The IUCN Red List of Ecosystems
Scope: Sub-global / Regional
Language: English

Mountain Ash forest in the Central Highlands of Victoria, south-eastern Australia, Australia

Assessment by: Burns, E L., Lindenmayer, D B., Stein, J., Blanchard, W., McBurney, L., Blair, D., & Banks, S C.

Overall risk category CR

NOT EVALUATED	DATA DEFICIENT	LEAST CONCERN	NEAR THREATENED	VULNERABLE	ENDANGERED	CRITICALLY ENDANGERED	COLLAPSED
NE	DD	LC	NT	VU	EN	CR	CO

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Arboreal marsupials, Biodiversity, Climate, Conservation, Drivers, Ecosystem collapse, Eucalypt forests, Fire, Fire severity, Leadbeaters, Logging, Management, Mountain ash, Possum, Southeastern australia, Viability

Ecosystem Description

The Mountain Ash forest is a globally iconic ecosystem. It is highly valued for its contributions to water and timber production (Flint and Fagg 2007; Viggers et al. 2013), its recreational and aesthetic values, and its unique biodiversity (Mueck 1990; Lindenmayer 2009). Many areas of Mountain Ash forest are generally dominated by a single overstorey tree species: Eucalyptus regnans. In addition to its unique species, the dynamics of the ecosystem are unusual among Australian forests because they can be subject to stand-replacing disturbance regimes such as wildfire (Lindenmayer et al. 2011). The Central Highlands region supports approximately 157,000 ha of Mountain Ash forest. The ecosystem typically occurs at altitudes between 85 and 1,380 m above sea level in mesic conditions favourable for tree growth (Mackey et al. 2002). This ecosystem occurs in a region approximately 120 km northeast of Melbourne, southeastern Australia. Fire is the primary form of natural disturbance in the Mountain Ash ecosystem (Ashton 1981).

Classification

IUCN Habitats Classification Scheme

- 1. Forest
  - 1.4. Forest - Temperate

IUCN Global Typology

- Terrestrial
  - T2. Temperate-boreal forests and woodlands
    - T2.5 Temperate pyric humid forests

Distribution

The Central Highlands region supports approximately 157,000 ha of Mountain Ash forest. It occurs in Victoria, south-eastern Australia.

System

Terrestrial

Biogeographic Realm

Australasian

Countries

Australia

Geographic Region

South-eastern Australia

Characteristic Native Biota

Many areas of Mountain Ash forest are generally dominated by a single overstorey tree species - Eucalyptus regnans. Mountain Ash forest can also contain other overstorey tree species like alpine ash (E. delegatensis) and shining gum (E. nitens) at higher elevations (Lindenmayer et al. 1993) or messmate (E. obliqua), mountain grey gum (E. cypellocarpa) and red stringybark (E. macrorhyncha) at lower elevations (Campbell 1984). Mountain Ash forest supports a wide range of plant species in the midstorey tree layer and shrub layers, and a rich array of native mammals (Lumsden et al. 1991). Native mammals include the endangered Leadbeater' possum (Gymnobelideus leadbeateri) which is virtually confined to the Central Highlands region (Lindenmayer et al. 2014) and the vulnerable yellowbellied glider (Petaurus australis) as well as six other species of arboreal marsupials and a diversity of forest bird species (Lindenmayer 2009). The reptile assemblage found in the Mountain Ash ecosystem in the Central Highlands of Victoria is depauperate (Brown and Nelson 1993) relative to many other Australian environments; the amphibian fauna of the Mountain Ash ecosystem is relatively species-poor. Several species of fish have been recorded from aquatic environments in the Mountain Ash ecosystem, although relatively limited work has been completed on this group (Doeg and Joehn 1990).

Taxa

Acacia dealbata, Acacia frigescens, Acacia obliquinervia, Acrobates pygmaeus, Alisterus scapularis, Anepischtos maccoyi, Antechinus stuartii, Antechinus swainsonii, Atherosperma moschatum, Austrelaps ramsayi, Austronomus australis, Bedfordia arborescens, Callopcephalon fimbriatum, Calyptorhynchus funereus, Cassinia aculeata, Cercartetus nanus, Chalinolobus gouldii, Chalinolobus morio, Correa lawrenciana, Crinia signifera, Cryptophyis nigrescens, Cyathea australis, Dicksonia antarctica, Egernia cunninghami, Egernia saxatilis, Eopsaltria australis, Eucalyptus cypellocarpa, Eucalyptus delegatensis, Eucalyptus macrorhyncha, Eucalyptus nitens, Eucalyptus obliqua, Eucalyptus regnans, Eulamprus tympanum, Falcunculus frontatus, Falsistrellus tasmaniensis, Gadopsis bispinosis, Gadopsis marmoratus, Galaxias fuscus, Galaxias olidus, Gymnobelideus leadbeateri, Hedycarya angustifolia, Limnodynastes dumerilii, Liopholis whitii, Littoria ewingii, Littoria peronii, Lomatia fraseri, Macropus giganteus, Macropus rufogriseus, Menura novaehollandiae, Niveoscincus conventryi, Notechis scutatus, Nothofagus cunninghamii, Nyctophilus geoffroyi, Nyctophilus gouldii, Olearia argophylla, Olearia phlogopappa, Persoonia arborea, Petauroides volans, Petaurus australis, Petaurus breviceps, Petroica phoenicea, Pittosporum bicolour, Platycercus elegans, Polyscias sambucifolia, Pomaderris aspera, Prostanthera lasianthos, Prostanthera melissifolia, Pseudechis porphyriacus, Pseudocheirus peregrinus, Pseudomoia entrecasteauxii, Pseudomoia spenceri, Rattus fuscipes, Scotorepens orion, Tachyglossus aculeatus, Tasmannia lanceolata, Trichosurus cunninghami, Vespadelus darlingtoni, Vespadelus regulus, Vespadelus vulturnus, Vombatus ursinus, Wallabia bicolor, Zieria arborescens

Abiotic Features

The climate is typically characterized by mild, humid winters with occasional periods of snow, generally cool summers, mean annual temperature varying from 7.2 to 14.1°C and mean annual precipitation varying from 815 to 1,775 mm (long-term mean climate variables estimated for the 1976 to 2005 period using ANUCLIM, Xu and Hutchinson 2013). Tree growth that is characteristic of the Mountain Ash forest can only occur within the 'wet and cool' environmental envelope defined by the Central Highlands of Victoria (Lindenmayer et al. 1996; Mackey et al. 2002). This ecosystem is therefore vulnerable to the effects of climate change, particularly higher temperatures and reduced rainfall (Nitschke and Hickey 2007; Wood et al. 2014). The ecosystem typically occurs at altitudes between 85 and 1,380 m above sea level in mesic conditions favourable for tree growth (Mackey et al. 2002).

Biotic Processes

Temperature and precipitation are the key abiotic variables in the Mountain Ash ecosystem and climatic conditions are the key determinant of its broad distribution patterns (Lindenmayer et al. 1996). At finer spatial scales, other environmental factors such as soil fertility, topography and natural disturbance also have an important influence on Mountain Ash forest (Florence 1996; Lindenmayer et al. 1999; Mackey et al. 2002). Fire is the primary form of natural disturbance (Ashton 1981), while logging is the primary form of human disturbance in the ecosystem, and large areas have been subject to timber and pulpwood harvesting. The effects of fire on stand structure are linked to the age of a forest at the time it is burned. Fire in an old growth forest will produce a cohort of large dead trees and fire-scarred living old trees that can provide nesting habitat for a suite of cavity-dependent species such as Leadbeater's possum (Lindenmayer 2009b). Such habitat does not develop in young burned forest. When the interval between stand-replacing disturbances is <20 years – the period required for trees to reach sexual maturity and begin producing seed (Ashton 1981) – stands of mountain ash will be replaced by other species, particularly wattle (Acacia spp.) (Lindenmayer et al. 2011a). Therefore, fires in rapid succession have the potential to

eliminate populations of fauna as a result of the direct effect they can have on floristic composition (Lindenmayer et al. 2013). There are two kinds of important interactions between natural disturbance (fires) and human disturbance (logging) in the ecosystem. First, burned forests are subject to salvage logging. Second, artificial stand regeneration practices following conventional clearfelling operations in green forest produce young stands of dense regrowth forest, which have been found to be at risk of re-burning at high severity (Taylor et al. 2014). The interacting effects of wildfire and logging have the potential to create a landscape trap (Lindenmayer et al. 2011) in which the Mountain Ash forest persists in short-interval disturbance dynamics.

Conceptual Model

Conceptual model of salient ecological processes relevant to the assessment of the mountain ash ecosystem (modified from Burns et al. 2015).

Threatening Processes

Fire is the primary form of natural disturbance in the Mountain Ash ecosystem (Ashton 1981), while logging is the primary form of human disturbance in the ecosystem, and large areas have been subject to timber and pulpwood harvesting.

Collapse

Ecosystem collapse was considered to have occurred when the abundance of hollow-bearing trees dropped below 1 per hectare averaged across the entire Mountain Ash ecosystem or there was less than 1% of old-growth forest remaining in the ecosystem. Also, collapse was considered to have occurred when 100% of the area where the ecosystem currently occurs was no longer bioclimatically suitable.

Ecosystem Risk Assessment

Assessment Protocol	IUCN Red List of Ecosystems Category and Criteria	Last Assessed
IUCN RLE v2.0	Critically Endangered D1+D2a+D3+E	2015

Justification

The current extent of Mountain Ash forest is 156,700 ha, 96.4% of which is on public land. It is assumed that due to stable land tenure its distribution has experienced virtually no change since 1964 and that it will not change in the next 50 years. However, due to natural and human disturbances there has been a significant reduction in the amount of old-growth since 1964 which has resulted in severe disruptions to the biotic processes and interactions associated to hollow-bearing trees. It was estimated that a minimum of 47,000 ha (30% of current extent) was old-growth in 1750, while the current area of old-growth forest is 1,700 ha. Furthermore, models project a severe future decline in the average number of large old hollow-bearing trees across the Mountain Ash forest ecosystem from approximately 3.77 ha-1 in 2011 to approximately 0.29-0.82 ha-1 by 2067, and quantitative models estimate that the probability of ecosystem collapse in the next 50 years is higher than 50%. Therefore, the ecosystem is assessed as Critically Endangered under subcriteria D1, D2a, D3 and criterion E.

Criterion A LC

Summary

Approximately 96.4% of the current distribution of the Mountain Ash ecosystem is on public land. It is assumed, due to stable land tenure, that there has been virtually no change in distribution since 1964. Meanwhile, the historical reduction in distribution is of approximately 2%, and it is predicted that the distribution will remain unchanged from 2014 until 2064. Thus, the status of the Mountain Ash forest ecosystem is Least Concern under criterion A.

Risk Category LC

Subcriterion	Category	Justification
A1	LC	The current distribution of the Mountain Ash ecosystem is 156,700 ha, 96.4% of which is on public land. Is assumed, due to stable land tenure that there had been virtually no change in distribution since 1964. The status of the ecosystem is therefore Least Concern under this subcriterion A1. **Key Indicators in detail** Evidence of Continuing Decline: Stable or Increasing Evidence of Threatening Processes: No **Indicator Variable:** Change in distribution Mapped distribution Year: 1964 Mapped distribution (ha): 156,700 Year: 2013 Mapped distribution (ha): 156,700
A2a	LC	Almost the entire extent of Mountain Ash forest occurs on public land. Therefore it is assumed that the distribution would remain largely unchanged from 2014 until 2064. The status of the ecosystem is therefore Least Concern under subcriterion A2a. **Key Indicators in detail** Evidence of Continuing Decline: Stable or Increasing Evidence of Threatening Processes: No **Indicator Variable:** Change in distribution Mapped distribution Year: 2014 Mapped distribution (ha): 156,700 Year: 2064 Mapped distribution (ha): 156,700
A2b	NE	This subcriterion was not assessed. **Key Indicators in detail** Evidence of Continuing Decline: Unknown Evidence of Threatening Processes: No
A3	LC	The amount of wet sclerophyll forest dominated by Mountain Ash has decreased from a modelled pre-1750 area of 183,000 ha to an extant area of 180,000 ha, a reduction of approximately 2%. The status of the ecosystem is therefore Least Concern under subcriterion A3. **Key Indicators in detail** Evidence of Continuing Decline: Stable or Increasing Evidence of Threatening Processes: No **Indicator Variable:** Change in distribution Extent (%): 2 Mapped distribution Year: 1750 Mapped distribution (ha): 183,000 Year: 2014 Mapped distribution (ha): 180,000

Criterion B EN

Summary

All occurrences of Mountain Ash forest are encompassed by a minimum convex polygon of 11 000 km2. In 1939, a single wildfire affected between approximately 74% and 96% of the ecosystem. This indicates that a single threatening event can affect almost the entire distribution of the ecosystem, which suggests it occurs in less than two threat-defined locations. Thus, the status of the ecosystem is Endangered under subcriterion B1c.

Risk Category EN

Subcriterion	Category	Justification
B1	EN	The area of the minimum convex polygon enclosing all mapped occurrences was 11,000 km2. In under to determine the number of threat-defined locations, fire was considered as the most plausible threat. In 1939, a single wildfire affected between approximately 74% and 96% of the ecosystem. This indicates that a single threatening event can affect almost the entire distribution of the Mountain Ash ecosystem. It was concluded there are less than 2 locations within the ecosystem. The simplification of the ecosystem through one such event is in itself sufficient to meet the Endangered criterion under subcriterion B1c. **Key Indicators in detail** Number of Threat-defined Locations: 2 Evidence of Continuing Decline: Stable or Increasing Evidence of Threatening Processes: Yes **Indicator Variable:** EOO Mapped distribution Year: 2014 Mapped distribution (km2): 11,000
B2	LC	The ecosystem was present within 96 (of 140) grid cells. Of these, 23 grid cells contained less than 1 km2 of the ecosystem. After excluding cells with limited occurrence, it was estimated that the ecosystem occupied 73 of the 10 × 10 km grid cells (i.e. more than 50 cells). Based on the number of occupied cells, the ranking of the ecosystem is therefore Least Concern under subcriterion B2. **Key Indicators in detail** Number of Threat-defined Locations: 2 Evidence of Continuing Decline: Stable or Increasing Evidence of Threatening Processes: Yes **Indicator Variable:** AOO Mapped distribution Year: 2014 Mapped distribution (10x10-km grid cells): 73
B3	VU	Based on the assessment of there being less than 2 locations, the judgement was that the Mountain Ash ecosystem was indeed prone to collapse within a short period of time. It therefore met the requirements for Vulnerable under subcriterion B3. **Key Indicators in detail** Number of Threat-defined Locations: 2 Evidence of Continuing Decline: Stable or Increasing Evidence of Threatening Processes: Yes

Criterion C VU

Summary

There were insufficient data to assess environmental degradation of the Mountain Ash forest historically and over the past 50 years. However, three different Intergovernmental Panel on Climate Change (IPCC) emission scenarios were used to calculate the predicted losses of extent of the ecosystem over the next 50 years relative to climatic suitability. From the current distribution of 156,700 ha, the predicted losses at the 50th percentile were 36,350 ha (23%), 29,900 ha (19%) and 70,500 ha (45%) respectively. Relative severity ranged from 14% to 100%. This ranks the system between Least Concern and Critically Endangered (LC-CR). Based on the 50th percentile predictions, and given that functional collapse will be realized prior to 100% physical loss of the ecosystem, the ecosystem was ranked as Vulnerable under subcriterion C2a.

Risk Category VU

Subcriterion	Category	Justification
C1	DD	There were insufficient data available to assess the environmental degradation of the ecosystem in the past 50 years; thus, it is classified as Data Deficient under subcriterion C1. **Key Indicators in detail** Evidence of Continuing Decline: Unknown Evidence of Threatening Processes: No
C2a	VU	The Intergovernmental Panel on Climate Change (IPCC) emission scenarios A2, A1b and A1F1 were used to calculate the predicted losses of extent relative to climatic suitability under these scenarios. From the current distribution of 156,700 ha, the predicted losses at the 50th percentile were 36,350 ha (23%), 29,900 ha (19%) and 70,500 ha (45%) respectively. Lower bounds at the 10th percentile were 17%, 14% and 47%, while upper bounds at the 90th percentile were 97%, 98% and 100% respectively. The amount of loss needed to trigger collapse is 156,700 ha; that is, the total current extent of the Mountain Ash forest. Relative severity ranged from 14% to 100%. This ranks the system between LC and CR (LC-CR). Based on the 50th percentile predictions, and given that functional collapse will be realized prior to 100% physical loss of the ecosystem, the ecosystem is classified as Vulnerable under subcriterion C2a. **Key Indicators in detail** Evidence of Threatening Processes: Yes **Indicator Variable:** Environmental degradation Extent (%): 100 Relative Severity (%): 14-100 projected Year: 2014 Mapped distribution (ha): 156,700 Year: 2064
C2b	NE	This subcriterion was not assessed. **Key Indicators in detail** Evidence of Threatening Processes: No
C3	DD	There were insufficient data available to assess the environmental degradation of the ecosystem historically; thus, it is classified as Data Deficient under subcriterion C3. **Key Indicators in detail** Evidence of Threatening Processes: No

Criterion D CR

Summary

The current extent of the Mountain Ash forest is 156,700 ha, of which a minimum of 47,000 ha (30%) is estimated to have been old-growth in 1750 and the current area of old-growth forest is 1,700 ha. While, over the past 50 years there has been a significant reduction in the amount of old-growth, it was estimated that the area of Mountain Ash forest that was unlogged and unburnt by wildfire in 1964 was 6,300 ha (4% of the estate); this had been reduced by 4,600 ha to 1,700 ha (1% of the estate) by 2011. It has been projected a severe future decline in the average number of large old hollow-bearing trees across the Mountain Ash forest from approximately 3.77 ha−1 in 2011 to approximately 0.29-0.82 ha−1 by 2067. Therefore, the ecosystem is classified as Critically Endangered under subcriteria D1, D2a and D3.

Risk Category CR

Subcriterion	Category	Justification
D1	CR	There has been a significant reduction in the amount of old-growth since 1964. It was estimated that the area of Mountain Ash forest that was unlogged and unburnt by wildfire in 1964 was 6,300 ha (4% of the estate). This had been reduced by 4,600 ha to 1,700 ha (1% of the estate) by 2011. To trigger ecosystem collapse, the amount of old growth forest would need to decline to 1,400 ha (which equals 0.9% of 156,700 ha an approximation for less than 1% old-growth forest remaining in the current ecosystem). Therefore, the loss needed to achieve ecosystem collapse was approximately 6,300 ha. It was concluded that the disruption of biotic processes over the past 50 years, based on a change in the number of hollow-bearing trees (using old-growth as a surrogate), indicated a decline with more than 80% relative severity (average across 100% extent). The ecosystem is therefore Critically Endangered under subcriterion D1. **Key Indicators in detail** Evidence of Threatening Processes: Yes **Indicator Variable:** Abundance of hollow-bearing trees Extent (%): 100 Relative Severity (%): 80 infered Year: 1964 Mapped distribution (ha): 6,300 Year: 2011 Mapped distribution (ha): 1,700
D2a	CR	The model projected for a severe future decline in the average number of large old hollow-bearing trees across the Mountain Ash forest from approximately 3.77 ha−1 in 2011 to approximately 0.29-0.82 ha−1 by 2067. Therefore, the ‘observed estimate of decline’ in the best case scenario was 78% and the worst case scenario was 92%. The ecosystem collapse was defined as occurring when the average abundance of hollow-bearing trees declined to less than 1 hollow-bearing tree per ha. Modelling in all 39 scenarios projected a decline of more than 78% with more than 100% relative severity (averaged across 100% extent of the ecosystem). The ecosystem is therefore Critically Endangered under this subcriterion D2a. **Key Indicators in detail** Evidence of Threatening Processes: Yes **Indicator Variable:** Abundance of hollow-bearing trees Extent (%): 100 Relative Severity (%): 92-78 projected Year: 2011 Mapped distribution (ha-1): 3.77 Year: 2067 Mapped distribution (ha-1): 0.29 Year: 2067 Mapped distribution (ha-1): 0.82
D2b		This subcriterion was not assessed.

NE

Key Indicators in detail

Evidence of Threatening Processes: No

D3 CR

Lindenmayer et al. (2014) suggest that between 30-60% of the forest was formerly old-growth. The current extent of the Mountain Ash forest is 156,700 ha, of which a minimum of 47,000 ha (30%) is estimated to have been old-growth in 1750. The current area of old-growth forest is 1,700 ha. Therefore, our lower bound 'observed estimate of decline' in the amount of old growth is 45,300 ha. It was concluded (based on the lower bound of the range in old growth cover) that the disruption to biotic process over the past 50 years has led to a decline with more than 90% relative severity. Therefore, the ecosystem is Critically Endangered under subcriterion D3.

Key Indicators in detail

Evidence of Threatening Processes: Yes

Indicator Variable: Extent of old-growth forest

Extent (%): 100
Relative Severity (%): more than 90

estimated
Year: 1750
Mapped distribution (ha): 47,000
Year: 2014
Mapped distribution (ha): 1,700

Criterion E CR

Summary

All scenarios indicated a greater or equal than 92% chance of reaching a collapsed state (less than 1 hollow bearing tree per hectare) by 2067, although there was some variation in the trajectory of collapse depending on which previous fire (1939, 1983 or 2009) was used as a template to simulate the future fire and the timing of that simulated fire event between 2014 and 2067. This model contain estimates of the probability of ecosystem collapse derived from 10,000 simulations generated by varying the input parameters with a coefficient of variation of 17.3%, it also shows the sensitivity of the probability of collapse and rating category to variation in the definition of collapse between 0.5 to 1.5 hollow-bearing trees per hectare (hbt/ha). Therefore, for Criterion E, the ecosystem was classified as Critically Endangered, with plausible bounds within this category because it has a greater or equal than 50% probability of collapse within 50 years (although our projections were made to 2067 because of the 14-year time steps used in the simulations.

Risk Category CR

Modelling

Name: The probability of collapse by fire/harvesting scenario and year
Source: Burns et al. 2014
Modelling type: Stochastic model
Collapse probability:

Years: 50 Probability : more than 92

Scenario	Category	Description
1939+1983, large, 0.5 hbt/ha	cr	In this scenario its considered: 1939 and 1983 regrowth, large fire regimes for the next 50 years and a definition of collapse of 0.5 hollow-bearing trees per hectare.
1939+1983, large, 1.0 hbt/ha	cr	In this scenario its considered: 1939 and 1983 regrowth, large fire regimes for the next 50 years and a definition of collapse of 1.0 hollow-bearing trees per hectare.

1939+1983, large, 1.5 hbt/ha	cr	In this scenario its considered: 1939 and 1983 regrowth, large fire regimes for the next 50 years and a definition of collapse of 1.5 hollow-bearing trees per hectare.
1939+1983, medium, 0.5 hbt/ha	cr	In this scenario its considered: 1939 and 1983 regrowth, medium fire regimes for the next 50 years and a definition of collapse of 0.5 hollow-bearing trees per hectare.
1939+1983, medium, 1.0 hbt/ha	cr	In this scenario its considered: 1939 and 1983 regrowth, medium fire regimes for the next 50 years and a definition of collapse of 1.0 hollow-bearing trees per hectare.
1939+1983, medium, 1.5 hbt,ha	cr	In this scenario its considered: 1939 and 1983 regrowth, medium fire regimes for the next 50 years and a definition of collapse of 1.5 hollow-bearing trees per hectare.
1939+1983, no fire, 0.5 hbt/ha	en	In this scenario its considered: 1939 and 1983 regrowth, no fire regimes for the next 50 years and a definition of collapse of 0.5 hollow-bearing trees per hectare.
1939+1983, no fire, 1.0 hbt/ha	cr	In this scenario its considered: 1939 and 1983 regrowth, no fire regimes for the next 50 years and a definition of collapse of 1.0 hollow-bearing trees per hectare.
1939+1983, no fire, 1.5 hbt/ha	cr	In this scenario its considered: 1939 and 1983 regrowth, fire regimes for the next 50 years and a definition of collapse of 1.5 hollow-bearing trees per hectare.
1939+1983, small, 0.5 hbt/ha	en	In this scenario its considered: 1939 and 1983 regrowth, small fire regimes for the next 50 years and a definition of collapse of 0.5 hollow-bearing trees per hectare.
1939+1983, small, 1.0 hbt/ha	cr	In this scenario its considered: 1939 and 1983 regrowth, small fire regimes for the next 50 years and a definition of collapse of 1.0 hollow-bearing trees per hectare.
1939+1983, small, 1.5 hbt/ha	cr	In this scenario its considered: 1939 and 1983 regrowth, small fire regimes for the next 50 years and a definition of collapse of 1.5 hollow-bearing trees per hectare.
1983, large, 0.5 hbt/ha	cr	In this scenario its considered: 1983 regrowth only, large fire regimes for the next 50 years and a definition of collapse of 0.5 hollow-bearing trees per hectare.
1983, large, 1.0 hbt/ha	cr	In this scenario its considered: 1983 regrowth only, large fire regimes for the next 50 years and a definition of collapse of 1.0 hollow-bearing trees per hectare.
1983, large, 1.5 hbt/ha	cr	In this scenario its considered: 1983 regrowth only, large fire regimes for the next 50 years and a definition of collapse of 1.5 hollow-bearing trees per hectare.
1983, medium, 0.5 hbt/ha	lc	In this scenario its considered: 1983 regrowth only, medium fire regimes for the next 50 years and a definition of collapse of 0.5 hollow-bearing trees per hectare.
1983, medium, 1.0 hbt/ha	cr	In this scenario its considered: 1983 regrowth only, medium fire regimes for the next 50 years and a definition of collapse of 1.0 hollow-bearing trees per hectare.
1983, medium, 1.5 hbt/ha	cr	In this scenario its considered: 1983 regrowth only, medium fire regimes for the next 50 years and a definition of collapse of 1.5 hollow-bearing trees per hectare.
1983, no fire, 0.5 hbt/ha	lc	In this scenario its considered: 1983 regrowth only, no fire regimes for the next 50 years and a definition of collapse of 0.5 hollow-bearing trees per hectare.
1983, no fire, 1.0 hbt/ha	cr	In this scenario its considered: 1983 regrowth only, no fire regimes for the next 50 years and a definition of collapse of 1.0 hollow-bearing trees per hectare.
1983, no fire, 1.5 hbt/ha	cr	In this scenario its considered: 1983 regrowth only, no fire regimes for the next 50 years and a definition of collapse of 1.5 hollow-bearing trees per hectare.
1983, small, 0.5 hbt/ha	lc	In this scenario its considered: 1983 regrowth only, small fire regimes for the next 50 years and a definition of collapse of 0.5 hollow-bearing trees per hectare.
1983, small, 1.0 hbt/ha	cr	In this scenario its considered: 1983 regrowth only, small fire regimes for the next 50 years and a definition of collapse of 1.0 hollow-bearing trees per hectare.

1983, small, 1.5 hbt/ha	cr	In this scenario its considered: 1983 regrowth only, small fire regimes for the next 50 years and a definition of collapse of 1.5 hollow-bearing trees per hectare.
No harvesting, large, 0.5 hbt/ha	cr	In this scenario its considered: No harvesting, large fire regimes for the next 50 years and a definition of collapse of hollow-bearing trees per hectare.
No harvesting, large, 1.0 hbt/ha	cr	In this scenario its considered: No harvesting, large fire regimes for the next 50 years and a definition of collapse of hollow-bearing trees per hectare.
No harvesting, large, 1.5 hbt/ha	cr	In this scenario its considered: No harvesting, large fire regimes for the next 50 years and a definition of collapse of hollow-bearing trees per hectare.
No harvesting, medium, 0.5 hbt/ha	lc	In this scenario its considered: No harvesting, medium fire regimes for the next 50 years and a definition of collapse of hollow-bearing trees per hectare.
No harvesting, medium, 1.0 hbt/ha	cr	In this scenario its considered: No harvesting, medium fire regimes for the next 50 years and a definition of collapse of hollow-bearing trees per hectare.
No harvesting, medium, 1.5 hbt/ha	cr	In this scenario its considered: No harvesting, medium fire regimes for the next 50 years and a definition of collapse of hollow-bearing trees per hectare.
No harvesting, no fire, 0.5 hbt/ha	lc	In this scenario its considered: No harvesting, no fire regimes for the next 50 years and a definition of collapse of 0.5 hollow-bearing trees per hectare.
No harvesting, no fire, 1.0 hbt/ha	cr	In this scenario its considered: no harvesting, no fire regimes for the next 50 years and a definition of collapse of 1.0 hollow-bearing trees per hectare.
No harvesting, no fire, 1.5 hbt/ha	cr	In this scenario its considered: no harvesting, no fire regimes for the next 50 years and a definition of collapse of 1.5 hollow-bearing trees per hectare.
No harvesting, small, 0.5 hbt/ha	lc	In this scenario its considered: No harvesting, small fire regimes for the next 50 years and a definition of collapse of hollow-bearing trees per hectare.
No harvesting, small, 1.0 hbt/ha	cr	In this scenario its considered: No harvesting, small fire regimes for the next 50 years and a definition of collapse of hollow-bearing trees per hectare.
No harvesting, small, 1.5 hbt/ha	cr	In this scenario its considered: No harvesting, small fire regimes for the next 50 years and a definition of collapse of hollow-bearing trees per hectare.

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