NATURE BESIEGED

THE MAJOR CAUSES OF SPECIES EXTINCTION AND DECLINE IN AUSTRALIA

Briefing Note

Threats to Nature project

August 2021

THREATS TO NATURE PROJECT

Contents

1. Introduction

> *The environment which moulded the most remarkable fauna in the world is beset on all sides by influences which are reducing it to a medley of semi-artificial environments, in which the original plan is lost and the final outcome of which no man may predict.*
>
> Hedley Finlayson (1936)[1]

For the past 230 years, since European colonisation, Australia's plants and animals have been besieged by numerous threats – voracious new predators, large scale destruction of habitat, dramatically intensified or suppressed patterns of fire, dominating new herbivores and aggressive weeds, intensive exploitation of forests and oceans and, more recently, a rapidly changing climate.

The consequences have been dire – averaging 4–5 documented extinctions each decade, we have lost more than 100 species unique to Australia. Unless we greatly strengthen threat abatement and threatened species recovery, the rate of extinctions is likely to accelerate – another 100 taxa are at imminent risk, likely to be lost within the next 2 decades. Thousands more are in decline, and some 1,800 species are listed as nationally threatened.

Here, we report the numbers behind Australia's extinction crisis and the threats driving it.

2. Extinctions

> *[It] is likely that there have been many more extinctions than those currently recognised in official lists. Many species, particularly of less charismatic groups, disappeared with little or no documentation or collection.*
>
> Woinarski et al (2019)[2]

2.1 Number of documented extinctions

About 100 unique Australian species have become extinct since European colonisation – equivalent to 4.4 extinctions a decade (**TABLE 1**).[2] These are the extinctions officially recognised by Australian governments or the IUCN.

Many more species are likely to be extinct, but they disappeared before being recorded or their loss has not been officially confirmed. In Western Australia, 23 endemic plant species have not been recorded for at least 50 years, and on Christmas Island more than 50 endemic invertebrate species have not been recorded for at least 100 years.[2,3] Even among mammals, at least another 8 endemic species – most previously not recognised as species – are likely to be extinct, and another 2 frog species are also probably extinct.[2,4]

> *Contemporary understanding of ecosystem processes may be prone to shifting baselines because we simply do not know how species that are now rare or extinct shaped ecosystems in the past.*
>
> Mills & Letnic (2018)[5]

Some of these extinctions have undoubtedly resulted in the loss of important ecological functions – and are therefore coupled with 'functional extinctions'. Such functions can be lost long before a species' extinction or even rarity, but too little is known about ecological interactions in Australia to understand the ecosystem consequences of most losses and declines.[5,6] Recent research on seed-eating by threatened mammals suggests that once-abundant small mammals used to be major regulators of vegetation, and that widespread shrub encroachment in grasslands and savannas is likely due in part to the profound depletion of mammals.[5,7]

TABLE 1. Officially recognised extinctions of endemic Australian plant and animal species

	Plants	Mammals	Invertebrates	Birds	Frogs	Reptiles*	Fishes*	Protist
Extinct species	38	34	10	9	4	3	2	1
Main cause	Land clearing	Invasive species	Land clearing	Invasive species	Invasive species	Invasive species	Invasive species / habitat destruction	Pollution

Source: Woinarski et al (2019)[2]

Notes: *2 reptiles and 1 fish are extinct in the wild but survive in captivity or in translocated populations. One fish included here was added to the extinction list by the IUCN in 2020, subsequent to the 2019 paper on which this list is based.[8]

2.2 Major causes of extinctions

Since European colonisation of Australia, the two major causes of extinction have been invasive species and land clearing (**FIGURE 1**). Invasive species have:[2]

- contributed to 79% of confirmed extinctions
- been primarily responsible for 45% of confirmed extinctions – mainly animals.

Land clearing has:[2]

- contributed to 62% of confirmed extinctions
- been primarily responsible for 36% of confirmed extinctions – mainly plants.

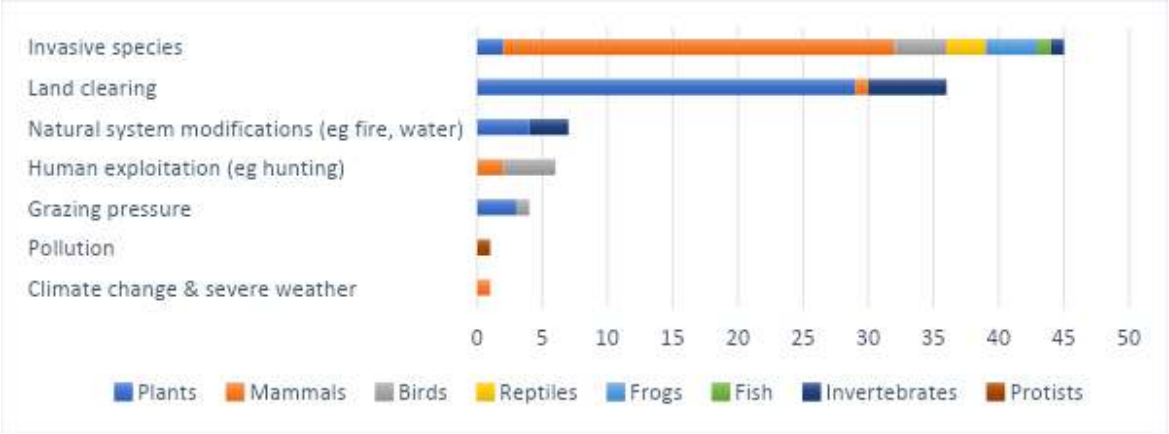


FIGURE 1. The primary causes of 100 confirmed extinctions of endemic Australian species

***Source**: Woinarski et al. (2019)[2]*

***Notes**: These are officially recognised extinctions (as at April 2019) under Australian, state or territory laws or by the IUCN. The attribution of causes was by expert opinion. The threats specified here were assigned >50% of the cause (except for one species, which was 45%).*

2.3 Imminent extinctions

> *A trout introduction by an uninformed or unsympathetic angler could eliminate any of several known galaxiid species.*[9]
>
> Lintermans et al (2020)[9]

Recent assessments (2016–2021) have identified 99 taxa at high risk of extinction within just 1– 2 decades (>50% chance of extinction for the 45 animal taxa) (**TABLE 2**). The most imperilled groups are plants (55 taxa) and freshwater fishes (20 species). Another 47 animal taxa have at least a 20% risk of extinction.

TABLE 2. Animal and plant taxa at high and moderate risk of extinction within 1–2 decades

Group	>50% risk (20 years)	20–50% risk (20 years)	Major threats
Freshwater fishes[9]	20	2	Climate change (increased frequency of extreme events), invasive species (mainly trout)[9]
Birds[10]	9	6	Invasive species (mainly predators), adverse fire regimes, habitat destruction, livestock grazing[11]
Frogs[12]	8	9	Invasive species (chytrid fungus, pigs, fish), climate change, adverse fire regimes, habitat destruction[12]
Lizards & snakes[13]	6	8	Invasive species (mainly weeds, cats, foxes), land clearing, livestock grazing, adverse fire regimes, climate change[13,14]
Mammals[10]	1	15	Invasive species (cats, foxes), adverse fire regimes[15]
Butterflies[16]	1	7	Adverse fire regimes, habitat destruction, invasive species, climate change[16]
	'High' risk (10 years)		
Plants[17]	55		Herbivores (feral, native, domestic), climate change, adverse fire regimes, invasive pathogens (mainly Phytophthora), urbanisation[17]

Notes: For plants, taxa at high risk within 10 years are those with continuing declines and that are extremely rare (known from <250 individuals and/or a single population).

3. Major threats to Australian species

We do not know in Australia exactly how many native species are threatened or even how many are extinct. That's because most species are not surveyed or monitored and the national listing process for threatened species is slow and cumbersome.

The listings under the EPBC Act are a poor reflection of the true state of Australian biodiversity. For example, of 22 freshwater fish assessed in 2020 as likely to go extinct within 2 decades only 3 were listed as threatened.[9] And of 55 plant taxa assessed in 2019 as being at high risk of extinction within a decade, 13 were not listed as threatened and only 12 were listed as critically endangered.[17]

For the 1795 threatened taxa listed under the EPBC Act in late 2019, the most-prevalent medium-to-high-impact threats, as judged by experts, were (**FIGURE 2**):[18]

- invasive species and diseases (impacting 42% of listed taxa)
- habitat loss, degradation and fragmentation (27%)
- adverse fire regimes (23%)
- climate change and extreme weather (8%).

Most threatened species are threatened by multiple factors – typically by one or more invasive species and by some form of habitat alteration (destruction, degradation, fragmentation) and ecosystem modification (changes to fire regimes or water flows), often by some form of exploitation (particularly fishing), and increasingly by climate change. Threatened animals listed under the EPBC Act are impacted by a median 6 threats, often interacting synergistically.[19]

We present below the most authoritative data we can find – from listings under the EPBC Act and on the IUCN Red List, and expert analyses – on threats to different groups of organisms. For the sake of consistency, we present data just for species (not subspecies or populations), even though it is important to conserve the diverse forms of species. Except for freshwater crayfish, we have not covered invertebrates. Too little is known about the conservation status of invertebrates, and about 70% of invertebrate species have not even been scientifically described.[20]

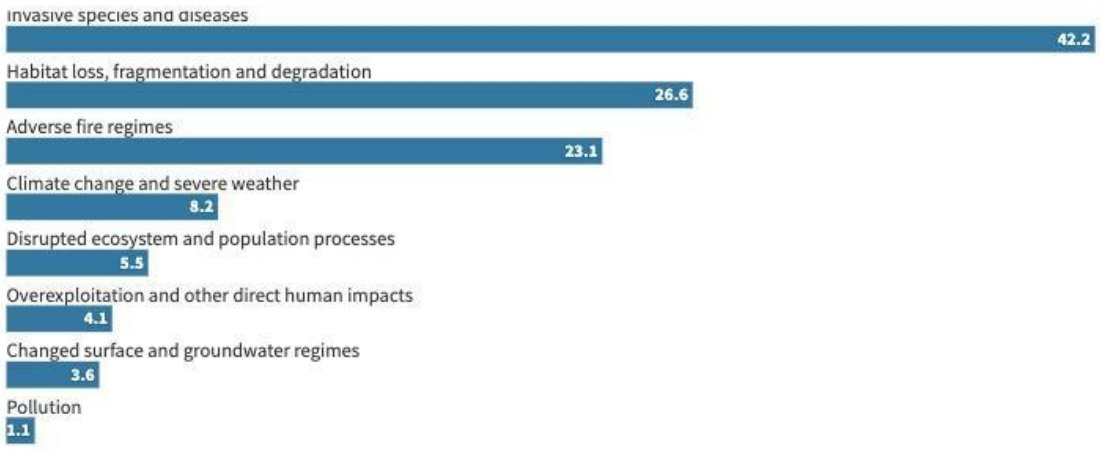


FIGURE 2: The percentage of nationally listed threatened taxa impacted to a high or medium degree by eight overarching key threatening processes

Source: Ward et al (2021)[18]

Note: The threatened species assessed in this study were the 1,795 taxa listed in late 2019 as extinct in the wild, critically endangered, endangered or vulnerable. The threatened species list has grown since then. The assessed taxa do not include those listed as conservation dependent (threatened fish species that are the target of commercial fisheries).

3.1 Threats to mammals

We see now only a faint shadow of the richness and abundance of the Australian mammal fauna that existed at the time of European settlement.

The Action Plan for Australia's Mammals 2012 (Woinarski et al 2014)[15]

Australia's mammal fauna

- 314 terrestrial species*[15]
- 58 marine species[15]
- 86% terrestrial species are endemic[15]

*Several additional species (known only from fossils or subfossils) are likely to have been present at the time of European colonisation.[15]

Extinctions

- 33 endemic species (~40 likely)[2]
- 12% of Australia's endemic mammal fauna
- Primary causes: feral cats and foxes

Nationally threatened

EPBC Act (2021)

Total: 65 species (+ 34 extinct)

- 7 critically endangered
- 27 endangered
- 31 vulnerable

Action Plan for Australian Mammals 2012[15]

Total: 56 species (+ 30 extinct)

- 10 critically endangered
- 10 endangered
- 36 vulnerable

Major threats

In order of threat impact:[21]

- feral cats & red foxes
- adverse fire regimes
- habitat loss & fragmentation

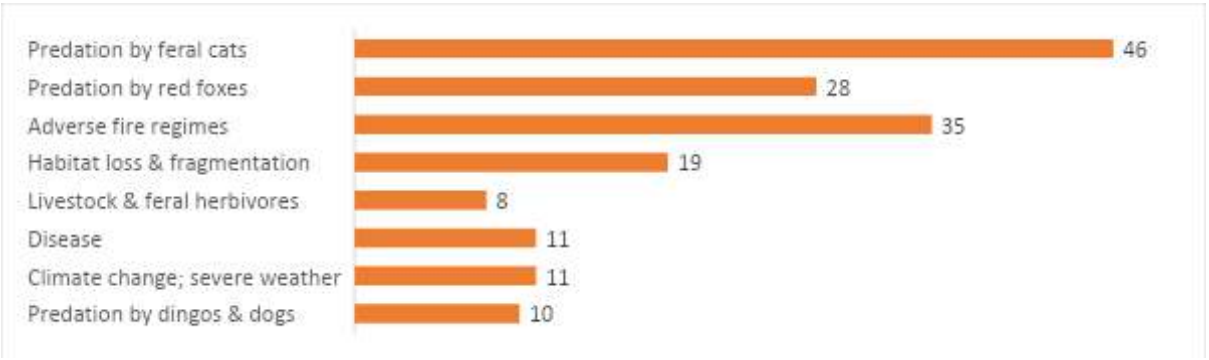


FIGURE 3. Major threats imperilling Australia's mammals

Source: Woinarski et al (2015)[21]

Notes: The numbers indicate the number of threatened taxa threatened by each type of threat

3.2 Threats to fishes

In Australia, freshwater fishes have fared poorly, with many species suffering from catastrophic declines since the 1950s.

Lintermans et al (2020)[9]

Australia's fish fauna

>5,000 described species:

- ~275 freshwater fishes (+ predicted >100 undescribed species)[9]
- 5,184 marine fishes (+ predicted 800 undescribed species)[22]
- 75% of freshwater species are endemic[23]
- 25% of marine species are endemic[22]
- The highest number of endemic marine fish in the world[24]

Extinctions

- Extinct: 1 freshwater,[9] 1 marine[8]
- Extinct in the wild: 1 freshwater[2]

Nationally threatened

EPBC Act (2021)

Total: 60 species (+ 1 extinct in the wild)

- Critically endangered: 8
- Endangered: 20
- Vulnerable: 25
- Conservation dependent: 7

Australian Society for Fish Biology (2016)[25]

Total: 74 species

- Critically endangered: 24
- Endangered: 18
- Vulnerable: 32

Major threats

22 highly imperilled freshwater fishes[9]

- Climate change (100%)
- Small, isolated populations (95%)
- Invasive fishes (particularly trout) (91%)
- Soil erosion, sedimentation (55%)

Marine fishes[26]

- Overfishing
- Capture as fishing bycatch

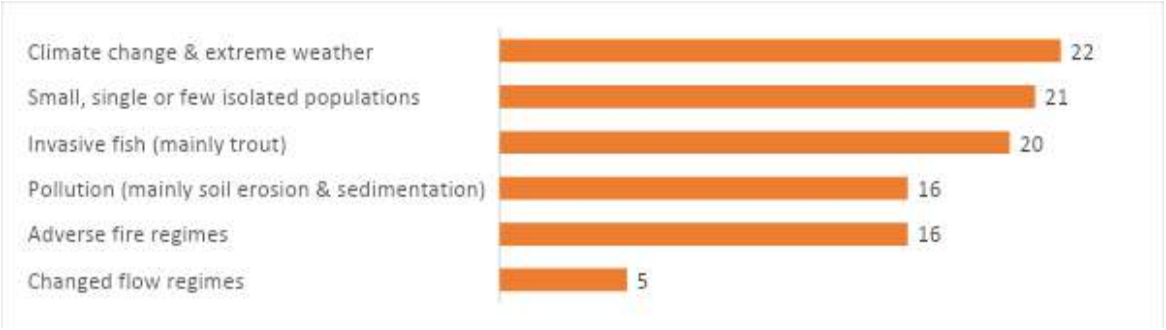


FIGURE 4. Major threats to Australia's most imperilled freshwater fishes (22 species)

Source: Lintermans et al (2020)[9]

Notes: The numbers indicate the number of highly threatened species threatened by each type of threat

3.3 Threats to birds

That in the 200 short years since Europeans arrived in Australia we have so diminished our natural capital that 234 Australian bird taxa are … extinct, threatened with extinction or near threatened, is a national disgrace.

The Action Plan for Australian Birds 2010 (Garnett et al 2011)[11]

Australia's bird fauna

- 753 species[27]
- 49% endemic[27]

Extinctions

- 9 endemic species[2]
- Primary causes: human hunting, black rats, grazing pressure[2]

Nationally threatened

EPBC Act (2021)

Total: 66 species (+ 9 extinct species)

- 10 critically endangered
- 29 endangered
- 28 vulnerable

BirdLife Australia (2019)[27]

Total: 77 species

- 13 critically endangered
- 31 endangered
- 33 vulnerable

Major threats

Per number of impacted taxa:[28]

- Cats
- Pastoralism
- Black rats
- Adverse fire regimes
- Farming

Current threat impact:*[28]

- Drought
- Adverse fire regimes
- Cats
- Longline fishing

*Taking into account current management

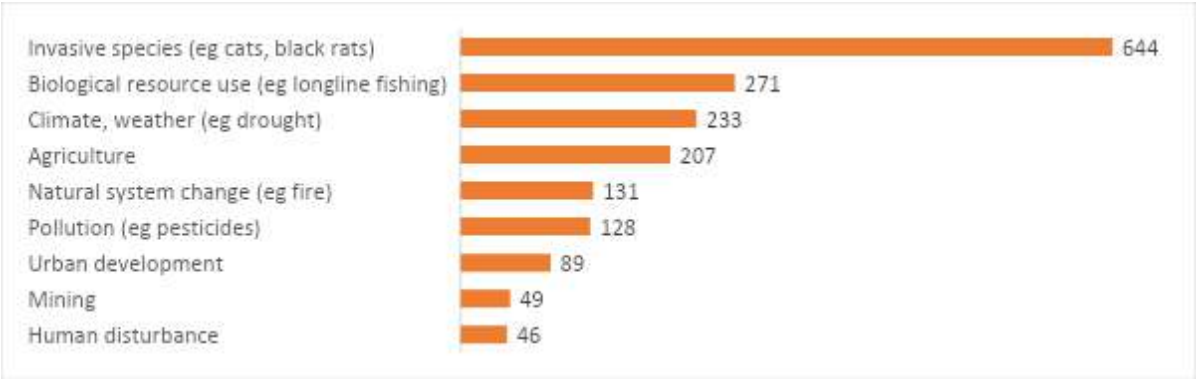


FIGURE 5. The threats imperilling Australia's birds

Source: Garnett et al. (2019)[28]

Notes: The numbers indicate the number of threat-taxa combinations (a species may be threatened by more than one type of threat in each category, particularly in the invasive species category)

3.4 Threats to reptiles

Australia is a hotspot for reptile diversity, hosting the largest number of species of any country in the world, and approximately 10% of all known species globally.

Geyle et al (2020)[13]

Australia's reptile fauna

- 1052 species (2018):[14]
  - 807 reptiles
  - 213 snakes
  - 24 freshwater turtles[29]
  - 6 marine turtles
  - 2 crocodiles
- 96% endemic to Australia[14]

Extinctions

- Extinct: 1 lizard[14]
- Extinct in the wild: 2 lizards[14]
- Primary causes: wolf snake, giant centipede[2,30]

Nationally threatened

EPBC Act (2020)

Total: 60 species (+ 1 extinct)

- Critically endangered: 9
- Endangered: 20
- Vulnerable: 31

IUCN (2020)

Total: 77 species

- Critically endangered: 15
- Endangered: 29
- Vulnerable: 33

Action Plan for Australian Snakes & Lizards (2017)[31]

Total: 64 snake & lizard species (+ 3 extinct)

- Critically endangered: 10
- Endangered: 26
- Vulnerable: 28

Major threats

Snakes & lizards[31]

- Invasive species (cats, weeds, cane toads)
- Habitat destruction
- Adverse fire regimes

Freshwater turtles[32]

- Predation (eg pigs, foxes)
- Changes in hydrology
- Habitat degradation
- Climate change

Marine turtles[33]

- Climate change
- Marine debris
- Pollution
- Predation (eg pigs, foxes)

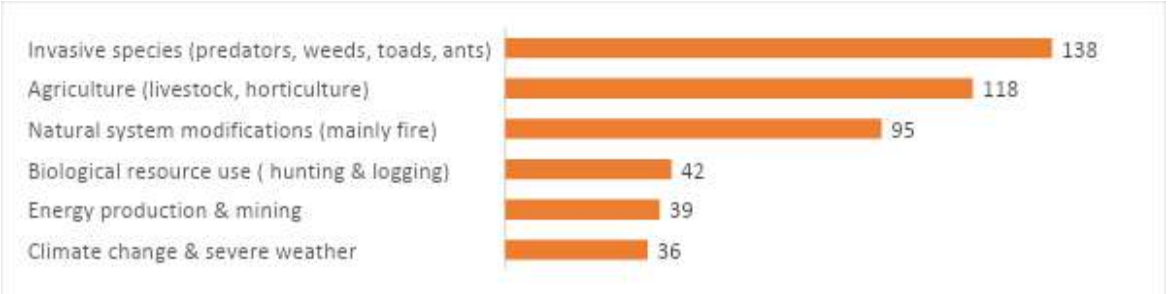


FIGURE 6. Major threats to Australia's snake and lizard species

Source: Tingley et al (2019)[31]

Notes: The numbers indicate the number of species threatened by each type of threat

3.5 Threats to frogs

The next few years provide the last chance to save the most endangered frogs in Australia from extinction caused by chytridiomycosis.

Skerratt et al (2016)[4]

Australia's frog fauna

- 247 described species (+32 likely species)[34]
- ~94% endemic[35]

Extinct[36]

- Extinct: 5
- Primary cause: chytrid fungus

Nationally threatened

EPBC Act (2021)

Total: 36 species (+ 4 extinct)

- Critically endangered: 15
- Endangered: 9
- Vulnerable: 12

IUCN Red List (2020)

Total: 47 species (+ 3 extinct)

- Critically endangered: 15
- Endangered: 18
- Vulnerable: 14

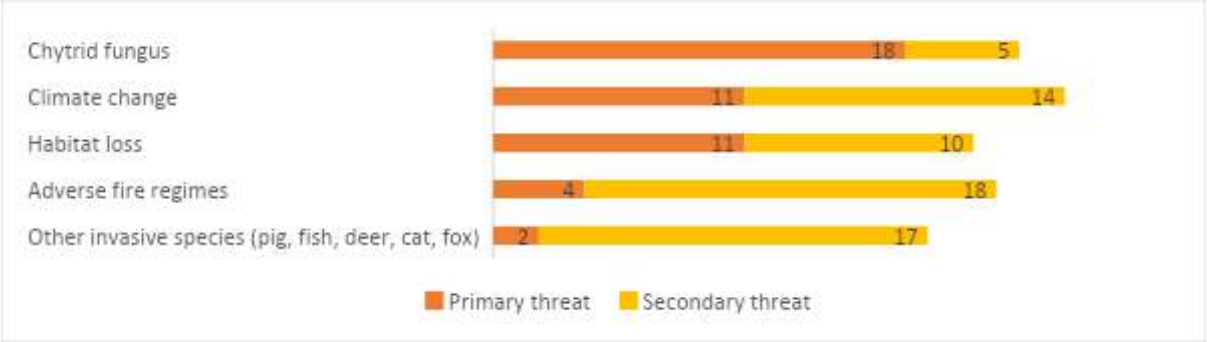
Gillespie et al (2020)[36]

Total: 40 species (+ 5 extinct)

- Critically endangered: 13
- Endangered: 11
- Vulnerable: 16

Major threats[4,36]

- Chytrid fungus (invasive pathogen)
- Climate change
- Habitat loss



Source: Gillespie et al (2020)[36]

3.6 Threats to plants

Most of Australia's imperilled plants have suffered historical declines due to habitat destruction and now survive as small, fragmented populations in small remnants that are inherently vulnerable to further loss and degradation.

Silcock & Fensham (2019)[17]

Australia's plants

- >21,000 species (predicted ~24,000)[20]
- 86% endemic[20]

EXTINCTions

- Probably extinct: 12[37]
- Likely extinct: 20[37]
- Primary cause: land clearing[2]

Nationally threatened

EPBC Act (2020)

Total: 1,231 species (+ 37 extinct)

- Critically endangered: 184
- Endangered: 502
- Vulnerable: 545

IUCN Red List (2020)

Total: 741 species (+ 3 extinct)

- Critically endangered: 92
- Endangered: 266
- Vulnerable: 383

Major threats

Most imperilled* (187 taxa)[17]

- Adverse fire regimes (24%)
- Herbivores (mostly invasive) grazing & trampling (23%)
- Urbanisation (21%)
- Invasive pathogens (*Phytophthora*, myrtle rust) (14%)
- Climate change (11%)

*Declining plants with high or moderate extinction risk

Threatened orchids (184 taxa)[38]

- Adverse fire regimes (74%)
- Weeds (65%)
- Habitat destruction (64%)
- Grazing (63%)
- Tourism & recreation (47%)
- Illegal collection (46%)

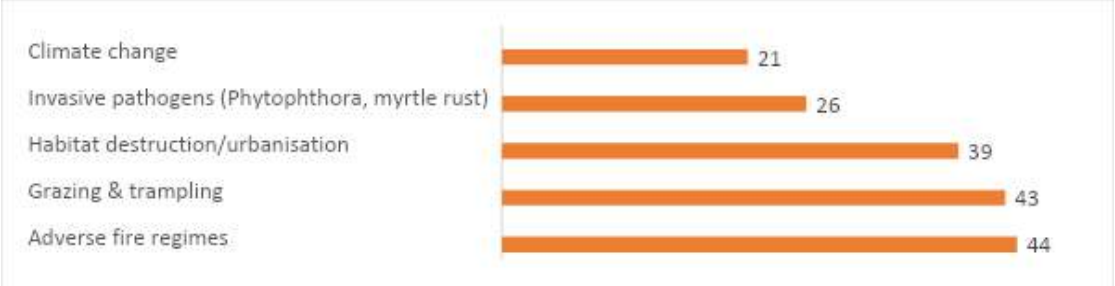


FIGURE 7. Major threats to Australia's most imperilled plants (187 taxa)

Source: Silcock & Fensham (2019)[17]

Notes: The numbers indicate the number of threatened taxa threatened by each type of threat

3.7 Threats to crayfish

The Australian continent is one of the two main centres of freshwater crayfish diversity…

Furse (2014)[39]

Australia's freshwater crayfish fauna

- >140 species
- >90% endemic

Threatened

EPBC Act (2020)	IUCN (2020)
Total: 13 species	Total: 72 species
• Critically endangered: 5 • Endangered: 5 • Vulnerable: 3	• Critically endangered: 26 • Endangered: 26 • Vulnerable: 20

Major threats*

- Climate change & severe weather
- Invasive species
- Natural system modifications (adverse fire regimes and changes to hydrology)

*Based on IUCN Red List assessments

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