during this period (Figure 1.2b-6 in the Supporting information for Indicator 1.2b).

Most threatened forest ecological communities occur in New South Wales (34), Queensland (16), Victoria (11) and Western Australia (10) (Table 1.2b-4). The distribution of threatened forest ecological communities was modelled against the indicative presence categories capturing the habitat that represents observed locations of

the ecological communities (known to occur) and habitat occurring in proximity to these locations (likely to occur) across the country. The modelled number of threatened forest ecological communities per hectare of forest is highest in central New South Wales (Figure 1.2b-3).

Table 1.2b-4: Number of forest ecological communities listed as threatened under the EPBC Act by jurisdiction as at December 2021

Jurisdiction	Critically Endangered	Endangered	Vulnerable	Total
ACT	1	0	0	1
NSW	22	12	0	34
NT	0	1	0	1
Qld	6	10	0	16
SA	3	14	0	7
Tas.	2	0	1	3
Vic.	7	4	0	11
WA	3	8	0	10
Australia	**33**	**23**	**1**	**57**

Allocation as a forest ecological community is based on information in conservation planning documents (conservation advice, recovery plans, and/or listing advice).

Individual listed ecological communities can occur in more than one state or territory, so the figures for Australia are not the sum of the figures for individual jurisdictions.

Source: Australian Government Department of Climate Change, Energy, the Environment and Water (DCCEEW) Species Profile and Threats (SPRAT) Database.

Click here for a Microsoft Excel workbook of the data for Table 1.2b-4.

Figure 1.2b-3: Modelled distribution of listed threatened forest ecological communities
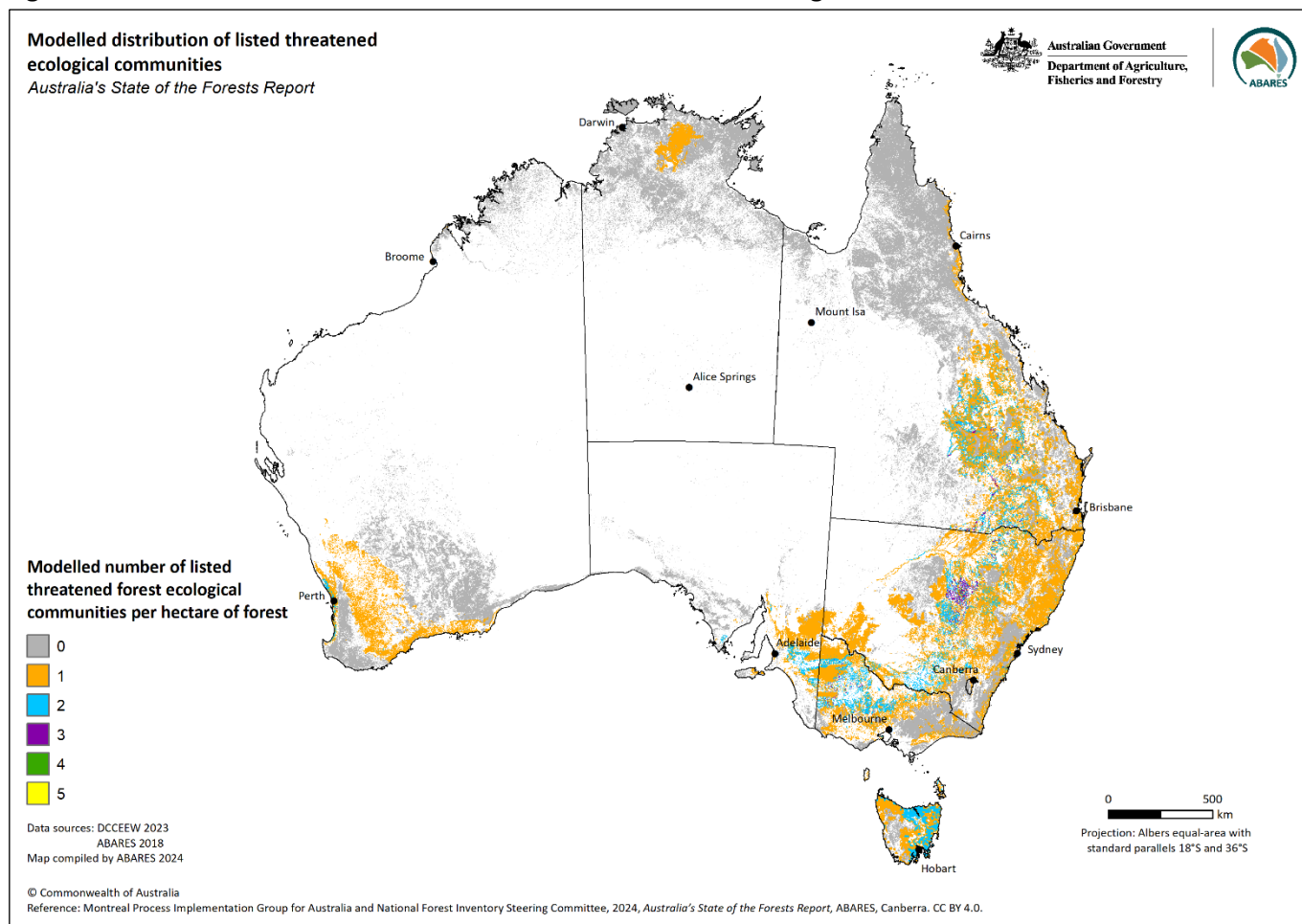
This map intersects the modelled potential extent of threatened forest ecological communities listed under the EPBC Act (areas known to occur plus areas likely to occur), and the Forests of Australia (2018) dataset. Modelling was undertaken by the Australian Government Department of the Climate Change, Energy, the Environment and Water (DCCEEW).

Source: DCCEEW; ABARES (2018).

Click here for high-definition copy of Figure 1.2b-1.

The number of forest ecological communities listed as threatened by jurisdiction and by listing period is presented in Table 1.2b-8 in Supporting information for Indicator 1.2b. The full list of threatened forest ecological communities is available for download from forest species and ecological communities data.

Threats to threatened forest ecological communities

The most commonly cited threat categories in the conservation planning documents to the 57 listed threatened forest ecological communities are weeds, fragmentation, forest loss for agriculture, small remnant size, fire pressures, and grazing pressure (Table 1.2b-5).

The threats to forest ecological communities have changed over time. For example, of the 15 forest ecological communities listed between August 2016 and December 2021:

- 14 (93%) are threatened by climatic impacts, compared to 31 of the 42 (74%) threatened forest ecological communities listed prior to August 2016

- all 15 (100%) are threatened by forest loss due to urbanisation, compared to 22 of the 42 (52%) listed prior to August 2016 (Table 1.2b-9 in Supporting information for Indicator 1.2b).

In addition, the threats of loss of ecological function, human pressures, isolation/disconnection, hydrological change, disease and forest loss due to mining are more commonly cited between August 2016 and December 2021 compared to those listed prior to August 2016 (Table 1.2b-9 in Supporting information for Indicator 1.2b).

Forestry operations is the equal-least cited threat to forest ecological communities listed between August 2016 and December 2021, although it is more commonly cited in this period than previously (Table 1.2b-9 in Supporting information for Indicator 1.2b).

Table 1.2b-5: Threats to listed threatened forest ecological communities, as at December 2021

Threat category	Number of communities with a threat in that category	Proportion of communities with a threat in that category	Proportion of total threats
Weeds	57	100%	8%
Fragmentation	56	98%	8%
Forest loss – agriculture	54	95%	8%
Small remnants	54	95%	8%
Fire pressures	53	93%	8%
Grazing pressures	53	93%	8%
Loss of ecological function	48	84%	7%
Human pressures	47	82%	7%
Climatic impacts	45	79%	6%
Feral animals	42	74%	6%
Isolation – disconnection	41	72%	6%
Hydrological change	41	72%	6%
Forest loss – urbanisation	37	65%	5%
Disease	33	58%	5%
Forestry operations	20	35%	3%
Forest loss – mining	16	28%	2%

Data are for forest ecological communities listed as threatened under the EPBC Act as at 31 December 2021, and their total threats specified in conservation planning documents (conservation advice, recovery plans, and/or listing advice).

Source: Australian Government Department of Climate Change, Energy, the Environment and Water (DCCEEW) Species Profile and Threats (SPRAT) Database.

Click here for a Microsoft Excel workbook of the data for Table 1.2b-5.

Supporting information for Indicator 1.2b: The status of forest dwelling species at risk of not maintaining viable breeding populations, as determined by legislation or scientific assessment

Compiling the list of threatened forest-dwelling species and ecological communities

The threatened forest-dwelling species lists presented in this Indicator were derived by intersecting the forest-dwelling species lists developed for Indicator 1.2a with the compilation of threatened species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as at December 2021 (as provided through the Species Profile and Threats (SPRAT) Database).

The species list in Indicator 1.2a contains forest-dwelling vertebrate fauna and vascular flora with distribution within National Forest Inventory (NFI) boundaries, and at species level only, while the EPBC Act threatened list considers infraspecific taxa (i.e. below species level including subspecies, ecotypes, varieties, or hybrids) with distribution not limited by NFI boundaries. Thus, compilation of threatened forest-dwelling species was extended to consider the following:

- Inclusion of forest-dwelling vertebrate fauna and vascular flora separately listed under the EPBC Act as infraspecific taxa. In such cases, habitat requirements for the specific taxa were examined and the infraspecific taxon retained as forest-dwelling only if its habitat requirements include forests.
- Inclusion of threatened vertebrate fauna and vascular flora assessed as inhabiting forests but that do not have sufficient Atlas of Living Australia records to have been classified as forest-dwelling for Indicator 1.2a, for example through rarity.
- Inclusion of forest-dwelling species with names not (or not yet) accepted by the Australian Plant Census or Australian Faunal Directory, and duplicates listed separately as threatened taxa.
- Exclusion of threatened forest-dwelling species found exclusively outside NFI boundaries (taxa found exclusively on external territories such as Norfolk Island, Lord Howe Island, Christmas Island, and Cocos (Keeling) Islands).

The resultant list of threatened forest-dwelling species contained 244 threatened vertebrate fauna and 983 threatened flora, and is available for download from forest species and ecological communities data.

The threatened forest ecological communities list was developed by examining the conservation planning documents (conservation advice and/or recovery plans) of the 94 threatened ecological communities listed as at December 2021, as provided through the SPRAT database. Of these, 57 are forest ecological communities.

Assessment and categorisation of threats to forest-dwelling species and forest ecological communities

Threats relating to listed threatened forest-dwelling fauna and flora were assessed and categorised from information in available conservation planning documents (conservation advice and/or recovery plans) and listing advice.

Threats were grouped into threat categories following Davey (2018) and Australia's State of the Forest Report 2018, with one exception. The 'Invasive species' category previously used solely for threats from invasive species specified as key threatening processes under the EPBC Act was not maintained. Instead, a new threat category of 'Indirect invasive species impacts' was created for threats other than competition and predation: examples are toxic ingestion of cane toads, trampling of riparian habitat by feral pigs, fouling of rock habitat by feral goats, and invasive weeds that can change floristic composition, habitat structure and flammability.

Threats in up to six threat categories were allocated for each forest-dwelling species, using the six greatest threats if a species had threats in more than six categories. Analysis on threats and determination of ranks are

based on the information described in the conservation planning documents. Threats were ranked as primary, secondary or tertiary based on the impact and likelihood (Davey 2018). Primary threats refer to known (certain and most likely) threats with major and extreme impacts. Secondary threats refer to known threats with moderate impacts or to threats that are likely to occur but when they do occur, they do not have major or extreme impacts on the species. Tertiary threats refer to threats with minor impacts or with low likelihood to occur. Evidence description of threats, emphasis of threats and other threat parameters available from conservation planning documents such as timing (current, future, past threats), confidence (observed, suspected, or inferred), trend (decreasing, static, or increasing), and extent (occurs across the entire range or only part of the range) were also used to guide the determination of the threat rank.

Threats to ecological communities were also assessed based on information in conservation planning documents. Threats for ecological communities were not analysed by rank (primary, secondary, tertiary). Unlike for species threat assessments, all threats specified for ecological communities were included in the calculation of total threats.

Information on threats is presented for three listing periods to identify changes in the main threats to species:
- all threatened forest-dwelling species listed as either Critically Endangered, Endangered or Vulnerable, as at December 2021
- recently listed forest-dwelling species, being species with a date of first listing between August 2016 and December 2021
- forest-dwelling species initially listed prior to August 2016.

The data are not directly comparable to data presented in *Australia's State of the Forests Report 2018* because of changes in the treatment of extinct species, species on external territories outside the National Forest Inventory boundaries, and some species now assessed as not inhabiting forest. Thus, to facilitate comparison of threats overtime, a completely new threat analysis was conducted for all threatened species listed as at December 2021. The new analysis was undertaken to filter out species not meeting the current definition of forest-dwelling species, addressing the revision of one threat category (Indirect invasive species impacts), as well as to eliminate assessors' differences in assigning threat categories and ranking. This approach has allowed for a more robust comparative analysis to determine whether the main threats (reasons for species listing) during the current reporting period (August 2016 to December 2021) differ from for species listed between July 2000 to August 2016.

Changes in conservation planning documents and conservation status

Changes to conservation planning documents and conservation status for the threatened forest-dwelling species and forest ecological communities between August 2016 and December 2021 are summarised in Figures 1.2b-4, 1.2b-5 and 1.2b-6.

Figure 1.2b-4: Change in the conservation status of threatened forest-dwelling fauna between August 2016 and December 2021
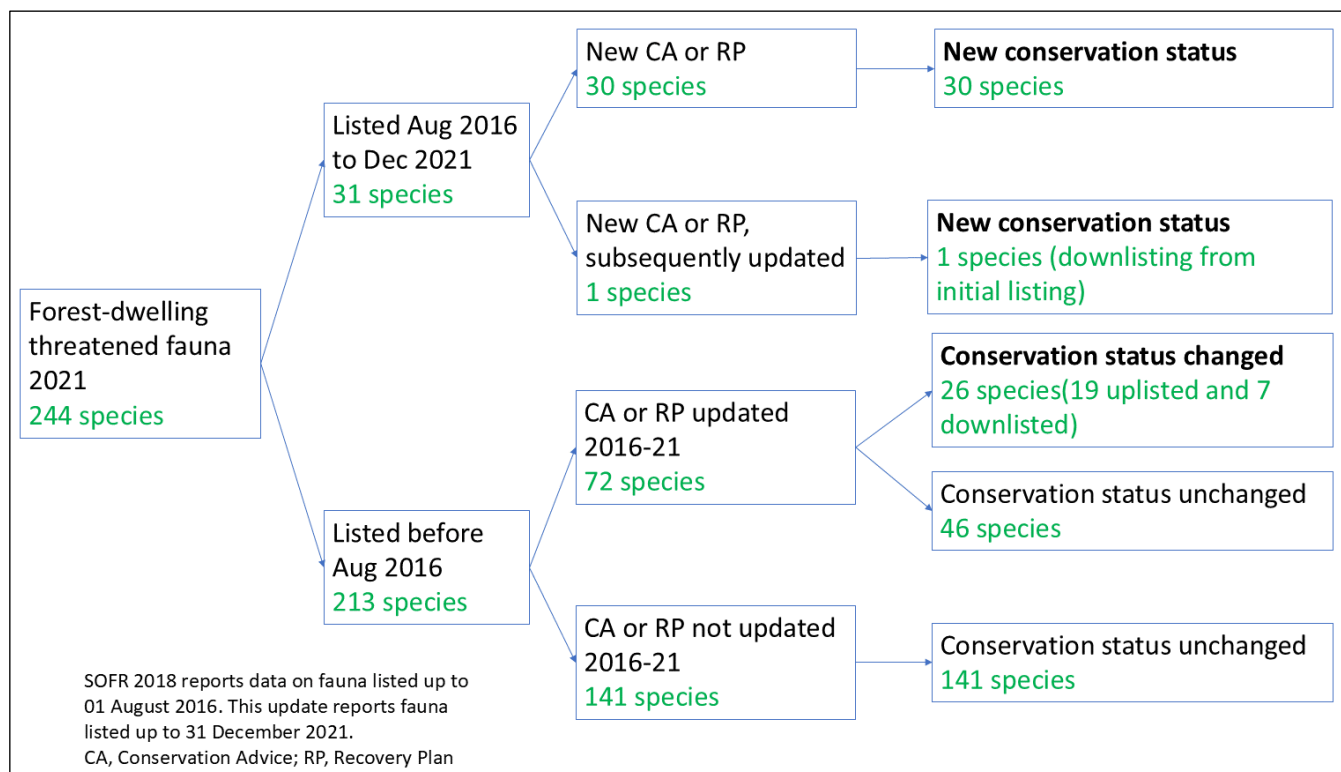
```
Forest-dwelling            Listed Aug 2016        New CA or RP              New conservation status
threatened fauna           to Dec 2021            30 species               30 species
2021                       31 species
244 species                                       New CA or RP,            New conservation status
                                                  subsequently updated     1 species (downlisting from
                                                  1 species                initial listing)

                           Listed before          CA or RP updated         Conservation status changed
                           Aug 2016               2016-21                  26 species(19 uplisted and 7
                           213 species            72 species               downlisted)

                                                                           Conservation status unchanged
                                                                           46 species

                           CA or RP not updated                            Conservation status unchanged
                           2016-21                                         141 species
                           141 species
```

SOFR 2018 reports data on fauna listed up to 01 August 2016. This update reports fauna listed up to 31 December 2021.
CA, Conservation Advice; RP, Recovery Plan

Figure 1.2b-5: Change in the conservation status of threatened forest-dwelling flora between August 2016 and December 2021

```
Forest-dwelling            Listed Aug 2016        New CA or RP              New conservation status
threatened flora           to Dec 2021            68 species               68 species
2021                       68 species
983 species
                                                  CA or RP updated         Conservation status changed
                           Listed before          2016-21                  12 species(all uplisted)
                           Aug 2016               133 species
                           915 species                                     Conservation status unchanged
                                                                           121 species

                                                  CA or RP not updated     Conservation status unchanged
                                                  2016-21                  782 species
                                                  782 species
```

SOFR 2018 reports data on flora listed up to 01 August 2016. This update reports flora listed up to 31 December 2021.
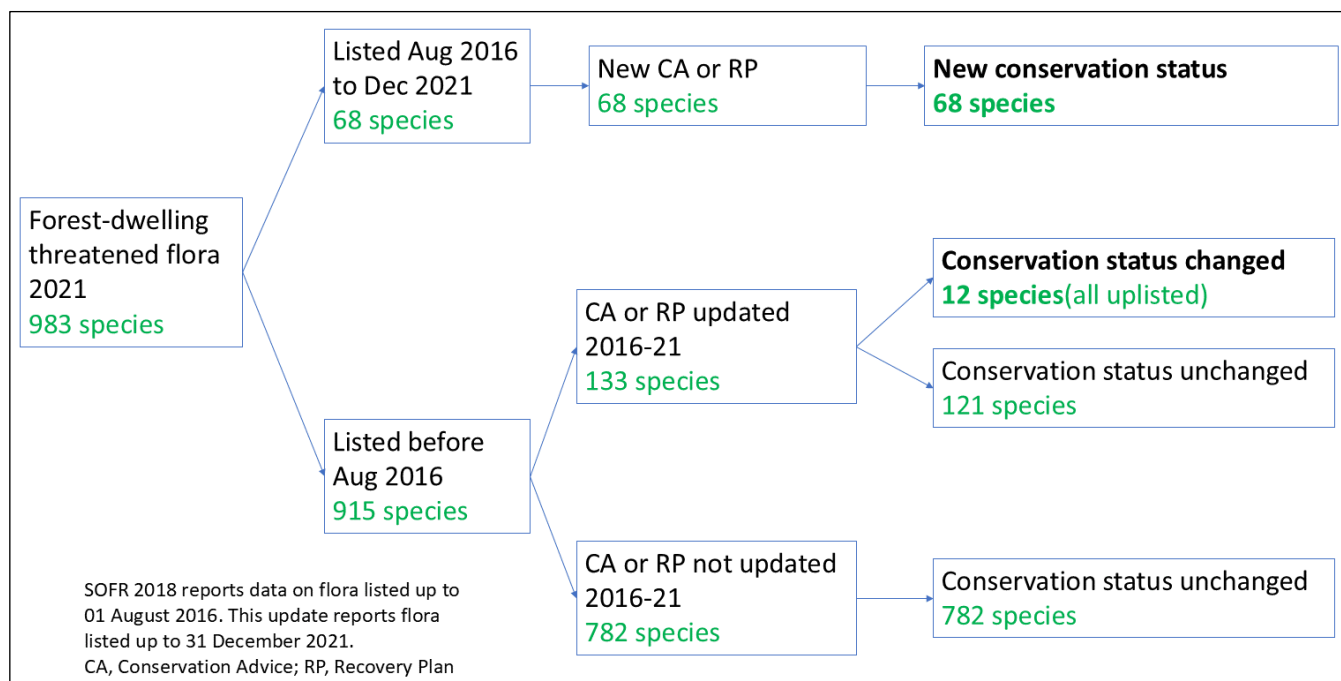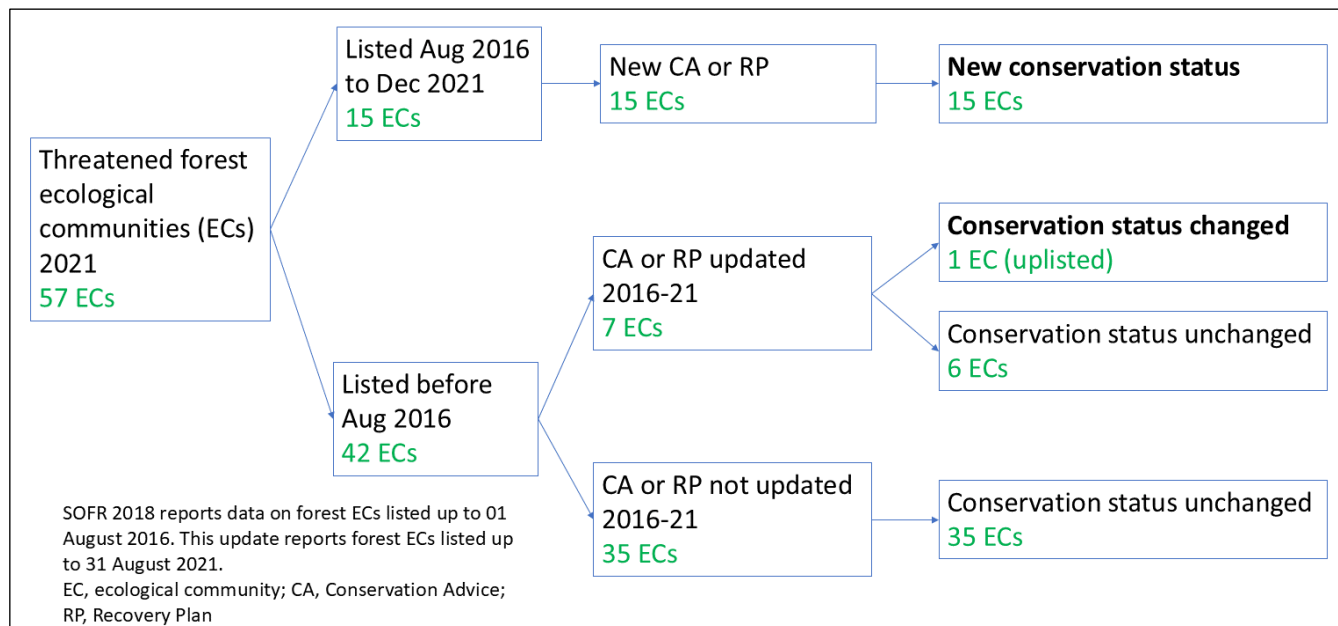CA, Conservation Advice; RP, Recovery Plan

Figure 1.2b-6: Change in the conservation status of threatened forest ecological communities between August 2016 and December 2021

Threatened forest ecological communities (ECs) 2021
57 ECs

Listed Aug 2016 to Dec 2021
15 ECs

New CA or RP
15 ECs

New conservation status
15 ECs

Listed before Aug 2016
42 ECs

CA or RP updated 2016-21
7 ECs

Conservation status changed
1 EC (uplisted)

Conservation status unchanged
6 ECs

CA or RP not updated 2016-21
35 ECs

Conservation status unchanged
35 ECs

SOFR 2018 reports data on forest ECs listed up to 01 August 2016. This update reports forest ECs listed up to 31 August 2021.
EC, ecological community; CA, Conservation Advice; RP, Recovery Plan

Threat categories for forest-dwelling species and forest ecological communities over time

The analysis of threat categories by listing period is aimed at identifying changes of threats over time which can be useful to inform decision making in forest management and biodiversity conservation.

Tables that summarise threats for all threatened forest-dwelling species and ecological communities listed as at December 2021 are presented in the Key information for Indicator 1.2b (Table 1.2b-3 and Table 1.2b-5). Information on threats differentiated by listing period (listing between July 2000 and August 2016; and listing between August 2016 to December 2021) are presented here.

Table 1.2b-6: Threat categories and threat ratings for forest-dwelling threatened species initially listed between July 2000 and August 2016

Threat category	Number of species with a threat in that category				Proportion of species with a threat in that category	Proportion of total threats
	Primary threat	Secondary threat	Tertiary threat	Total		
Vertebrate fauna						
Land-use change and/or forest loss	137	20	4	161	76%	14%
Unsuitable fire regime	71	48	12	131	62%	12%
Predation by introduced fauna	64	41	26	131	62%	12%
Small or localised population	64	48	14	126	59%	11%
Indirect invasive species impacts	55	53	12	120	56%	11%
Mortality agents	47	52	18	117	54%	10%
Climatic effects	39	37	16	92	43%	8%
Competition from introduced fauna	24	41	9	74	35%	7%
Forestry operations	22	23	13	58	28%	5%
Hydrological change	35	15	10	60	28%	5%
Disease and/or pathogens	23	18	16	57	27%	5%
Vascular flora						
Small or localised population	443	146	63	652	71%	15%
Unsuitable fire regime	360	238	46	644	70%	15%
Mortality agents	398	185	27	610	67%	14%
Competition from introduced flora	366	139	25	530	58%	12%
Land-use change and/or forest loss	404	115	10	529	58%	12%
Predation and grazing	316	112	23	451	49%	10%
Invasive species impacts	237	132	14	383	42%	9%
Hydrological change	87	62	16	165	18%	4%
Disease and/or pathogens	52	74	20	146	16%	3%
Climatic effects	35	57	24	116	13%	3%
Forestry operations	54	37	19	110	12%	3%

Data are for forest-dwelling species listed as threatened under the EPBC Act as at 31 December 2021 that were initially listed between July 2000 and August 2016.

Threats in up to six separate categories were included for each species; the total number of threat categories containing threats is thus larger than the total number of threatened species. Detailed description of threat categories can be found in Davey (2018), with modifications.

Assessments of threats were based on available conservation planning documents (conservation advice, recovery plans, and/or listing advice). Classification of threats into primary, secondary and tertiary threats is based on the emphasis given in the documents and on the assessed likelihood and consequence of each threat (Davey 2018).

Source: Australian Government Department of Climate Change, Energy, the Environment and Water (DCCEEW) Species Profile and Threats (SPRAT) Database, with threats categorised by ABARES; species as on Table 1.2b-1.

Click here for a Microsoft Excel workbook of the data for Table 1.2b-6.

Table 1.2b-7: Threat categories and threat ratings for forest-dwelling threatened species initially listed between August 2016 and December 2021

| Threat category | Number of species with a threat in that category | | | | Proportion of species with a threat in that category | Proportion of total threats |
	Primary threat	Secondary threat	Tertiary threat	Total		
Vertebrate fauna						
Climatic effects	18	7	1	26	84%	16%
Small or localised population	15	1	3	19	61%	12%
Indirect invasive species impacts	1	15	4	20	65%	12%
Land-use change and/or forest loss	7	6	6	19	61%	12%
Unsuitable fire regime	14	4	1	19	61%	12%
Disease and/or pathogens	2	2	12	16	52%	10%
Predation by introduced fauna	4	8	2	14	45%	9%
Hydrological change	6	8	0	14	45%	9%
Mortality agents	5	2	3	10	32%	6%
Competition from introduced fauna	4	0	0	4	13%	2%
Forestry operations	0	0	0	0	0%	0%
Vascular flora						
Small or localised population	42	7	10	59	87%	17%
Unsuitable fire regime	31	12	7	50	74%	14%
Competition from introduced flora	23	13	6	42	62%	12%
Mortality agents	21	16	4	41	60%	12%
Predation and grazing	19	16	3	38	56%	11%
Land-use change and/or forest loss	21	8	5	34	50%	10%
Climatic effects	14	14	4	32	47%	9%
Indirect invasive species impacts	14	4	1	19	28%	5%
Hydrological change	5	6	2	13	19%	4%
Disease and/or pathogens	6	6	5	17	25%	5%
Forestry operations	0	3	3	6	9%	2%

Data are for forest-dwelling species listed as threatened under the EPBC Act as at 31 December 2021 that were initially listed between August 2016 and December 2021.

Threats in up to six separate categories were included for each species; the total number of threat categories containing threats is thus larger than the total number of threatened species. Detailed description of threat categories can be found in Davey (2018), with modifications.

Assessments of threats were based on available conservation planning documents (conservation advice, recovery plans, and/or listing advice). Classification of threats into primary, secondary and tertiary threats is based on the emphasis given in the documents and on the assessed likelihood and consequence of each threat (Davey 2018).

Source: Australian Government Department of Climate Change, Energy, the Environment and Water (DCCEEW) Species Profile and Threats (SPRAT) Database, with threats categorised by ABARES; species as on Table 1.2b-1.

Click here for a Microsoft Excel workbook of the data for Table 1.2b-7.

Table 1.2b-8: Number of forest ecological communities listed as threatened under the EPBC Act, by jurisdiction and by listing period

Jurisdiction	Critically Endangered			Endangered			Vulnerable			Total		
	2000-16	2016-21	2000-21	2000-16	2016-21	2000-21	2000-16	2016-21	2000-21	2000-16	2016-21	2000-21
ACT	1	0	1	0	0	0	0	0	0	1	0	1
NSW	16	6	22	8*	4	12	0	0	0	24*	10	34
NT	0	0	0	1	0	1	0	0	0	0	0	1
Qld	6	0	6	6	4	10	0	0	0	12	4	16
SA	2	1	3	3	1	14	0	0	0	5	2	7
Tas.	0	2	2	0	0	0	1	0	1	1	2	3
Vic.	5	2	7	3	1	4	0	0	0	8	3	11
WA	2*	1	3	6*	1	8	0	0	0	3*	8	10

* Correction to numbers misreported in *Australia's State of the Forest Report 2018*. Shale/Sandstone Transition Forest was removed from listed threatened ecological communities in 2014 but was included in *Australia's State of the Forest Report 2018*; and 2 threatened forest ecological communities (Clay Pans of the Swan Coastal Plain – Critically Endangered, and Shrublands and Woodlands of the eastern Swan Coastal Plain – Endangered) were not included.

Includes all threatened forest ecological communities listed as at 31 December 2021. Allocation as a forest ecological community is based on distribution information in the conservation planning documents (conservation advice, recovery plans, and/or listing advice) for each ecological community.

Individual listed ecological communities can occur in one or more state or territory, so the totals for Australia are not the sum of the totals for individual jurisdictions.

Source: Australian Government Department of Climate Change, Energy, the Environment and Water (DCCEEW) Species Profile and Threats (SPRAT) Database.

Click here for a Microsoft Excel workbook of the data for Table 1.2b-8.

Table 1.2b-9: Threats to threatened forest ecological communities by listing period, July 2000 to July 2016 and August 2016 to December 2021

Threat category	Number of communities with a threat in that category	Proportion of communities with a threat in that category	Proportion of total threats	Number of communities with a threat in that category	Proportion of communities with a threat in that category	Proportion of total threats
	2000-2016			2016-2021		
Weeds	42	100%	9%	15	100%	7%
Fragmentation	41	98%	8%	15	100%	7%
Forest loss – agriculture	39	93%	8%	15	100%	7%
Small remnants	39	93%	8%	15	100%	7%
Fire pressures	38	90%	8%	15	100%	7%
Grazing pressures	38	90%	8%	15	100%	7%
Loss of ecological function	33	79%	7%	15	100%	7%
Human pressures	32	76%	7%	15	100%	7%
Climatic impacts	31	74%	6%	14	93%	7%
Feral animals	31	74%	6%	11	73%	5%
Isolation – disconnection	28	67%	6%	13	87%	6%
Hydrological change	28	67%	6%	13	87%	6%
Forest loss – urbanisation	22	52%	5%	15	100%	7%
Disease	23	55%	5%	11	73%	5%
Forestry operations	13	31%	3%	7	47%	3%
Forest loss – mining	9	21%	2%	7	47%	3%

Data are for forest ecological communities listed as threatened under the EPBC Act as at 31 December 2021.

Listing periods represent communities initially listed July 2000 to August 2016 (2000-2016), and communities initially listed August 2016 to December 2021 (2016-2021).

Source: Australian Government Department of Climate Change, Energy, the Environment and Water (DCCEEW) Species Profile and Threats (SPRAT) Database.

Click here for a Microsoft Excel workbook of the data for Table 1.2b-9.

Key threatening processes

As at the end of December 2021, there were 21 key threatening processes listed under the *Environment Protection and Biodiversity Conservation Act 1999*, 18 of which are direct threats to forest-dwelling species and forest ecological communities (Table 1.2b-10).

Table 1.2b-10: Listed key threatening processes affecting forest-dwelling threatened species and forest ecological communities as at December 2021

Key threatening processes	Effective date[a]
Competition and land degradation by rabbits	16 July 2000
Competition and land degradation by unmanaged goats	16 July 2000
Dieback caused by the root-rot fungus (*Phytophthora cinnamomi*)	16 July 2000
Predation by European red fox	16 July 2000
Predation by feral cats	16 July 2000
Land clearance	4 April 2001
Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases	4 April 2001
Psittacine circoviral (beak-and-feather) disease affecting endangered psittacine species	4 April 2001
Predation, habitat degradation, competition and disease transmission by feral pigs	6 August 2001
Infection of amphibians with chytrid fungus, resulting in chytridiomycosis	23 July 2002
The reduction in the biodiversity of Australian native fauna and flora due to the red imported fire ant, *Solenopsis invicta*	2 April 2003
Loss of biodiversity and ecosystem integrity following invasion by the yellow crazy ant (*Anoplolepis gracilipes*) on Christmas Island, Indian Ocean	12 April 2005
Biological effects, including lethal toxic ingestion, caused by cane toads (*Bufo marinus*[b])	12 April 2005
Predation by exotic rats on Australian offshore islands of less than 1,000 km^2 (100,000 hectares)	29 March 2006
Invasion of northern Australia by gamba grass and other introduced grasses	16 September 2009
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	8 January 2010
Novel biota and their impact on biodiversity	26 February 2013
Aggressive exclusion of birds from potential woodland and forest habitat by over-abundant noisy miners (*Manorina melanocephala*)	9 May 2014

[a] Date from which the threatening process was listed.
[b] Current scientific name *Rhinella marina*.
Source: DCCEEW (2023).

Data sources

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