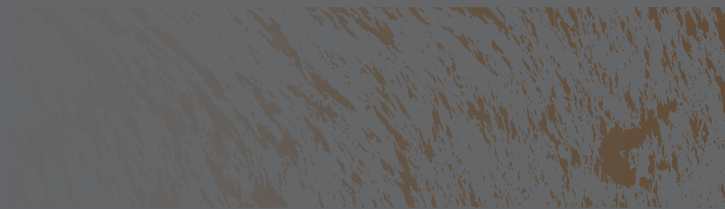
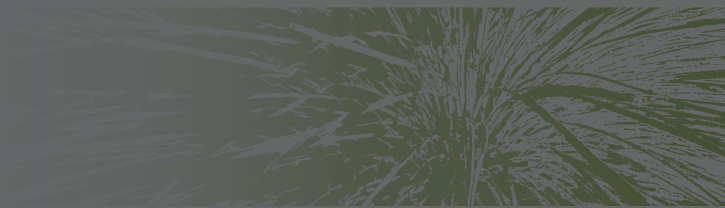


DEPARTMENT OF PLANNING, INDUSTRY AND ENVIRONMENT

Report card: Invasive species

Supplement to the NSW Biodiversity Outlook Report



This report card

This report card is a supplement to the [NSW Biodiversity Outlook Report, Results from the Biodiversity Indicator Program: First Assessment](#). Results are presented for the **Invasive species (pests, weeds, disease)** indicator. This indicator monitors the exposure of native biodiversity and ecosystems to invasive species pressures as well as the consequences (impacts) of these pressures. The **Invasive species** indicator belongs to the **Pressures** family (Figure 1). The Pressures indicator family identifies pressures which degrade the quality of ecosystems or the survival of species or ecological communities.

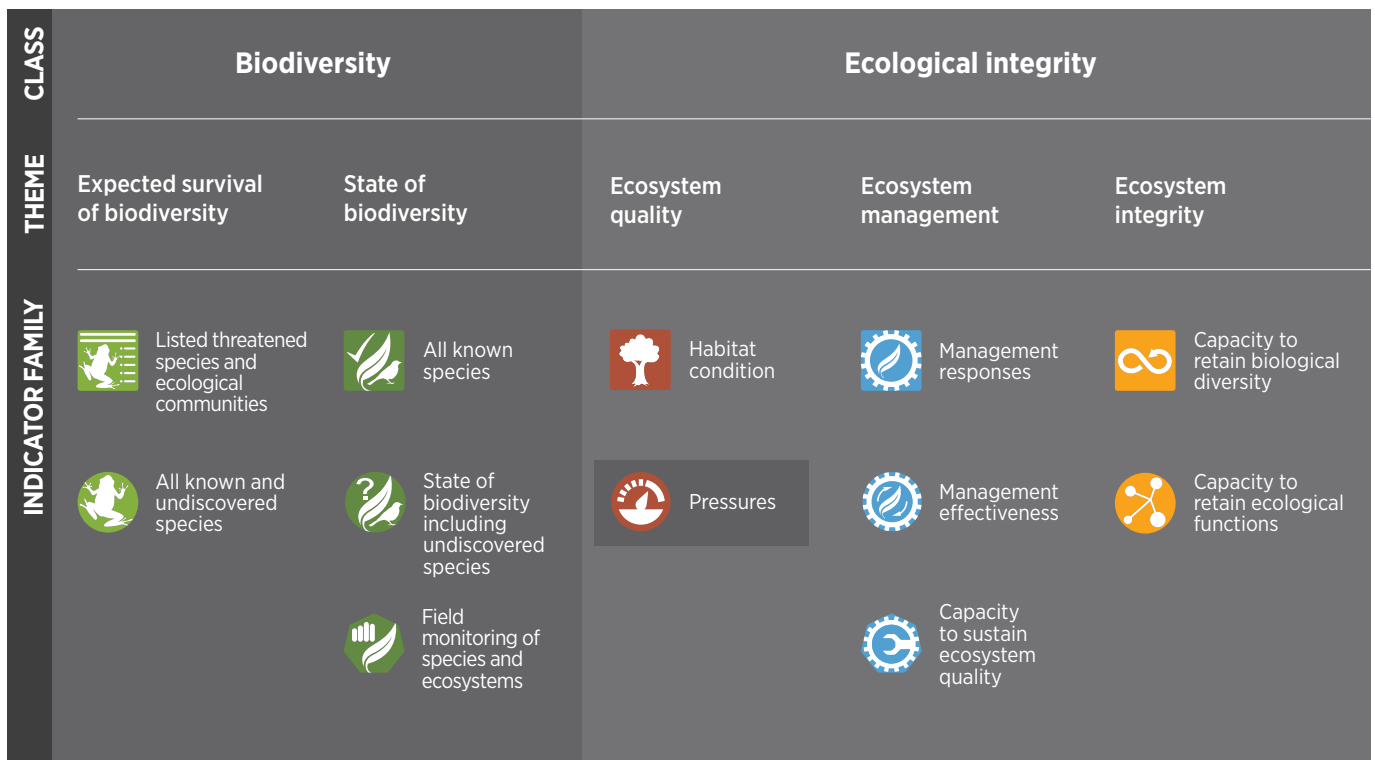



Figure 1 Nested structure used to arrange and link indicators for measuring biodiversity and ecological integrity in New South Wales. This implementation report addresses an indicator in the **Pressures** indicator family (shown by the darker grey box) within the **Ecosystem quality** theme and the **Ecological integrity** class.

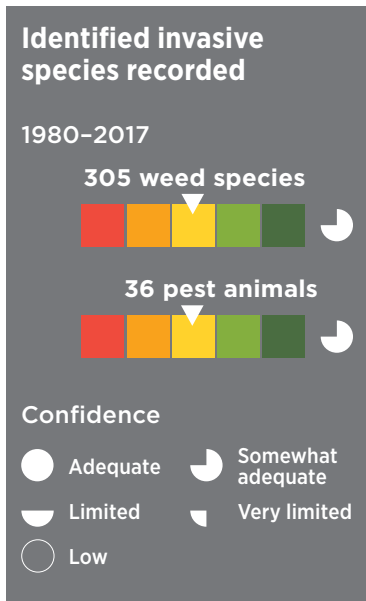


Key insights

Biodiversity is threatened by a range of pressures, such as habitat loss, climate change, and invasive pest animals, weeds and disease. Monitoring these pressures and their impact on species or entire ecological communities is critical to understanding how to respond.

305 weeds and 36 pest animals that cause biodiversity loss have been recorded across New South Wales since 1980.

Detrimental impacts of selected invasive species (15 weeds and 7 pest animals) on 97 listed threatened species and ecological communities (16 threatened animals, 46 threatened plants and 35 threatened ecological communities) were evaluated by experts in a plot study.



Indicator results: Invasive species

Exposure to invasive weeds and pest animals

305 weeds and 36 pest animals that cause biodiversity loss have been recorded across New South Wales since 1980.

The degree of exposure to pressures caused by invasive species depends on how well individual weeds and pest animals establish themselves in a location ('invasiveness'), and the overall numbers at a location ('invasion level').

This measure uses information from publicly accessible lists, location records and mapping for the most commonly identified invasive species in well-documented groups, that is, weeds and (mostly vertebrate) pest animals (see Box 1). The report card will require recalculation and updating when new information about invasive species introductions becomes available or more comprehensive surveys are conducted. This indicator can be used by NSW land managers to track the incidence of invasive species and the rate of new introductions.

In this first assessment, comprehensive coverage of disease was not possible. A case study describing biodiversity exposure to myrtle rust is provided in Box 2.

Invasive species counts vary across NSW bioregions.

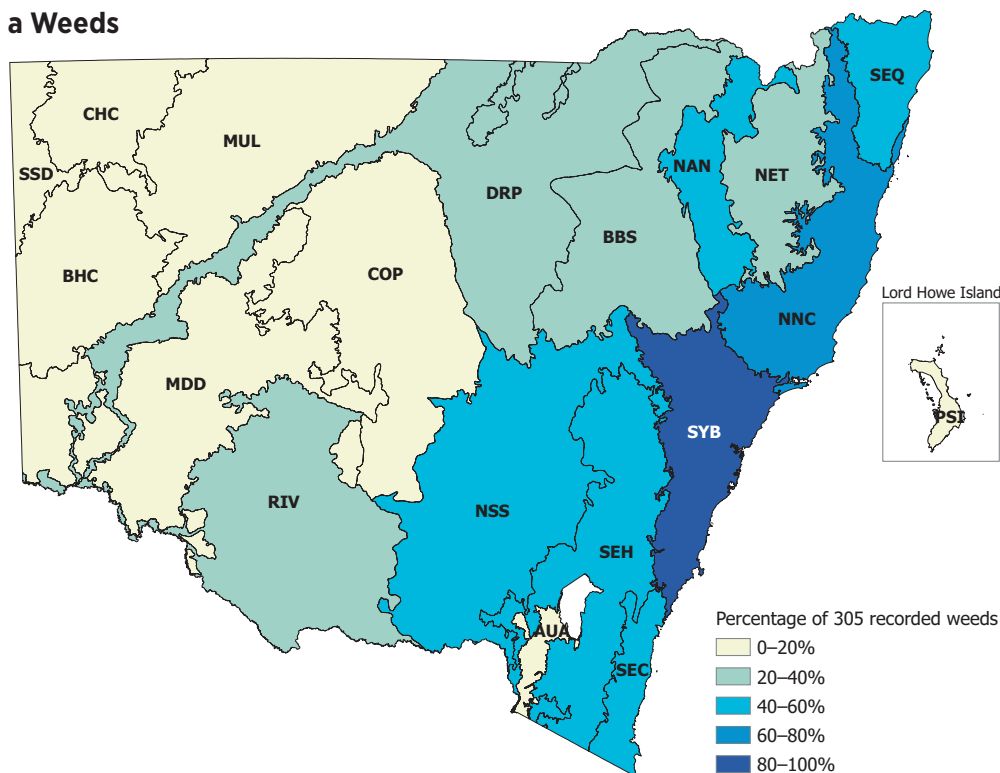
There is no place in New South Wales that is entirely free of invasive species.

The overall number of weed species varies considerably within each bioregion. Very high local weed numbers are concentrated around human population centres. Of all 305 weeds recorded in New South Wales, 264 (87%) are found in the coastal Sydney Basin bioregion and 210 (69%) in the North Coast bioregion (Figure 2a and Table 1). In contrast, only six (about 2%) are found in the inland arid Simpson Strzelecki Dunefields bioregion and four (about 1%) are found in the Channel Country bioregion (Figure 2a and Table 1).

While overall species counts are much lower for pest animal species across New South Wales (36 species recorded in the State), these pests are more evenly distributed across bioregions (Figure 2b). For example, of the 36 pest animals recorded in New South Wales, 10 species (28%) are found in Simpson Strzelecki Dunefields and 34 species (94%) are found in the Sydney Basin (Table 1).



a Weeds



b Pest animals

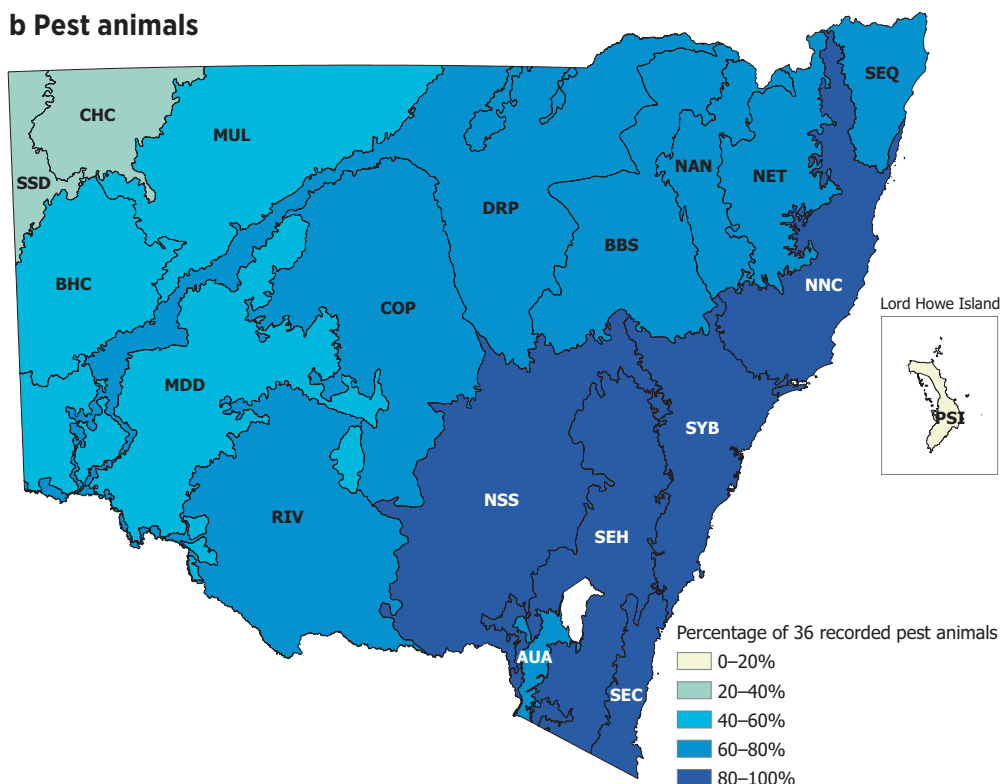


Figure 2 Exposure to invasive species recorded within NSW bioregions from 1980 to 2017. (a) Percentage of 305 weeds recorded across New South Wales and (b) percentage of 36 pest animals recorded across New South Wales. Shortened forms for bioregions are defined in Table 1.



Table 1 Weeds and pest animals in NSW bioregions.

Bioregion code	Bioregion name	Weed species (total count 305)		Pest animal species (total count 36)	
		Count	%	Count	%
AUA	Australian Alps	36	12	22	61
BBS	Brigalow Belt South	108	35	26	72
BHC	Broken Hill Complex	29	10	15	42
CHC	Channel Country	4	1	11	31
COP	Cobar Penepplain	55	18	24	67
DRP	Darling Riverine Plains	68	22	28	78
MDD	Murray Darling Depression	26	9	18	50
MUL	Mulga Lands	18	6	20	56
NAN	Nandewar	129	42	28	78
NET	New England Tableland	112	37	27	75
NNC	NSW North Coast	210	69	30	83
NSS	NSW South Western Slopes	133	43	29	81
PSI	Pacific Subtropical Islands (Lord Howe Island only)	50	16	5	14
RIV	Riverina	83	27	27	75
SEC	South East Corner	160	53	30	83
SEH	South Eastern Highlands	139	46	31	86
SEQ	South Eastern Queensland	180	59	25	69
SSD	Simpson Strzelecki Dunefields	6	2	10	28
SYB	Sydney Basin	264	87	34	94

Note: Bioregions naturally extend across state boundaries and we report only for the area within New South Wales. The table shows both the number (count) of weeds and pest animal species recorded in each bioregion, and that number as a percentage (%) of all weeds or pest animals recorded in New South Wales.

Mapping shows all New South Wales is affected by invasive species.

The most widespread weeds are Paterson's curse, sweet briar, saffron thistle and lantana; each occupying between 5% and 9% of New South Wales (Table 2).

In contrast, pest animals are more widespread. Six vertebrate pest animals each occupy more than a quarter of New South Wales and their ranges often overlap (Table 2).

Most invasive species are relatively local, each occupying less than 1% of New South Wales (84% or 257 weeds, and 36% or 13 pest animals). These locally restricted species may require specific management measures to prevent further spread and future impacts, depending on their potential to have detrimental impacts on native species and ecological communities.



Table 2 The most widespread weeds and pest animals in New South Wales.

Common name	Spatial extent (%)
Weeds	
Paterson’s curse	9
Sweet briar	5
Saffron thistle	5
Lantana	5
Pest animals	
Red fox	99
Feral cat	98
Feral rabbit	82
Feral pig	70
Feral goat	47
Wild dog	46

Note: Spatial extent is the percentage of ~5-kilometre grid cells in the State where the weed or pest animal is recorded as an established wild population.

Pilot study: Expert evaluation of the impact of selected weeds and pest animals

Invasive species have detrimental impacts on listed threatened species and ecological communities.

Experts were asked to provide information about the known detrimental impacts of a selected set of 22 invasive species (15 weeds and seven pest animals) on 97 listed threatened species and ecological communities (16 threatened animals, 46 threatened plants and 35 threatened ecological communities) (Box 3). Experts evaluated the level of impact an invasive species has on a threatened species or ecological community by assigning one of five categories. The categories corresponded to minimal or minor impacts on individuals, a decline in population size or a change in community composition (moderate impact) and local extinction, which may be reversible (major impact) or irreversible (massive impact) (Box 3).

The study found there was an 85% chance that evaluated threatened species are experiencing a decline in population size, and that evaluated threatened ecological communities are experiencing changes to their composition due to impacts from the selected set of weeds (Figure 3a).

There was a 57% chance that an evaluated weed could cause a local population extinction of a threatened species or characteristic species of a threatened ecological community (Figure 3b).

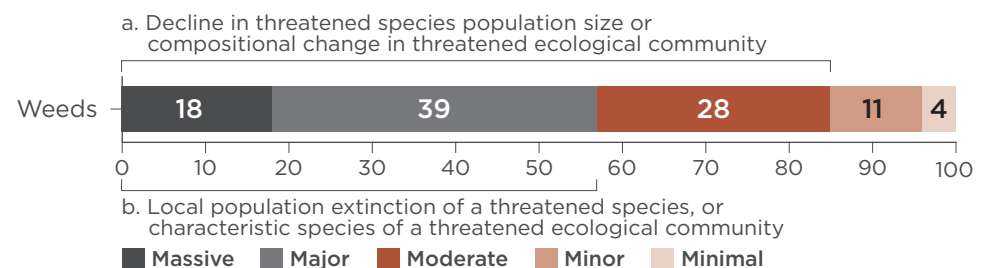


Figure 3 Impact of a selected set of weeds on evaluated listed threatened species and ecological communities. Values are the average expert evaluated likelihood (in percent of total) that impacts are of a certain magnitude (one of five impact categories)



There was a 78% chance that expert evaluated threatened species are experiencing a decline in population size, and evaluated threatened ecological communities are experiencing changes to their composition due to impacts from the selected set of pest animals (Figure 4a).

There was a 36% chance that an evaluated pest animal could cause a local population extinction of a threatened species or characteristic species of a threatened ecological community (Figure 4b).

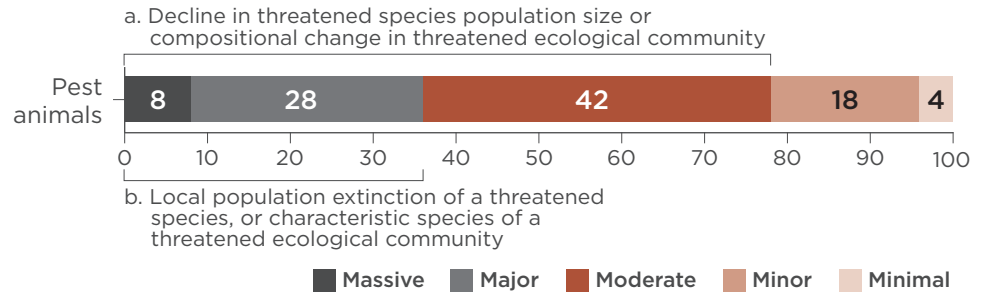


Figure 4 Impact of a selected set of animals on the evaluated listed threatened species or ecological communities. Values are the average expert evaluated likelihood (in percent of total) that impacts are of a certain magnitude (one of five impact categories)

Nine of the selected set of 22 invasive species are most harmful.

These nine species have, on average, a greater than 50% chance of causing a local population extinction of a listed threatened species or at least one characteristic species in at least one remnant patch of a threatened ecological community.

The nine species comprise one pest animal (red fox) and eight weeds: three perennial grasses (African lovegrass, coolatai grass and serrated tussock), two vines (cat’s claw creeper and Madeira vine), two woody shrubs (bitou bush and lantana) and one invasive tree (African olive). See Figure 5 and Figure 6 (species outlined in red are the most harmful).

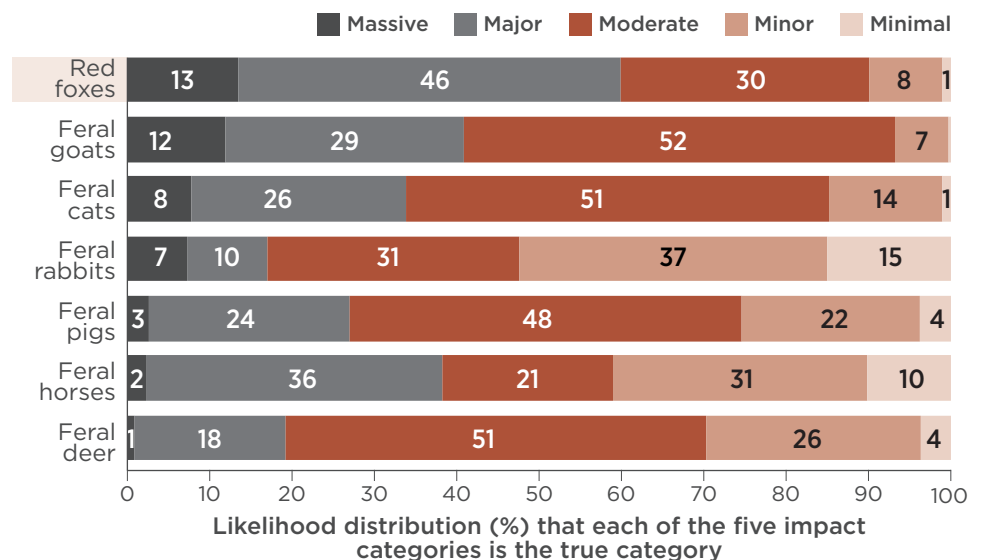


Figure 5 Impact of a selected set of pest animals on the evaluated threatened species or ecological communities. Values are the average expert evaluated likelihood (in percent) that impacts are of a certain magnitude (one of five impact categories). Species outlined in red is the most harmful pest animal.

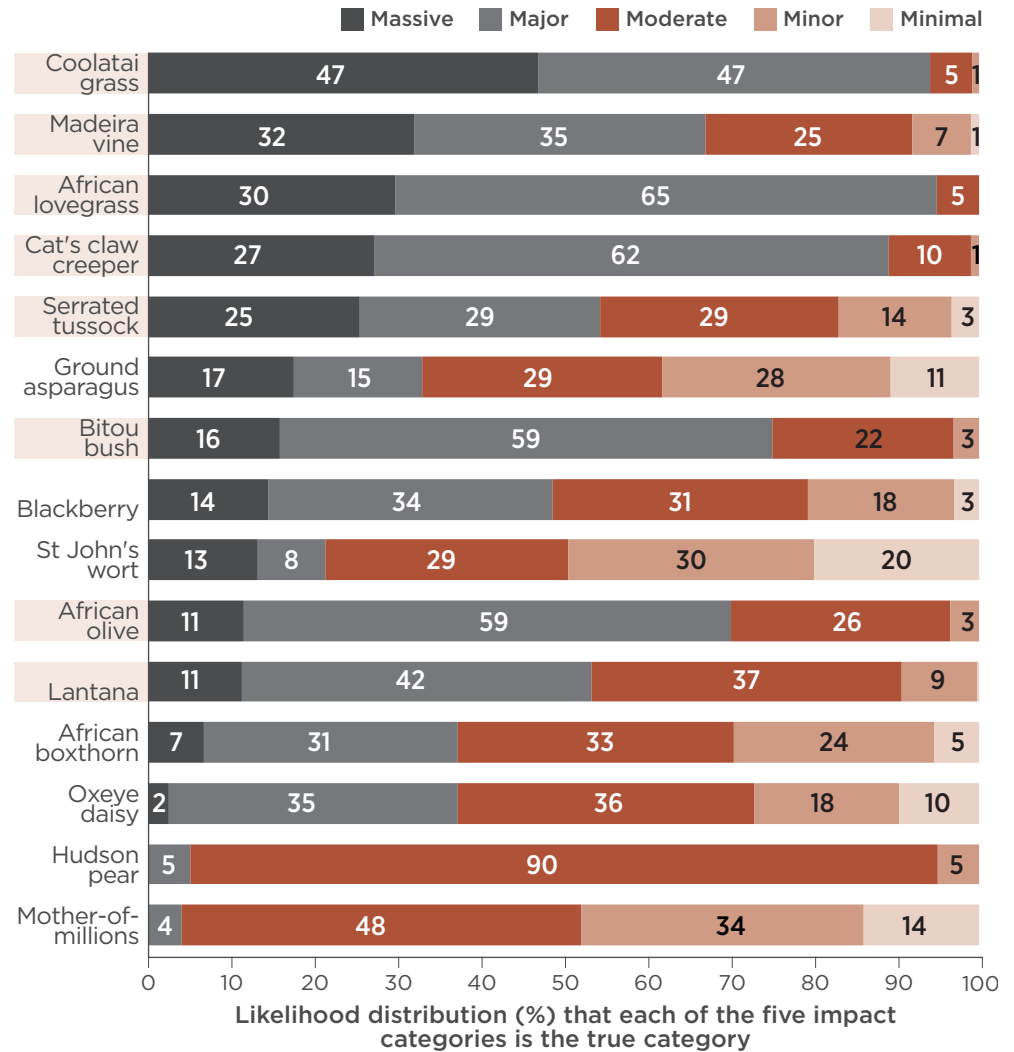


Figure 6 Impact of a selected set of weeds on the evaluated threatened species or ecological communities. Values are the average expert evaluated likelihood (in percent) that impacts are of a certain magnitude (one of five impact categories). Species outlined in red are the eight most harmful weeds.

Box 1 Invasive species



In this report card, ‘invasive species’ are those species (plant, animal or disease) that do not naturally occur in any location in New South Wales and whose introduction or spread threatens biodiversity and ecosystems. These species are known technically as ‘invasive alien species’.

Disease is not covered in this report card due to a scarcity of data. A myrtle rust case study (see Box 2) highlights the role of monitoring and surveillance.

An invasive species status list of known threats to native biodiversity and ecosystem quality in New South Wales was compiled from nine data sources. Occurrence records for these species were obtained from publicly accessible datasets. These mainly capture commonly identified invasive species in the most well-documented groups, that is, weeds and (mostly vertebrate) pest animals.

Comprehensive surveys establishing the presence or absence of invasive species are rarely available at the statewide scale. Additional information from a range of unpublished sources (including field data) would enhance data completeness and comparability.



Box 2 Invasive disease: Myrtle rust, a key threatening process



Myrtle rust is an introduced and highly invasive fungal disease from South America, and a key threatening process impacting biodiversity. The fungus negatively affects plants within the Myrtaceae family (such as paperbark, tea-tree, eucalypt and lilly pilly). First detected in Australia in 2010, myrtle rust has established along the entire eastern seaboard of the mainland, as well as parts of the Northern Territory and marginally in parts of Tasmania and Victoria.

Myrtle rust spores are mostly dispersed by wind. In mainland New South Wales it is thought the pathogen already fully occupies locations that meet its climate and environmental needs. This includes a range of ecosystems such as coastal heath, shoreline vegetation, subtropical and tropical rainforest, wet and dry sclerophyll forests and sand island ecosystems.

Myrtle rust cannot be eradicated in mainland New South Wales by any means currently available. Its impact on infected plants ranges from minor leaf spotting, to loss of new stem and foliage growth; and cumulative infection can lead to defoliation, dieback, and death of plants. Flower and fruit infection affect the plant's ability to reproduce.

The *Saving our Species* program has drafted a strategy in response to the key threatening process listing of myrtle rust under the *Biodiversity Conservation Act 2016*. The strategy aims to understand and manage the impact of myrtle rust on Myrtaceae species in New South Wales by:

1. monitoring species and communities at risk of decline and securing populations through seed and plant collection and storage
2. conducting research to enable long-term conservation of affected species and associated plant communities
3. improving management and monitoring through collaboration among government and non-government partners.

All Australian Myrtaceae species that grow where there are suitable conditions for the pathogen are potentially susceptible to myrtle rust. In New South Wales, the previously common and widespread scrub turpentine and native guava were listed as critically endangered in February 2019 because of severe declines due to myrtle rust. The *Saving our Species* program enacted emergency conservation actions to rapidly survey the entire range of both species, determine myrtle rust impact and identify any myrtle-rust-resistant populations, sites or individuals. Nationally, there are around 45 species known or suspected to be declining due to myrtle rust. Little is known about the impacts of myrtle rust on ecological communities dominated by Myrtaceae.



Box 3 Pilot study: Assessing the impact of invasive species



Collecting direct evidence about the interactions and impacts of invasive species on native species or ecological communities is time consuming and expensive. As part of this report card, a pilot study to assess impacts of invasive species was undertaken in 2019. Thirty-six experts used available data and current knowledge to assess the magnitude of impact of a selected set of invasive species (seven pest animals and 15 weeds) on 97 listed threatened species and ecological communities (16 threatened animals, 46 threatened plants and 35 threatened ecological communities). Experts evaluated magnitude of impact through a series of structured steps, one of which was to assign to a particular interaction one of five impact categories. Categories are:

- **massive:** where interaction causes irreversible local extinction of a listed threatened species or irreversible local extinction of a characteristic species of a listed threatened ecological community
- **major:** where interaction causes reversible local extinction of a listed threatened species or reversible local extinction of a characteristic species of a listed threatened ecological community
- **moderate:** where interaction causes decline in population size of listed threatened species or decline in population size of a characteristic species of a listed threatened ecological community.
- **minor:** where interaction causes reduction in performance of individuals of listed threatened species or reduction in performance of individuals of a characteristic species of a listed threatened ecological community.
- **minimal concern:** causes negligible impacts.

More information

Froese JG, Gooden B, Hulthen AD, Ponce-Reyes R, Burley AL, Cherry H, Hamilton M, Nipperess DA, Russell B, West P & Williams KJ 2021, *Assessing invasive alien species pressures on biodiversity in NSW*, Biodiversity Indicator Program Implementation Report, Department of Planning, Industry and Environment, Sydney, Australia, environment.nsw.gov.au/research-and-publications/publications-search/assessing-invasive-alien-species-pressures-on-biodiversity-in-new-south-wales.

Froese JG, Gooden B, Hulthen AD, Ponce-Reyes R, Burley AL, Cherry H, Hamilton M, Nipperess DA, Russell B, West P & Williams KJ 2021, *Assessing invasive alien species pressures on biodiversity in New South Wales: Data packages for the Biodiversity Indicator Program, first assessment*, *SEED Portal*, datasets.seed.nsw.gov.au/dataset/biodiversity-indicator-program-data-packages.



Glossary



Alien: not naturally occurring in any location in New South Wales.

Characteristic species: a native species that, together with other native species and biological features, defines the identity of an ecological community.

Disease: any disease of a native species that is caused by a pathogen that is an invasive species.

Extirpation: the elimination of all individuals of a local population of a native species, or all individuals of a characteristic native species from a remnant patch of an ecological community.

Invasion level: the severity of the observed invasion at a location; this could be affected by the richness, abundance and diversity of both invasive species and native species.

Invasiveness: the ability of an invasive species to spread, establish and persist in a location.

Invasive species exposure: exposure to invasive species pressures, that is, the presence, size and extent of these pressures on native biodiversity and ecosystems.

Invasive species impact: the consequences of invasive species pressures, that is, the magnitude of changes to the properties of ecosystems caused by invasive species that reduce native biodiversity or alter ecosystems to the detriment of native biodiversity.

Invasive species pressure: the threat posed by invasive species to native biodiversity and ecosystems.

Listed key threatening processes: pests and weeds, climate change and habitat loss are some of the key threatening processes facing native plants and animals. A threat may be listed as a key threatening process under Schedule 4 of the *NSW Biodiversity Conservation Act 2016* if it: (i) adversely affects threatened species or ecological communities; and (ii) could cause species or ecological communities to become threatened.

Local population: a geographically or otherwise distinct group of individuals of a native species, which may be connected to other groups of individuals by frequent immigration to may form a subpopulation. In situations where a single group of individuals of a native species is isolated from other groups of individuals, local population and subpopulation are the same.

Local population extinction: the elimination of all individuals of a local population of a native species, or all individuals of a characteristic native species from a remnant patch of an ecological community. Also known as extirpation.

Magnitude of impact: the intensity of detrimental impacts caused by invasive species. Here referring to one of five impact categories that differentiate impact depending on the level of biological organisation of a native species, or a characteristic species of a native ecological community, that is impacted and the consequences of this impact.

Native: naturally occurring in at least one location in New South Wales.

Occurrence record: information about the presence of a species in a given location.



Pest animal: any animal, whether vertebrate or invertebrate and in any stage of biological development, that is an invasive species.

Remnant patch: a geographic location in which groups of individuals of the characteristic native species that define the identity of an ecological community co-occur.

Reversibility, reversible: here referring to evidence (in a hypothetical scenario) that if an invasive species were no longer present in an area where a local population of a native species, or a characteristic native species of an ecological community, has been extirpated, the impacted native species, or characteristic species of a native ecological community, **would likely return** to the area within 10 years or three generations, whichever is longer, without additional human assistance that was not already in place at the time the invasive species led to the local population extirpation.

Reversibility, irreversible: here referring to evidence (in a hypothetical scenario) that if an invasive species were no longer present in an area where a local population of a native species, or a characteristic native species of an ecological community, has been extirpated, the impacted native species, or characteristic species of a native ecological community, **would not return** to the area within 10 years or three generations, whichever is longer, without additional human assistance that was not already in place at the time the invasive species led to the local population extirpation.

Weed: any plant, whether vascular or non-vascular and in any stage of biological development in the taxonomic kingdom of Plantae, that is an invasive species.





Acknowledgements

Developing this report card has drawn on a wide range of knowledge and expertise and would not have been possible without the dedication and input of many people. We thank them most sincerely:

Donella Andersen, Graeme Armstrong, Nancy Auerbach, Tony Auld, Ron Avery, Laura Babian, Guy Ballard, Michelle Ballestrin, Mathew Bell, David Berman, Clare Brandon, James Brazill Boast, Alana Burley, Matt Cameron, Madelaine Castles, Tom Celebrezze, Steve Chapple, Hillary Cherry, Troy Crittle, James Dawson, Michael Drielsma, David Egan, Gareth Evans, Peter Fleming, Jens Froese, Ben Gooden, Mark Hamilton, Matt Hayward, Andrew Hulthen, Stephen Johnson, David Keith, Robert Kooyman, Wayne Kuo, James Lawson, Enhua Lee, Michelle Leishman, Jedda Lemmon, Mark Littleboy, Jamie Love, Paul Mahon, Peter Michael, Andrew McConnachie, Melodie McGeoch, Danielle Murphy, Helen Murphy, David Nipperess, David Parker, Deyarne Plowman, Rocio Ponce-Reyes, Brad Purcell, Julia Rayment, Nick Reid, Sharon Rolfe, Benjamin Russell, Raghu Sathyamurthy, Tim Scanlon, Mel Schroder, Peter Sherratt, Chris Slade, Jill Smith, Rob Smith, Phil Spark, Steve Taylor, Jeff Thomas, Sean Thompson, Alyssa Trotter, Peter West, Kristen Williams, Genevieve Wright.



Prepared by:

The Department of Planning, Industry and Environment

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Published by:

Department of Planning, Industry and Environment 59 Goulburn Street, Sydney NSW 2000 PO Box A290, Sydney South NSW 1232

Phone: +61 2 9995 5000 (switchboard) Phone: 1300 361 967 (DPIE and national parks enquiries) TTY users: phone 133 677, then ask for 1300 361 967 Speak and listen users: phone 1300 555 727, then ask for 1300 361 967

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This report should be cited as: DPIE 2021, *Report card: Invasive species, Supplement to the NSW Biodiversity Outlook Report*, Department of Planning, Industry and Environment, Sydney.

978-1-922715-90-6; EES 2021/0486; October 2021



