Nominating Threatened Species in Queensland

A Practical Manual

Version 4.1

DELIVERING FOR QUEENSLAND

Queensland Government

Prepared by: Queensland Herbarium and Biodiversity Science
Department of the Environment, Tourism Science and Innovation.

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Version control

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V1	TDC	VJN	Minor text edits.	21 Aug 2022
V2	TDC	VJN	Transfer to Queensland Government template for publication. Key Parameter Table example added. Updated examples provided throughout.	29 Oct 2022
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V4.1	TDC	GB	Minor text edits to taxonomy section. Revision of table 19.	18 Aug 2026

List of figures

i. Introduction

i.i Listing and changing the conservation status of Queensland species

All plant and vertebrate species native to Queensland (excluding most fish, which are managed under the Queensland *Fisheries Act 1994*) are protected under the *Nature Conservation Act 1992* (*NC Act*). These taxa are assigned to various wildlife classes depending on their risk of extinction. Plants and vertebrates (excluding fish) are assigned a status of 'Least Concern', unless they have been assessed as eligible for a different wildlife class. A plant under the *NC Act* is defined as any member of the plant or fungus kingdom. Fish and invertebrate taxa are only protected under the *NC Act* if they have been separately listed under a wildlife class. The Department of the Environment, Science, Tourism and Innovation (the Department) coordinates the process for assessing and listing (or delisting) species under the *NC Act.*

In Queensland, changes to a species' wildlife class are assessed via a formal nomination process. To nominate a species to change wildlife class under the NC Act, the Nomination to change the conservation status of a species under the *Queensland Nature Conservation Act 1992* form must be completed. The Species Technical Committee (STC) undertakes the expert assessment of species listing nominations. Any subspecies, variety, race, hybrid, mutation or geographically separate population (hereafter 'species') can be nominated. Nominations can be prepared and submitted internally by Queensland Government scientists or externally by members of the public. Other jurisdictions can also forward nominations to the STC for consideration. The STC make recommendations to the Minister for the Environment and Minister for Science and Innovation (the Minister) to list or change the wildlife class of a species. Once this has been approved, wildlife classes are then amended in the *Nature Conservation (Plants) Regulation 2020* or the *Nature Conservation (Animals) Regulation 2020*.

i.ii Common Assessment Method (CAM)

The Common Assessment Method (CAM) is a consistent approach to listing threatened species across all Australian jurisdictions (State, Territories and the Australian Government). Previously, species nominations were assessed using different criteria, threat categories and scales of assessment, thus resulting in differences between lists and duplication of effort.

The Queensland Government is a signatory to the Intergovernmental Memorandum of Understanding – Agreement on a Common Assessment Method (CAM MOU) for listing of threatened species and threatened ecological communities, which governs the implementation of CAM. The CAM MOU outlines a standardised approach to species' assessments throughout Australia's State, Territory and Australian Government jurisdictions. The approach is based on the International Union for the Conservation of Nature (IUCN) Red List categories and criteria. Under CAM, States and Territories lead the assessments for their respective endemic species, and the Australian Government leads assessments for cross-jurisdictional species. The Queensland Herbarium and Biodiversity Science (QHBS) and Threatened Species Operations (TSO) Business Units are responsible for implementing CAM in Queensland.

To facilitate the implementation of CAM, Queensland amended the wildlife classes under the *NC Act* in August 2020. Species can now be listed in Queensland under wildlife classes of Extinct (EX), Extinct in the Wild (EW, sometimes referred to as PE in WildNet), Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT) or Least Concern (LC, sometimes referred to as C in WildNet). The CR, EN and VU categories are considered 'threatened'. Prior to August 2020, the CR category did not exist.

The IUCN does not have specific thresholds for NT. Rather, species can be considered NT where they "*do not qualify as threatened now, but may be close to qualifying as threatened, and to taxa that do not currently meet the criteria for a threatened category but are likely to do so if ongoing conservation actions abate or cease*". To avoid confusion, Queensland has introduced quantitative guidelines for the Near Threatened category based on the examples provided by the IUCN Standards and Petitions Committee (2024).

Currently, the VU under Criterion D2 and NT categories are not present within Australian Government legislation. This means that a species can be listed as VU under D2 or NT in Queensland but remain not listed under the *Environment Protection and Biodiversity Conservation Act (EPBC Act),* thus remaining 'misaligned'. Conversely, the *EPBC Act* category of 'Conservation Dependent' is not available within the *NC Act.*

i.iii Using this manual

This manual is intended to be used alongside the Nomination to change the conservation status of a species under the *Queensland Nature Conservation Act 1992* form (the nomination form) and the Guidance for using the nomination for to change the conservation class of a species under the *NC Act*. Each section in this manual aligns with those in the nomination form. This allows nominators to work sequentially through the nomination form, using the manual as a guide for each section.

ii. Completing the nomination form

This section explains the level of detail required for each section of the nomination form. Each heading below corresponds to a section in the nomination form (i.e. section 1 Taxonomy aligns with section 1 of the nomination form). These are presented sequentially as per the nomination form.

The following preparation work should be undertaken prior to completing the nomination form.

ii.i Collate background information

Start the nomination process by collating the relevant background information required to complete the nomination form. Refer to Section 19 ('Key Resources') for additional information.

Create a folder labelled with the species name to save all relevant data and materials. This folder can then be easily shared with experts when reviewing the nomination, or others who may be nominating similar taxa. A suggested folder structure includes the following subfolders:

  - Nomination form
  - Data and maps
  - Correspondence
  - Photos
  - Supporting information (references and previous listing assessments)
  - Superseded files

- Download the *nomination form* and save it into the species folder.

ii.ii Literature Review

Undertake a literature review for the species. Save relevant information to the species folder. Peer-reviewed publications on the species or its genus are especially valuable. If information is scarce, information on related taxa will be particularly useful. Remember to search for synonyms (previous names) of the species (refer Section 1.1). Some sources of literature to consider:

- The original species nomination form (if the species is currently listed as threatened). This may be unpublished and need to be requested from the Queensland Herbarium and Biodiversity Science.
- The taxonomic paper in which the species was described.
- Peer-reviewed journal articles (Google Scholar or similar databases) related to the biology and ecology of the species or the genus more broadly.
- Textbooks / field guides
- Management Plans for conservation areas where the species occurs.
- The Species Profile and Threats Database (SPRAT) if the species is already listed by the Australian Government.
- Grey literature sources from local governments/councils/NRM groups.

Nominators should familiarise themselves with the content of the literature and start to relate this to the nomination form sections.

Eucryphia wilkiei is restricted to elevations above 1000m on Mt Bartle Frere in the Wet Tropics bioregion. The species was recently reassessed using the Common Assessment Method as Critically Endangered due montane drying associated with future climate changes.

Image © Andrew Ford.

1 Taxonomy

1.1 Species name

The following section describes how to define the nominate species for the purposes of assessment.

Confirm the current name of the species. Species names can change with taxonomic revisions and may differ between jurisdictions depending on the accepted taxonomy. If there is any contention about the species' name, or description whilst gathering information to fill out this section of the form, it may indicate some taxonomic uncertainty. Taxonomy can substantially influence the listing outcome for a species. If nominators find evidence to suggest the species may not be taxonomically sound, it is important to seek guidance from the Species Technical Committee (STC) and/or the relevant experts to determine whether to progress the species nomination.

- *For CAM-compliant listings*, current names should be obtained from the Australian National Species List (which has multiple indices):
  - For flora, the accepted authority for taxonomy is the Council of Heads of Australasian Herbaria (CHAH), which is available via the Australian Plant Name Index (APNI) or the Australian Plant Census (APC). The currently accepted name in the APC will be indicated by a 'red tick' (Figure 1). Nominators should cross check the taxonomy in the Census of the Queensland Flora and Fungi (Queensland Herbarium and Biodiversity Science, 2025) and any updated names in WildNet (which may occur between annual census releases). Where the taxonomy differs, this should be documented and potentially discussed with the STC.
  - For fauna, the accepted authority for taxonomy is the Australian Faunal Directory (AFD). However, nominators should cross check the currently accepted taxonomy in WildNet. (Figure 2). Where the taxonomy differs, this should be documented and potentially discussed with the STC.
  - For bryophytes, lichens, algae and fungi, follow the Census of the Queensland Flora and Fungi (Queensland Herbarium and Biodiversity Science, 2025), and/or the relevant list within the Australian National Species List. Where the taxonomy differs, this should be documented and potentially discussed with the STC.
  - For varieties and hybrids (flora only), the Queensland Plant Census (Queensland Herbarium and Biodiversity Science, 2025), or updated names in WildNet should be followed.
- Note of any synonyms that may be useful to include in the literature review (see Section 1.3.5).
- Identify and save the paper where the species was formally described. For plants, the reference for this should be listed in the APNI search (Figure 1). Most taxonomic descriptions for Queensland endemic plants are published in *Austrobaileya,* which is freely available online (see Section 19).
- In some cases, it is appropriate to supplement the original taxonomic paper with a contemporary description of the species (for example, if the description is very brief as with some historical descriptions, or is written in a language other than English such as Latin). For fauna, edited field guides/reference texts such as Reptiles and Amphibians of Australia (Cogger, 2018) may be suitable. For flora, a contemporary description may be found in the *Flora of Australia.* Note that the botanical / scientific name will retain the authority of the original species author.

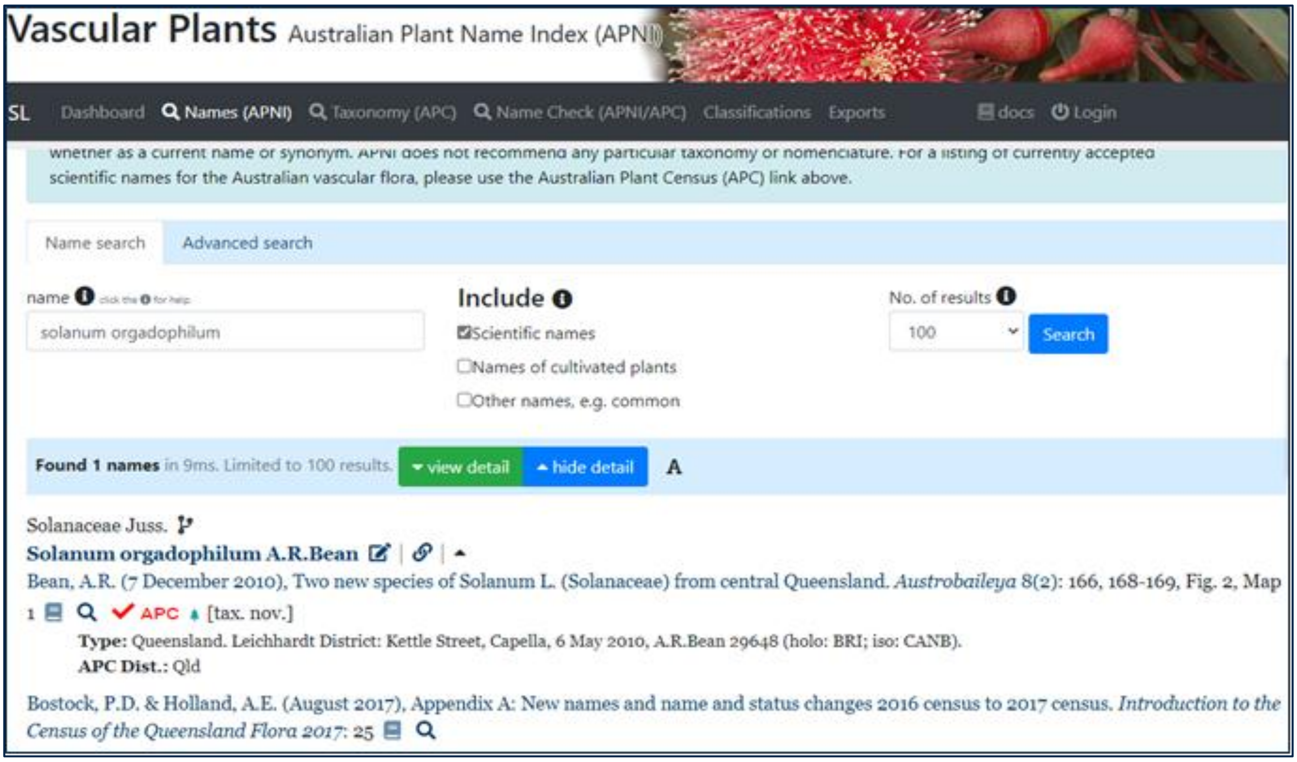


Figure 1. Screenshot of the Australian Plant Name Index, showing a search for *Solanum orgadophilum*. The red text indicates the currently accepted taxonomy.

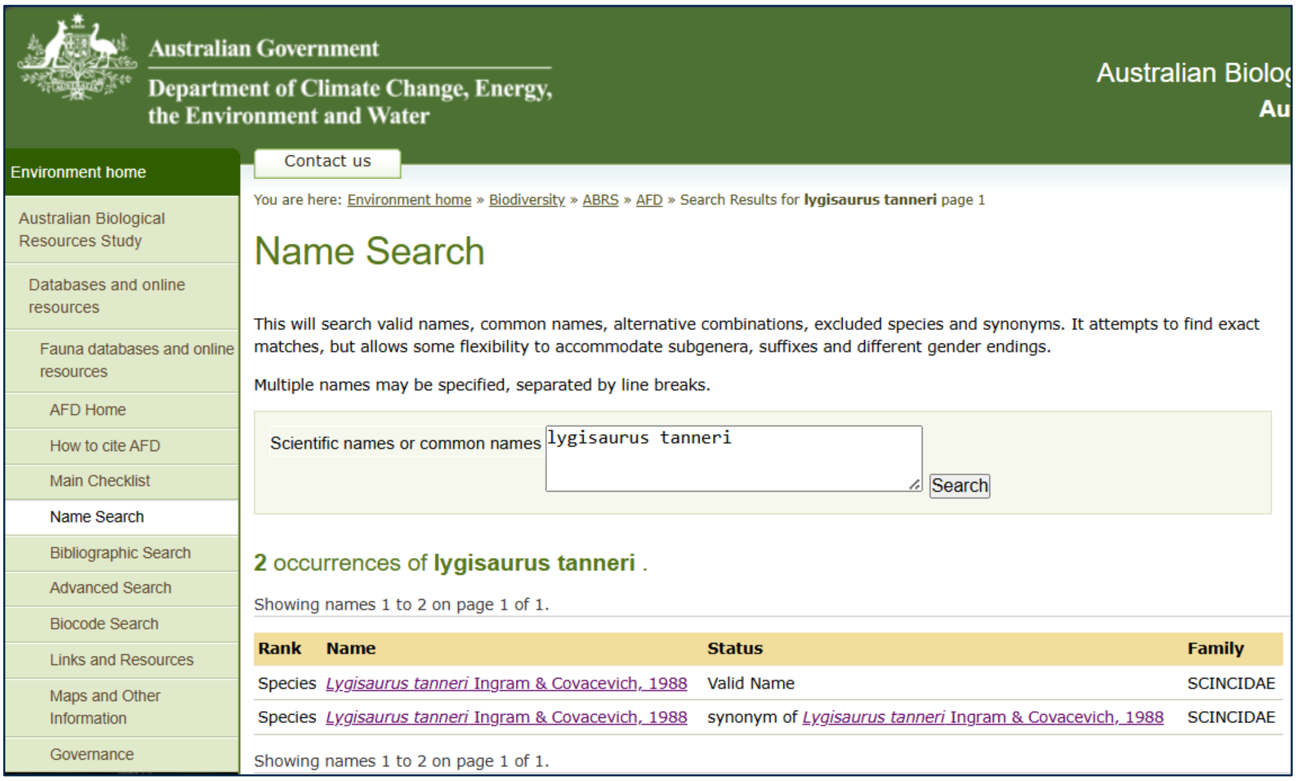


Figure 2. Screenshot of the Australian Faunal Directory, showing currently accepted taxonomy for *Lygisaurus tanneri.*

1.1.1 Scientific name

Provide the scientific name including species author (Box 1.).

1.1.2 Common name

Enter frequently used common names for the species (Box 1.). Nominators may include any published Indigenous names, if they are from a reputable source, preferably connected to the Traditional Custodians, such as a bush-tucker book authored by the relevant Traditional Custodians. If used, it may be helpful to provide the First Nations group in brackets after the relevant name.

Box 1. Example of text format for the 'Name of species' in the nomination form.

Scientific name *Lygisaurus tanneri* Ingram & Covacevich, 1988 **Common name** Endeavor River litter-skink
Scientific name *Solanum orgadophilum* A.R.Bean **Common name** Capella potato bush

Note: the style guidelines for the Queensland Government do not capitalise common names unless they form part of a proper noun. For example, 'Capella potato bush' (noting that 'Capella' is a proper noun).

Note: scientific names must be used for species mentioned throughout the text of the nomination (except for certain fauna with a well-established common name [i.e. feral pigs, koala, etc]).

1.2 Taxonomic scale of categorisation

1.2.1 Scale of categorisation

Select the relevant taxonomic categorisation for the nominate species. According to the CAM MOU, eligible species include all native organisms within the taxonomic units of species, subspecies and varieties. Populations and hybrids are also eligible if they meet specific criteria (see below).

Taxa can only be listed at one taxonomic level (i.e. species or subspecies, but not both). Nested listings, where taxa are listed at multiple levels are being resolved as part of CAM implementation. Where a taxon is listed at the species level, it includes relevant infraspecific taxa. Where a taxon is listed at the infra-specific level, other relevant infra-specific taxa are not afforded the same wildlife class and thus require a separate assessment.

1.2.2 For a population

Nominators should contact the STC or relevant experts to seek prior endorsement for nominating a population. Populations can be nominated if they:

- are not part of a taxon that is eligible for listing as nationally threatened; and
- are geographically isolated; and

- are distinct; and
- can be defined in a way that differentiates it from all other populations.

Geographic isolation should be justified with reference to the dispersal capacity of the taxon. Distinctiveness should be justified using evidence of genetics, phylogeny, morphology, ecology, physiology, behaviour, ecosystem role or other aspect of the population's biology. Justify the scale of categorisation for a population in the box provided (Box 2).

1.2.3 For a hybrid

Hybrids can be nominated if they are:

- a distinct entity (the progeny are consistent within the agreed taxonomic limits for that taxon group);
- capable of self-perpetuating (not reliant on parent stock for replacement); and
- the product of a natural event (both parents are/were naturally occurring, and cross-fertilisation was by natural means.

Nominators should contact the STC or relevant experts to seek prior endorsement for nominating a hybrid.

Box 2. Example justification for nominating a population based on geographic isolation, genetic and morphological distinctness, and the species of which the population is a part not being eligible for a national threatened status[1].

Details

Nepenthes mirabilis (Bramston Beach) is a distinct population of the greater *N. mirabilis* taxon, of which the main population occurs in the Cape York Peninsula (CYP) from the Jardine River south to the Silver Plains on the east coast, and south of Aurukun on the west coast (Figure 1) (A. Field, pers. comm. 2023; A. Ford, pers. comm. 2023). *Nepenthes mirabilis* (Bramston Beach) is distinguished from the northern population by its homozygosity, whereas the northern population has been observed to hybridise with other *Nepenthes* spp., namely *N. tenax* and *N. rowaniae*; which co-occur with *N. mirabilis* within the CYP *N. mirabilis* distribution (A. Field, pers. comm. 2023). While it is possible that *N. mirabilis* (Bramston Beach) may have the ability to obtain heterozygous genetics resulting from hybridisation, the fact that it has not hybridised thus far distinguishes the population from the CYP *N. mirabilis* population by being the most genetically isolated and highly homozygous population (A. Field, pers. comm. 2023).

A preliminary assessment of *N. mirabilis* indicates the species is not eligible for listing as threatened on a national scale. Therefore, *N. mirabilis* (Bramston Beach) is considered eligible for a population level assessment under the Common Assessment Method.

1.3 Taxonomy authority

1.3.1 For conventionally accepted species

Conventionally accepted species are those that are formally described and listed in the relevant authoritative taxonomic list for flora and fauna, respectively. For flora, the accepted authority for taxonomy is the Council of Heads of Australasian Herbaria, listed in APNI. However, nominators

[1] Excerpt adapted from Department of the Environment, Science and Innovation (2024). Nomination to change conservation class of *Nepenthes mirabilis* (Bramston Beach) under the Queensland *Nature Conservation Act 1992*.

should also refer to the currently accepted taxonomy in the Queensland Plant Census (Queensland Herbarium and Biodiversity Science, 2025).

For fauna, the accepted authority for taxonomy is either the Australian Faunal Directory, except where the State agrees on an updated taxonomy and nomenclature based on the latest scientific evidence. Nominators should also refer to the currently accepted taxonomy in WildNet. If the nomenclature differs, nominators should contact the Species Technical Committee for advice on which nomenclature to use.

For algae, bryophytes, lichens and fungi, the accepted authority for taxonomy is listed in the corresponding Australian National Species List, but also follow Queensland Herbarium and Biodiversity Science (2025).

If a species name is likely to be imminently updated due to recent scientific evidence, it can be nominated under the updated name and the box selected identifying that ‘a taxonomy and nomenclature agreed upon by relevant parties based on the latest scientific evidence’. The relevant parties will include species experts and the STC.

Even where a species with a phrase name is conventionally accepted (i.e. is included on relevant authoritative lists), it is advised to include the supporting documentation required for species that are not conventionally accepted (see Section 1.3.2).

This section should also be completed for ‘populations’ described in Section 1.2.2 using the taxonomy of the species.

1.3.2 For species that are not conventionally accepted

Species that are not considered conventionally accepted are those without a formal (published) description, that are also not included in the relevant accepted taxonomic lists for flora and fauna, respectively. This often includes species with phrase names that are not present within the respective lists. If the species is not conventionally accepted nominators will need to provide either:

- a taxonomic description of the species in a form suitable for publication in conventional scientific literature, OR
- evidence that a scientific institution has a specimen of the species, and a written statement signed by a person who is a taxonomist and has relevant expertise (has worked with or is a published author on the group of species nominated) that the species is a new entity.

Nominators must seek advice from the STC prior to proceeding with nominations for taxa that are not conventionally accepted.

1.3.3 Taxonomic authority details

Include the full reference for the scientific name of the species (Box 3). These may be found in the species description, other literature or via expert communications. Ensure the relevant details of any taxonomic uncertainty or confusion are presented here, alongside explanations of alternate taxonomic perspectives (if taxonomy is in doubt). If the taxa is a hybrid, include the parent names and associated references here.

1.3.4 Order/family

Write the order and family according to the authoritative naming sources (Box 3). For fauna, provide the order/family from the AFD and WildNet. For plants/fungi provide the order/family from APNI (family only), WildNet (family only) and the Queensland Plant Census (Queensland Herbarium and

Biodiversity Science, 2025). Order and family are also provided in the Atlas of Living Australia. Provide a reference for the Order and family, particularly where these differ between sources. Document any differences by providing the alternate classifications with references.

1.3.5 Synonyms

List any synonyms and include the authors of these synonyms. These may be in species description publications or in the relevant Australian National Species List index (i.e., APNI or AFD), identified by the label *'syn'* (Box 3).

Box 3. Example of text format for the Taxonomy section in the nomination form[2].

Taxonomic authority details Covacevich, J and McDonald, KR 1980, 'Two new species of skinks from mid-eastern Queensland rainforest', *Memoirs of the Queensland Museum*, vol. 20, pp. 95-101.
Order/family Squamata/Scincidae
Synonyms *Sphenomorphus luteilateralis* Covacevich & McDonald, 1980 *Eulamprus luteilateralis* (Covacevich & McDonald, 1980) *Tumbunascincus luteilateralis* (Covacevich & McDonald, 1980)

Summary of documentation requirements for Section 1. Taxonomy

- The species' name, including accepted scientific name and author abbreviations (or voucher specimen reference for undescribed species); order/family, synonyms (where relevant); common name(s); and Indigenous names (where known).
- Species description reference, current taxonomic status and areas of uncertainty/confusion.
- The taxonomic level being assessed (e.g. species, subspecies, variety, population), noting that a taxon should only be represented (listed) at one taxonomic level.
- If the taxon is a population or hybrid, a clear statement on how the population meets the requirements above.
- Confirmation that the entity is conventionally accepted; or, if *not* conventionally accepted:
    - a taxonomic diagnosis and description of the species/subspecies in forms suitable for publication in conventional scientific literature; or
    - evidence that a scientific institution (such as state/territory museum or herbarium) has a voucher specimen of the species/subspecies; and a written statement signed by a taxonomist or other person who has relevant expertise, confirming the validity of the new species/subspecies.

[2] Excerpt adapted from Department of Environment, Science and Innovation (2024). Nomination to change conservation class of *Magmellia luteilateralis* under the Queensland *Nature Conservation Act 1992*. Queensland Department of Environment, Science and Innovation.

Solanum orgadophilum (Capella potato bush) is restricted to the Brigalow Belt and is listed as Critically Endangered due to land clearing.

Image © Teghan Collingwood.

2 Description

Present the description in two paragraphs as set out in the example below (Box 4).

- First, provide a full description, as a direct quotation from the paper where the species was first described. Ensure it is in inverted commas, italicised and referenced.
- In some cases, it is appropriate to supplement or replace the original taxonomic description with a contemporary description of the species (for example, if the description is very brief [i.e. 1-2 sentences] as with some historical descriptions, or is written in a language other than English such as Latin).
- If the nominator is experienced in taxonomic descriptions, a paraphrased version can be provided in addition to the full description under an additional heading called 'Brief description'.
- Second, describe the distinguishing features of the species, including closely related taxa, and how the species being nominated is differentiated from these taxa. This is often stated in the original description or dichotomous key of the genus. If it was described some time ago, check for updated information by reviewing descriptions from closely related taxa. In many cases, the distinguishing features may come from multiple sources. List all distinguishing features using direct quotations of these sources. Alternatively, if the nominator is experienced in taxonomic descriptions, a paraphrased version can be provided in place of a direct quote.

If no description is available, state that this is the case in the nomination.

Box 4. Example text for the Description section of the nomination form[3]. There should be two key paragraphs: the full description and an overview of distinguishing features.

Full description (as in Bean 2010): "*Erect herbaceous resprouter, 0.2-0.4 m high. Adult branchlets white, grey or brown; prickles 1-5 per decimeter, straight, acicular, 1-3.5 mm long, 5-8 times longer than wide, glabrous or with scattered stellate hairs on lower half; stellate hairs dense or very dense, 0.4-0.7 mm diameter, stalks 0-0.15 mm long; lateral rays 7-8, porrect, central ray 0.3-1.3 times as long as laterals, not gland-tipped; type 2 hairs absent. Adult leaves ovate or broadly ovate, margins entire but often undulate; …*"

Distinguishing features

This species belongs to the *Solanum macoorai* group but is easily distinguished from other species. It is most similar to *S. jucundum*, but differs in plant height, prickle length, leaf shape, corolla indumentum and habitat (Bean 2010).

[3] Excerpt adapted from Collingwood T.D. (2021). Nomination to change the conservation class of *Solanum orgadophilum* under the Queensland *Nature Conservation Act 1992*. Queensland Department of Environment and Science.

Corymbia rhodops is currently listed as Vulnerable under the *Nature Conservation Act 1992* but requires reassessment under the Common Assessment Methodology.

Image © Andrew Ford.

3 Distribution

Information on where a species occurs is used to calculate key assessment parameters as part of the nomination. This data can come from a variety of different sources. The most reputable sources are "vouchered" specimen-backed records. Records associated with other surveys (i.e. field surveys or citizen science databases) may also provide important information, as do personal communications.

In this section, several important metrics will be defined that are used to assess the species against the criteria. Nominators will also start to build a picture of potential threats that may be relevant to the species. There are six key steps:

- Confirm the scale of assessment.
- Review occurrence records.
- Estimate the EOO and AOO.
- Present information on the subpopulations and population size for the species.
- Make a series of maps that display the spatial context of the species.
- Describe and interpret these maps in a succinct series of paragraphs.

Note that some taxa have sensitive records that may not be released from the respective data repository unless via special request. If a nomination is being prepared for a species that has sensitive records, nominators will need to seek guidance from someone with appropriate authority or permission to use these. Publicly available records for these species will be obscured, and thus not in a form suitable for a nomination. A list of species with sensitive records for Queensland species can be found here.

Minimum software requirements include an internet browser to access the ALA Spatial Portal and Queensland Globe (see Appendix 3. Calculation of EOO and AOO in ALA Spatial). The 'calculate AOO and EOO' tool within the ALA Spatial Portal can be used to assess the species' distribution metrics (EOO and AOO) and Queensland Globe is used to assess the landscape context of the species (see Appendix 5. Spatial characterisation of species distribution in Queensland Globe and QGIS). Nominators experienced in using Geographic Information Systems (GIS) (i.e., QGIS, ArcPro or ArcGIS) can use these in place of Queensland Globe. However, this will require experience in downloading and manipulating spatial layers from Queensland Spatial Catalogue.

3.1 Scale of assessment

Under CAM, species must be assessed at the national scale. This means that their entire distribution within Australia, regardless of state jurisdictions, must be included in the assessment. Usually, Queensland-led assessments focus on Queensland-endemic species, for which records only occur within Queensland.

In some instances, species that only occur within Queensland within Australia, will also have an international distribution. For flora, this typically includes species that are also distributed throughout Papua New Guinea and Indonesia. For fauna, this may also include cases where species are visiting/migratory. The following rules of scale apply to nominations under CAM:

- Species are assessed at the national scale (all occurrences within Australia, but no occurrences outside of Australia)
- Where a species is vagrant (only occurs in Australia on a random or occasional basis, without reliable breeding in Australia), they are not typically eligible for assessment.

- Where a species is visiting or migratory (that use part of Australia for their life cycle or migration route), they should be assessed on factors critical to their life cycle within Australia (breeding sites, feeding grounds or other significant habitat), and their relative risk within and outside Australia.
- Where a species has a contiguous global population (e.g. pelagic fish and marine organisms), they are assessed per their national distribution, however global threats that may impact the national assessment can be considered.
- Where a species has a discrete Australian population, they are assessed at the national scale with no adjustment for global distribution or threats.

Nominators should confirm the scale of assessment if it is unclear and seek clarification from the STC for any issues/questions.

3.2 Review of occurrence records

3.2.1 Flora occurrence records

There are three key sources of occurrence records used in Queensland flora nominations. These are the Queensland Herbarium (BRI) records, the Australasian Virtual Herbarium (AVH) which contains records from other herbaria, and WildNet which contains all the data from BRI but additional survey data (not specimen-backed). Citizen science data from the iNaturalist platform is being increasingly used with caution (Section 3.2.3.6).

3.2.2 Fauna occurrence records

Fauna records are typically held over several dispersed databases including WildNet, Queensland Biodiversity and Ecological Research Database (QBERD, an unpublished QHBS database), Queensland Museum and Australian Museum databases, which are then aggregated in the Atlas of Living Australia. Experts will also often have their own personal, unpublished data. Records within WildNet tend to have the highest precision and should be accessed first. Then, data from ALA that is not within the WildNet records should be downloaded and considered for inclusion based on the source. Typically, Queensland fauna nominations should include records from WildNet, and any additional records from Queensland Museum and Australian Museum (obtained directly or via ALA). Records from other institutions outside of Queensland will need careful vetting. Citizen science data from various platforms is available in ALA and is being increasingly used.

It is crucial that all records are ‘cleaned’ and then verified by an expert, particularly where they are historic. Cleaning should correct imprecise geo-referencing, remove duplicates, remove dubious records and review outliers to determine if they are correctly identified (see Section 3.2.4).

3.2.3 Sources of occurrence data

The following section describes the various data sources for species occurrence records used in nominations. Appendix 1. Downloading species occurrence data explains how to access these records.

3.2.3.1 BRI

The most reliable source of collection records for Queensland endemic flora are the BRI records. These records are specimen-backed and stored at the Queensland Herbarium. These records are publicly available on AVH but will have generalised coordinates for sensitive species. These records should be reviewed and updated where required (or ‘cleaned’) by an expert prior to use. Cleaning should correct imprecise geo-referencing, remove duplicates, remove dubious records and review outliers to determine if they are correctly identified (see Section 3.2.4).

3.2.3.2 AVH

Records from AVH should be reviewed to supplement the BRI records, as in many cases other herbaria will hold collections of Queensland endemic taxa. For example, the Australian Tropical Herbarium (CNS/QRS) is likely to hold additional specimen-backed records for taxa endemic to northern Queensland. Records for Queensland-endemic taxa held by other state herbaria (e.g. NSW) can also be used, however the identity and geolocations of these specimens should be carefully reviewed as they may not be actively curated.

3.2.3.3 Queensland Biodiversity and Ecology Information System (QBEIS)

For some Queensland flora, additional records will be available within state site monitoring datasets – QBEIS (formerly CORVEG). As these records are not backed by a specimen (but are field observations) it is critical they are spatially reviewed by an expert, with any outliers investigated prior to inclusion in a nomination. These non-specimen backed records should only be included for taxa that are easy to identify in the field. Additional data associated with these records (i.e. site disturbance, stems/ha) may be useful in other areas of the nomination.

3.2.3.4 WildNet

For taxa endemic to Qld, flora and fauna records can be obtained from the WildNet Database. WildNet maintains a curated selection of data from several internal and external data sources including:

- Queensland Herbarium and Biodiversity Science internal databases (BRI, Queensland Biodiversity and Ecosystem Research Database [QBERD], Queensland Biodiversity and Ecology Information System [QBEIS] and Queensland Fauna Database [QFD])
- Threatened Species Operations (Queensland Parks and Wildlife Services and Partnerships [QPWS&P]) research and monitoring programs
- QPWS&P Management Operations research and monitoring programs (coastal bird surveys, post-fire monitoring etc.)
- Permit returns
- Grant programs
- other Queensland Government departments including the Queensland Museum, Department of Primary Industries, Department of Transport and Main Roads
- Australian government
- local governments
- other state and tertiary agencies (including museums and herbaria)
- citizen science programs
- researchers (independent and educational institutions)
- environmental professionals
- public (limited).

WildNet contains both sensitive records that require approved access and published records that are publicly available. All data contributed to WildNet is curated for quality control but still requires careful vetting.

3.2.3.5 Atlas of Living Australia records

Atlas of Living Australia (ALA) contains records from the above sources in addition to international occurrences, museum records and citizen science records. Given the overlap in some of the data originating from the above resources and iNaturalist (below), it is imperative that duplicate records are identified if multiple data sources are being used. As ALA acts as a data aggregator, there are often delays in ingestion from the original source. Therefore, it is best to access the source first to have the most updated information.

3.2.3.6 iNaturalist and citizen science records

Some Queensland flora and fauna have a large number of reliable records in citizen science databases, such as iNaturalist. These non-specimen backed records should only be included for taxa that are easy to identify in the field. The following principles should be applied when reviewing and considering use of iNaturalist records in a nomination:

- iNaturalist records that expand the EOO and AOO should be thoroughly vetted by a species expert, and where reliable, included in the nomination. If there is uncertainty around the identify of records outside of the species' known range, they can be included in the maximum and minimum EOO/AOO only and this uncertainty should be clearly documented (i.e. not used as the 'value assessed').
- iNaturalist records that are considerably more recent than existing specimen-backed data should be included where reliable to demonstrate the species is still extant in an area. If the ID is uncertain, communicate this in the body of the text.
- iNaturalist records that are neither more recent than existing specimen-backed records, nor expand the EOO and AOO may also be included on the basis they contain field collection notes that add value to the nomination (population abundance, habitat, threats).

For taxa such as birds, there are other high-value citizen science data sources available on ALA such as EBird. Apply the same data vetting principles outlined for iNaturalist data. Sources such as Flickr and Biocollect should not be used as they are generally low quality.

3.2.3.7 Other occurrence record sources

It can be useful to contact experts to obtain additional species records. If experts can provide additional records, it is important for nominators to check for significant outliers. Inclusion of records that are not specimen-backed should be clearly stated and justified in the distribution section. Inclusion could potentially be justified on the basis of a high-quality photograph of the species that clearly shows its distinguishing features. Additional records that are included from experts should have accurate latitude and longitude information, including any other field notes that the expert can provide.

3.2.3.8 Record sources summary

Table **1** summarises the data sources used to obtain occurrence data. Each are ranked to demonstrate priority of data from one source over another. This is based on the source, quality, and verification/validation of occurrence data indicated in the *Data Quality* column.

Table 1. Summary of data sources and relative importance for use in threatened species nominations.

Data source	Data Quality	Priority (flora)	Priority (fauna)
Queensland Herbarium (BRI)	Original data source; verified data (specimens)	1st	NA
Australasian Virtual Herbarium (AVH)	Non-sensitive BRI data; verified data (specimens)	2nd	NA
Queensland Biodiversity and Ecology Information System (QBEIS)	Expert field surveys; verified & unverified data	3rd	NA
WildNet	All the above data and other surveys (e.g. permit returns / development surveys); curated data	4th	1st
iNaturalist (iNat) / EBird	General surveys; unverified	6th	3rd
Atlas of Living Australia (ALA)	Includes all of the above and museum collections; verified & unverified data	5th	2nd

3.2.4 Data cleaning

Occurrence data downloads will be in a spreadsheet format. To ensure this data is fit-for-purpose it will need to be reviewed for accuracy, or 'cleaned'. Follow these steps to clean the occurrence data:

- Check the spreadsheet(s) refers to the correct species.
- Delete any unnecessary columns.
- Add a column called 'Decision' or similar, where a decision to retain or exclude the record can be flagged.
- Add a column called 'Reason' or similar, where details on why the record was retained or excluded can be provided.
- Aggregate the data sources (multiple spreadsheets) using common column headings. The column headings will differ depending on the data source, so combination and homogenisation of fields is often required. An example of cleaned specimen records is provided in Appendix 2. Example of retained and excluded herbarium specimen records. For example, using Darwin Core terms:
    - **scientificName** to identify the organism.
    - **institutionCode** to determine the herbaria.
    - **catalogNumber** to distinguish each unique record.
    - **recordNumber** to determine the collecting number and remove duplicates.
    - **recordedBy** to determine the collector.
    - **eventDate** to identify the date of the occurrence record.
    - **decimalLatitude** to indicate the location of the occurrence record.
    - **decimalLongitude** to indicate the location of the occurrence record.
    - **datum** to indicate the geodetic datum associated with longitude and latitude information

- **maximumElevationInMeters** to indicate the elevation of the occurrence record.
- **coordinateUncertaintyInMeters** to determine the accuracy of the occurrence record.
- **locality** to identify the broad area where the occurrence record was taken.
- **eventRemarks** provides information on habitat and sometimes abundance.
- **occurrenceRemarks** provides information on habitat and sometimes abundance.
- **fieldNotes** provides information on habitat and sometimes abundance.
- **habitat** provides information on habitat.

- Remove duplicates by identifying unique record values.
    - For AVH flora records, remove duplicate records by checking the “recordNumber” column for repeated values and prioritise the retention of BRI records.
    - It is important to refer to the **catalogNumber** and the **recordNumber** to identify duplicates, keeping in mind that string characters (often specific to a database) preceding a unique number may obscure duplicate identification.
    - Where these original identification numbers are not present or are overwritten by database specific ID’s, use other sources of information such as **eventDate** combined with **decimalLatitude** and **decimalLongitude** to determine duplication.
- Additionally, review the **locality** column as this information can help identify duplicates. See brief example in
    - Table 2. This demonstrates the requirement to review information from multiple columns to guide duplicate identification.
- Review the precision of the occurrence records.
    - Generally, any records with precision of >2,000km should be reviewed for accuracy. Any records with poor precision or where the locality description does not match the actual GPS location should be adjusted or excluded in consultation with the relevant expert. Where records cannot be verified, consider excluding any that have a precision of >2,000km.
    - If nominators can improve the precision of any records, provide this information to the relevant person/organisation, who can ensure the data curator is notified.
- Remove any non-wild records. For flora, this is anything cultivated in a garden or nursery, and for fauna this is any captive records / populations. For more details on how ‘wild’ is defined, and whether ex-situ records should be included or not, refer to (IUCN SPC, 2024).
- Ensure the final file is saved in a .csv format for use in the ALA Spatial Portal and Queensland Globe.
- If nominators are using ALA Spatial Portal or Queensland Globe, specific headings are required to import the data for viewing.
    - For ALA Spatial Portal, columns must include **scientificName, catalogNumber, eventDate, decimalLatitude** and **decimalLongitude**.
    - For use in Queensland Globe, columns **Latitude** and **Longitude** are required.

- Ensure the final occurrence data included AND excluded from the assessment is reported in the body of writing for completeness. A table of included records and excluded records should be provided in the supplementary material section.

Table 2. Example of duplicate identification during record cleaning stages for two flora records where priority samples from BRI are bolded, with information from other databases in proceeding rows colour coded yellow, for information that matches the BRI records, and grey, for information that does not match.

	database	Event Date	Decimal Latitude	Decimal Longitude	Geodetic Datum	Catalog Number	Record Number	locality
Record 1	**BRI**	**28/04/1990**	**-24.85611111**	**150.9388889**	**GDA94**	**AQ471369**	**PIF6717**	**State Forest 28.**
	ALA	28/04/1990	-24.8486296	150.9508742	EPSG:4326	AD 99125139	PIF_6717	State Forest 28
	ALA	28/04/1990	-24.855009	150.942012	EPSG:4326	BRI AQ0471369	PIF6717	State Forest 28.
	ALA	28/04/1990	-24.85	150.95	EPSG:4326	MEL 1585353A	6717	State Forest 28, grid ref. 9048-919493.
	ALA	28/04/1990	-24.85	150.95	EPSG:4326	NSW450175	6717	State Forest 28, grid reference 9048-919493.
Record 2	**BRI**	**13/02/1996**	**-24.29869589**	**150.682464**	**GDA94**	**AQ571861**	**BIL212**	**18km NE of Biloela (GPS 24 18 01 150 10 53)(site 393).**
	QBEIS	13/02/1996	-24.29646686	150.6602509	EPSG:4326	NA	NA	18.5KM NE OF BILOELA
	WildNet	13/02/1996	-24.298683	150.682471	GDA2020	7380449	NA	18km NE of Biloela (GPS 24 18 01 150 10 53)(site 393).
	ALA	13/02/1996	-24.298696	150.682464	EPSG:4326	BRI AQ0571861	BIL212	18km NE of Biloela (GPS 24 18 01 150 10 53)(site 393).
	ALA	13/02/1996	-24.3	150.175278	EPSG:4326	NSW419610	BIL_212	18 km NE of Biloela (site 393).

3.3 Extent of Occurrence and Area of Occupancy

The Extent of Occurrence (EOO) and Area of Occupancy (AOO) are the primary metrics used to measure the spatial spread of risk to a species. The Extent of Occurrence is defined as *“the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a species, excluding cases of vagrancy”* (IUCN SPC, 2024). This is measured using a minimum convex hull (IUCN SPC, 2024). The Area of Occupancy is defined as “*the area within its EOO which is occupied by the species, excluding cases of vagrancy*” (IUCN SPC, 2024). This is measured using 2 x 2km grid cells (IUCN SPC, 2024).

Nominators will need to determine which occurrence records are used to generate the current EOO and AOO of the species. A summary of record attributes to consider when calculating the value used for EOO, AOO, and the minimum and maximum plausible bounds is provided in

Table 3. Where a species has become extirpated from a site, nominators should generate two (or more) EOO and AOO calculations to demonstrate how these metrics have changed over time. These values can then inform any reductions or declines discussed under the criteria assessment component of the nomination. Where there is uncertainty (i.e. possibly extinct records), these can also be used to generate a minimum plausible EOO and AOO. If the EOO and AOO are close to the thresholds of a criteria, nominators may justify the ‘value used’ based on this information.

Refer to Criterion B, or the relevant section in the IUCN Guidelines (IUCN SPC, 2024) for further explanation of EOO and AOO. See Appendix 3. Calculation of EOO and AOO in ALA Spatial and Appendix 4. Calculating EOO and AOO in QGIS for methods to calculate EOO and AOO. If mapping assistance is required, please contact the Species Technical Committee via email here: speciestechnical.committee@detsi.qld.gov.au.

Table 3. Adapted from (IUCN SSC Red List Technical Working Group, 2024)

Presence type	Definition	Use in EOO/AOO calculations?
Extant	Species known or very likely to currently occur in the area, which encompasses localities with current or recent (last 20-30 years) records where suitable habitat at appropriate elevations remains.	Yes
Possibly extant	No record of the species in the area but may possibly occur based on potentially suitable habitat at appropriate elevations. The area is beyond known extant range and the probability of it occurring here is lower due to geographic barriers or considerable range extensions.	No Apply to maximum plausible EOO and AOO values only
Possibly extinct	Species formerly known or thought very likely to occur in the area (post 1500CE) but is now likely extirpated due to threats that are plausibly related to its apparent absence. There have been no recent confirmed records despite searches.	No Discuss these in the nomination and use to calculate a **suspected** or **inferred** reduction in EOO/AOO and other relevant parameters; consider when calculating plausible minimum bounds.
Extinct	Species formerly known or thought very likely to occur in the area (post 1500CE) but no longer occurs based on exhaustive searches that have failed to relocate the species. The intensity and timing of threats plausibly relate to the species absence here.	No Discuss these in the nomination and use to calculate an **estimated** or **observed** reduction or decline in EOO/AOO and other relevant parameters.
Uncertain	A record(s) exists of the species presence in the area but it requires verification due to uncertainty of identity or geolocation.	No Discuss in the nomination and use to calculate a **suspected** EOO/AOO; consider when calculating maximum plausible bounds.
Expected additional range	Areas strongly suspected to become suitable habitat for the species in next 100 years due to range shifts associated with climate change and other local/global processes, including translocations.	No Not generally used in IUCN/CAM assessments, however, could be used to propose a maximum possible future EOO/AOO if that was required in the nomination.

3.4 Reviewing land use and management characteristics

The land use and management characteristics of the species' habitat should be described according to the distribution of the occurrence data. This can be done visually using several methods that overlay spatial data over the occurrence data points. Methods are provided to use (i) Queensland Globe or (ii) QGIS to create relevant maps that display the geographical context of the species in Appendix 5. Spatial characterisation of species distribution in Queensland Globe and QGIS. Useful spatial layers to produce these maps in QGIS are outlined in Appendix 5. Example maps are provided in Section 3.5.

3.5 Response structure for Distribution

Nominators should then construct a succinct and concise series of paragraphs summarising the abovementioned information. A suggested format is provided below. It is appropriate to model the paragraph text from the example provided in Box 5.

Paragraph 1 – Geographic distribution context

- Describe whether the species has a narrow, disjunct, widespread or fragmented range based on a visual assessment of the EOO and AOO map.
- For species that also occur outside of Australia, state the scale of assessment (i.e. the assessment only includes the Australian distribution) and any relevant details (i.e. if threats that occur overseas will be considered for visiting species, per Section 1.2.1).
- State the general geographic details, including the nearest population centre and the bioregion; this can be for each subpopulation (widespread) or for the entire population (narrow).
- State the Traditional Custodians of the Country that overlap the distribution of the species.
- For fauna, describe the species home range and movement patterns, particularly where these change seasonally.

Paragraph 2 – EOO and AOO

- State the EOO and AOO rounded to a whole number, and how this was calculated. Typically, the EOO and AOO are calculated using expert verified records, a minimum convex hull (EOO) and 2 x 2km grid (AOO). Reference the IUCN guidelines (IUCN SPC, 2024).
- Nominators should clearly explain the number of records included and excluded and outline the reasons for excluding any records.
- Comment on temporality of collection records. Specifically, if there are any parts of distribution where recent records have not been collected. If this is the case, note follow up surveys in these areas as a high priority conservation action in Section 6.
- Include the year the species was first collected and the most recent collection year.
- Optional: Potential Habitat Modelling (PHM) can be used to project a maximum EOO and AOO for some species. That is, calculating the area of a convex hull around the PHM polygon for EOO, and the area of 2 x 2km grid cells intersecting the polygon for the AOO. Often such modelling will result in large projections, particularly where a species' environmental associations are not well-understood due to a paucity of collecting records. This uncertainty should be stated in the assessment as required.

Paragraph 3 – Define the number of subpopulations

- Spatially define the subpopulations, including the number of subpopulations for the purposes of the assessment. Subpopulations are defined as *“geographically or otherwise distinct groups in the population between which there is little demographic or genetic exchange (typically one successful migrant individual or gamete per year or less)”* (IUCN SPC, 2024). To define subpopulations, nominators should consider the relative geographic isolation and dispersal capacity of the species. For further information on how to define subpopulations see Section 9.4.4.

Where there are only a few subpopulations, nominators should attempt to name each one and refer to these throughout the nomination form. For example, the eastern, western, and northern subpopulations. Use place names for clarity where possible. Consider whether all suitable habitat has been searched. Make a statement about survey adequacy and confidence regarding the likelihood of finding additional subpopulations/occurrences with further survey in suitable habitat.

Paragraph 4 – Population size

- Comment on the size of the subpopulations, and the total population size. Population metrics should be discussed in terms of the ‘number of **mature individuals**’.
    - Mature individuals are defined as *“the number of individuals known, estimated, or inferred to be capable of reproduction.”* (IUCN SPC, 2024).
    - When estimating this number, the following should be considered:
        - Individuals that cannot reproduce (juveniles, senescent individuals, suppressed individuals, and individuals that occur in densities that are too low for fertilisation should not be counted as ‘mature’).
        - Populations with sizes that fluctuate or biased sex ratios should have a lower estimated quantity to reflect this.
        - Within a clone, only reproducing units that can survive alone can be counted as an individual.
        - In taxa with life cycles that naturally lose all or a subset of mature breeding individuals at some point, the estimate should be made at the point where mature individuals are available for breeding.
        - Re-introduced individuals may only be counted as mature individuals following the production of viable offspring.
    - The list of points above is not exhaustive and should not restrict the nominator’s interpretation of mature individuals. The IUCN guidelines provide more detailed examples of defining mature individuals particularly where the biology or ecology of the species is complex.
    - In any case, the nominator should make a justified judgement of mature individuals with respect to the species biology and ecology.
- Often, there are not enough data to provide precise population estimates for use in assessments. In this case, nominators should use 'plausible bounds’ to account for this uncertainty by providing a range of values.

- In addition to stating the number of mature individuals used in the assessment, nominators should also provide a 'plausible' minimum and maximum value.
- Note that the value used, minimum plausible value and maximum plausible value can all be presented as a range (e.g. minimum of 200 – 350 mature individuals, maximum of 1000-1500, and value used of 200-800).
- When constructing minimum and maximum bounds, it is useful to consider the key quantitative thresholds for number of mature individuals that will determine eligibility for a category, which are:
    - *<50 (CR under D)*
    - *50-250 (CR under C; EN under D)*
    - *250-1,000 (EN under C; VU under D1)*
    - *1,000-2,500 (EN under C; NT under D1)*
    - *2,500-10,000 (VU under C)*
    - *10,000-20,000 (NT under C).*
- State the appropriate data qualifier (IUCN SPC, 2024) for the population size value used. Note that population estimates must meet the required data quality of 'estimated' as per the IUCN guidelines to enable listing under Criterion C or D. 'Suspected' population sizes cannot be used to inform listing under Criterion C or D. Refer to Appendix 8. Data qualifier examples for key parameters for how to apply data qualifiers to population sizes.
- Describe the population size of the subpopulations if known. This is particularly important where the population estimate is less than 10,000 mature individuals (and meets the required data quality), and there is evidence of continuing decline. This relates to eligibility under Criterion C2:
    - <50 (CR)
    - 50-250 (EN)
    - 250-1,000 (VU).
- The lower plausible bounds may be used in the assessment if a precautionary approach is warranted given reasonable survey effort and a high level of threats. Conversely, the maximum plausible bounds may be used where survey effort has been very poor and threats are low. Where survey effort is low, but threats are serious, a precautionary approach would also be warranted. Ensure the value used is justified clearly.
- Where there are population counts for multiple years, and across multiple subpopulations, it can be useful to tabulate this information to help discern trends. The table can also include information on land tenure to help explore threatening processes at each subpopulation. An example format is provided below in Table 4.

Table 4. Population parameters for each subpopulation, including land tenure and trends.

Subpopulation	Count of mature individuals (juveniles)	Land tenure	Trend
1a (name)	YYYY: 12 (6) YYYY: 'uncommon' YYYY: 14 (6) + 17T	Freehold/national park	Increasing/decreasing/static/unknown
1b (name)			
2 (name)			
3T (name)			

*(T) = Translocated subpopulations/individuals.

Paragraph 5 – Land use and management context

- Describe the current land tenure (freehold, national park) and land use (grazing, nature conservation) for each subpopulation. If the species occurs in protected areas, list these areas.
- List and relevant Native Title bodies / Aboriginal Corporations that may be engaged in land management within the species' distribution. List any relevant Indigenous Land Use Agreements.
- Finally, describe the vegetation management status of the areas where the species occurs, for example, remnant habitat (i.e., Category B under the *Vegetation Management Act 1999* [VMA]), or cleared land (Category X under the VMA).

Note: Although it is normal convention to display figures immediately after relevant text, in nomination forms, it aids comprehension to group figures together at the end of the text box. So, the Distribution text box should include paragraphs of text grouped together, followed by a series of maps.

Box 5. Example of text format and paragraph structure for the Distribution section of the nomination form[4].

Dioclea hexandra is known from a narrow distribution between Tully Heads to Thornton Beach in the Wet Tropics bioregion. The species occurs on the lands of the Kuku-Yalanji, Djabuganjdji, Mamu, Djiru, Gulngay, Yidinjdji, Mbabaram and Djirbalngan People (Figure 1). Outside of Australia, the species is widespread, occurring throughout tropical Africa, India, tropical Asia, tropical Oceania and tropical America (Adema 1998; GRIN 2009). However, this assessment considers localities restricted to mainland Australia (Figure 1).

Extent of Occurrence and Area of Occupancy

The species has an Extent of Occurrence (EOO) of 5447km^2 and Area of Occupancy (AOO) of 60km^2, calculated using a 2 x 2km grid (AOO), a minimum convex hull (EOO), and 24 expert verified herbarium specimen records (Figure 2; IUCN SPC 2022; BRI 2023). The species was first collected in 1912 and most recently collected in 2020.

[4] Excerpt adapted with minor updates from Department of Environment and Science. (2023). Nomination to change the conservation class of *Dioclea hexandra* under the Queensland *Nature Conservation Act 1992*. Queensland Department of Environment and Science.

Subpopulations

For the purposes of this assessment, *D. hexandra* is considered to occur within four subpopulations; the two northern subpopulations (Daintree catchment and Mossman), the central subpopulation (Innisfail) and the southern subpopulation (Tully). These subpopulations were delineated according to the distance of separation between clusters of records, the likelihood of suitable habitat between the clusters, surrounding topography and the likely dispersal capacity of the species. The species is passively dispersed through the water and ocean, drifting across large areas whilst remaining viable (Green 2001; Gunn and Dennis 1976). Although gene flow may occur between subpopulations, it is unlikely to occur regularly due to the distance and barriers between subpopulations. The northern cluster of records were considered two separate subpopulations as they occur in different drainage basins (Daintree and Mossman), which are likely to limit seed dispersal.

The species is distinctive and unlikely to be overlooked during surveys when in fertile, as the large purple flowers or seed fall to the ground beneath plants. However, given the species is a canopy vine, it is possible it may be overlooked during surveys when flowers or seed are not present under mature plants, or within intact rainforest where visibility to the top of the canopy is difficult. This trend is evident in the collection records (Queensland Herbarium 2023), which almost exclusively occur on rainforest edges where it is easy to see and reach hanging branches (A. Ford, pers. comm. 2023). It is likely that additional occurrences exist in close proximity to current subpopulations.

Population size

The population size of the species is not precisely known. The species has not been adequately surveyed to make accurate or definitive estimates of the number of mature individuals, and additional surveys are required especially in adjacent and similar habitats.

Land use and presence in conservation estate

The species occurs across a variety of land uses across its distribution. In the north, the species is known to occur on land designated as cropping, other minimal use, utilities, intensive horticulture, grazing native vegetation, managed resource protection and nature conservation. The central subpopulation occurs on land classified as minimal use, managed resource protection and marsh/wetland. The southern occurrences for the species are on land classified as minimal use and cropping. Similar to the variety of land use that the species is known to occur on, the remnant and cleared land categories vary considerably across the distribution.

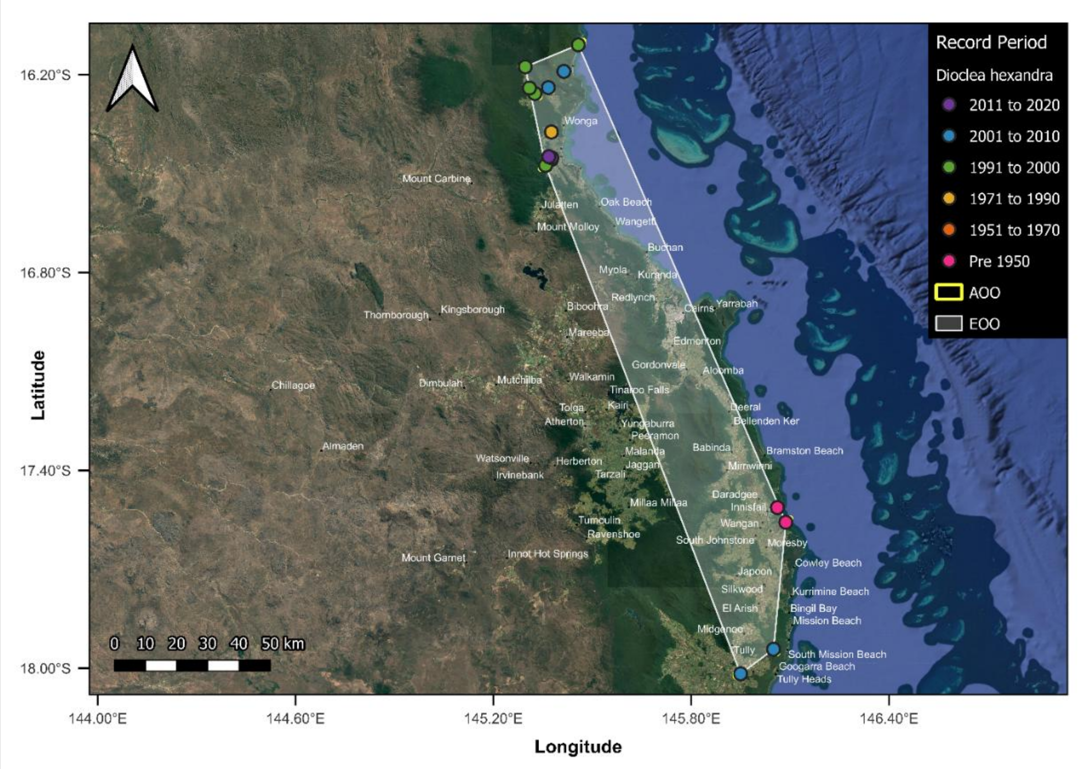


Figure 1. *Dioclea hexandra* is known from a narrow distribution between Tully Heads to Thornton Beach in the Wet Tropics bioregion. The species occurs on the lands of the Kuku-Yalanji, Djabuganjdji, Mamu, Djiru, Gulngay, Yidinjdji, Mbabaram and Djirbalngan People. The species has an Extent of Occurrence (EOO) of 5446.79km^2 and Area of Occupancy (AOO) of 60km^2, calculated using a 2 x 2km grid cell (AOO), a minimum convex polygon (EOO), and 24 expert verified herbarium specimen records (Figure 2; IUCN SPC 2022; BRI 2023).

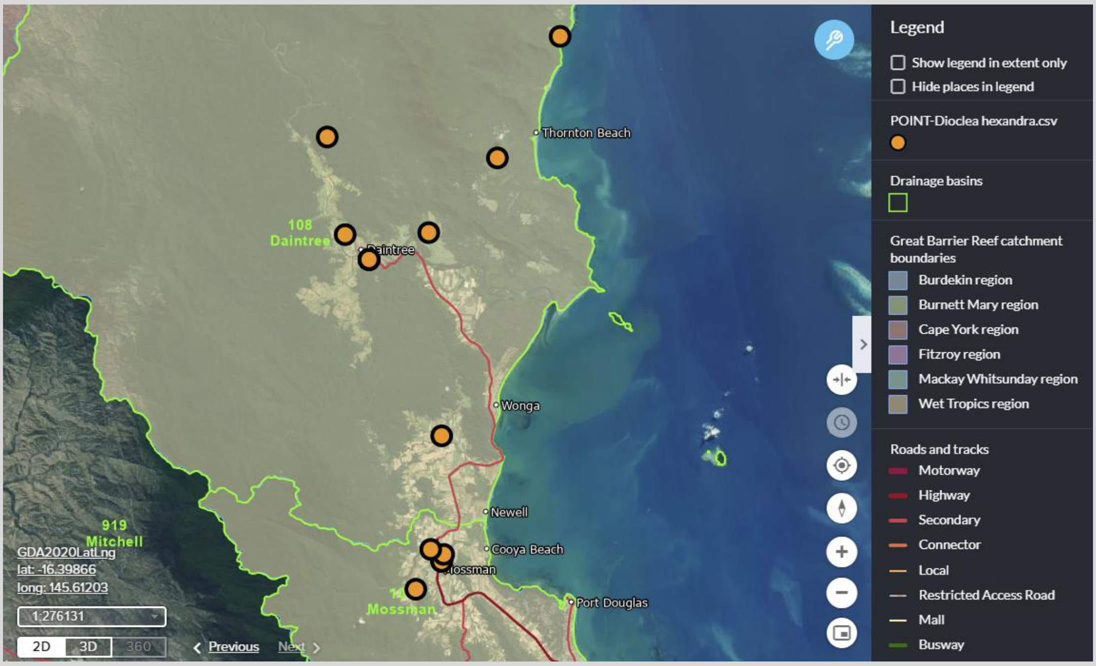


Figure 2. *Dioclea hexandra* occurrence points for the northern subpopulations in relation to drainage basins. The occurrences are split across two drainage basins; Daintree and Mossman, which are considered separate subpopulations in this assessment as the species is water dispersed. Map generated on Q Globe.

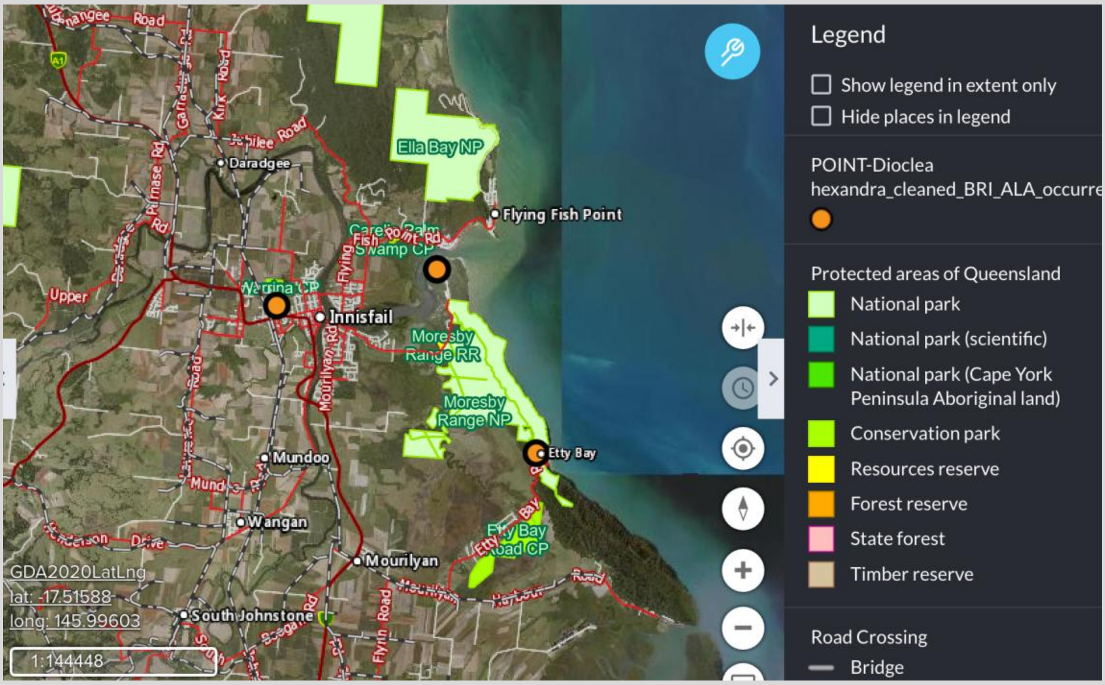


Figure 3. *Dioclea hexandra* occurrence points for the central subpopulation and the overlap of protected areas of Queensland. Some occurrences are within the Moresby Range National Park. Map generated on Q Globe.

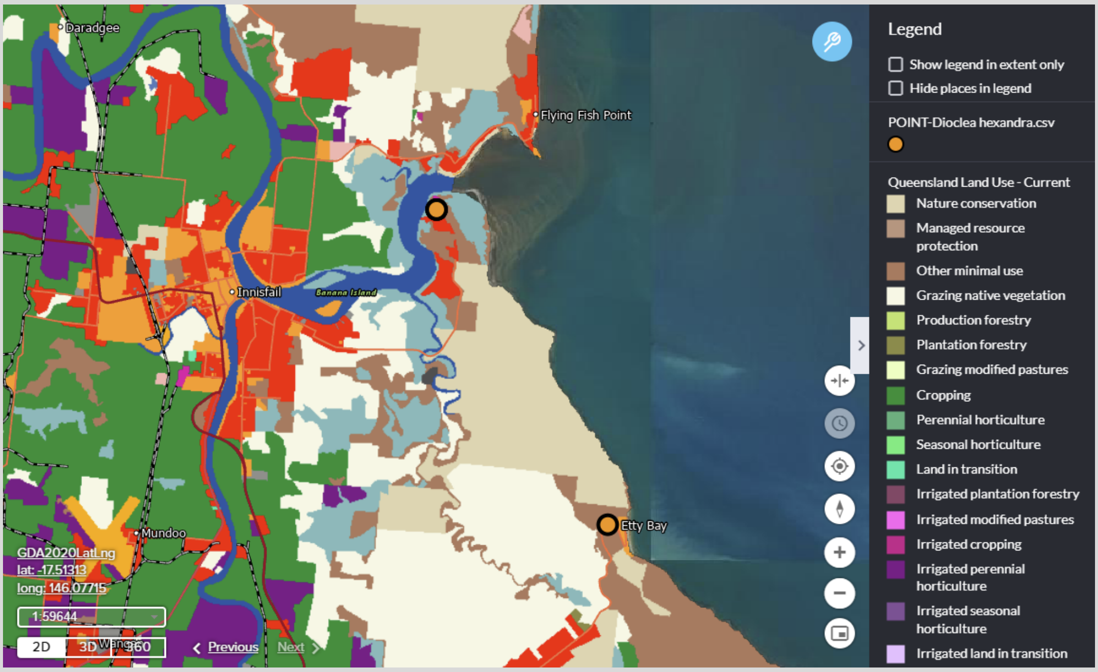


Figure 4. *Dioclea hexandra* occurrence points for the central subpopulation in relation to the land use of the region (Q Globe 2023). The central subpopulation occurs on land classified as minimal use, managed resource protection and marsh/wetland. Map generated on Q Globe.

Summary of documentation requirements for Section 3. Distribution

- The species' distribution, including known/estimated current and past national distribution (including international distribution if relevant).
- For species with an extra-limital distribution, confirmation that the taxon has been assessed at the national scale; OR for visiting species, how extra-limital populations/threats were considered in the assessment.
- The species' EOO and AOO, plus calculation method.
- Data used to calculate EOO and AOO (e.g. point data, expert advice, habitat maps), along with a justification for any excluded data. Include upper and lower bounds (plausible range), if calculated.
- Any gaps in understanding of the species' distribution.
- The number of mature individuals, including upper and lower plausible bounds.
- The number of subpopulations of the species including justification for delineation.
- For fauna, any daily or seasonal distribution patterns, e.g. breeding and non-breeding ranges.
- Desired but not essential:
    - Information on land tenure and land use for each subpopulation
    - Instances where the species' distribution intersects with protected areas such as listed heritage sites or ecological communities, Indigenous Protected Areas etc.
    - Map(s) at the appropriate scale and level of detail to support the assessment.

Xanthostemon verticillatus occurs on the lands of the Eastern Kuku Yalanji Bama (People) and is restricted to the Wet Tropics bioregion in northern Queensland. It was reassessed using the Common Assessment Methodology as Vulnerable due to plausible future threats associated with infrastructure, invasive weeds and feral pigs.

Image © Andrew Ford.

4 Biology and ecology

Nominators should then describe the biology and ecology for the species. The IUCN criteria rely on an understanding of how threatening processes interact with a species' biology and ecology. Therefore, this section provides important context when applying the criteria in later sections of the nomination form. Importantly, the summary of biology and ecology must be concise, and limited to information relevant to the assessment against the criteria and conservation actions.

4.1 Response structure for Biology and ecology

While each species will be different, responses can be structured following the below format (Box 6).

Paragraph 1 – Habitat requirements

- Define the key characteristics of the habitat occupied by the species. This should include the vegetation type and underlying soil/substrate as well as vegetation structure, elevational range, aspect, and climate. This information can be found in occurrence records and the original taxonomic description; although the former is likely to be more current.
- State the REs in which the species occurs (for plants, and animals if restricted to a small number of REs). The utility of RE mapping as a surrogate for habitat extent may depend on how consistently the species of concern is found in the RE.
- For restricted taxa, habitat information recorded within the specimen collections or taxonomic paper are the authority, rather than regional ecosystem (RE) descriptions. Note that habitat of the species does not necessarily equate to the RE that intersect the occurrence records. 'Regional' ecosystem mapping is often coarse relative to the habitat of restricted species, and comprises multiple 'local' ecosystems within a polygon. Therefore, RE mapping information (i.e., what REs the species occurs in) should only be stated after a more specific review of habitat requirements (see final dot point for RE information).
- If the species occurs in different habitats depending on the subpopulation, nominators should note this by referring to the specimen record information. If the habitat is markedly different (i.e. lowland riparian habitat compared with upland montane habitat), nominators should consult experts about whether the species' taxonomy is under review and proceed with caution.
- For fauna, explain how habitats are used, for example describe seasonal/breeding changes in habitat, if applicable. Provide detail on refugial habitat (i.e., does the species use different habitat in times of fire, drought, reproduction or flood)?
- Describe associated taxa. These can be found in the occurrence records or taxonomic description.
- List the RE that the species' occurrence records are associated with, and reference back to the figure provided in the Distribution section. Details on REs can be found in the Regional Ecosystem Description Database search tool (see Section 19 Key resources).

Paragraph 2a – Reproduction, life cycle and generation length (flora)

- Describe the reproductive characteristics (i.e. sexually or asexual reproduction). If the species reproduces vegetatively, describe when, how and what conditions are needed.
- Provide detail on the age at sexual maturity, average life expectancy, natural mortality rates

and then use these metrics to calculate generation length. If this information is not available for the species, nominators should use information from related or ecologically similar species to make an inference.

Generation length is defined as *"the average age of parents of the current cohort (i.e., newborn individuals in the population) [and] reflects the turnover rate of breeding individuals in a population. Generation length is greater than the age at first breeding and less than the age of the oldest breeding individual, except in taxa that breed only once"* (IUCN SPC, 2024). Where generation length varies under threat, use the more natural pre-disturbance generation length (IUCN SPC, 2024). It is often calculated as:

*Age of first reproduction + (0.5 * length of reproductive period)*

Provide full details of the method(s) used to calculate the generation length. For further detail see Section 9.2.1.2.

Paragraph 2b – Reproduction (fauna)

- Provide details on when the species breeds and the conditions needed for breeding.
- Provide details on specific breeding sites and characteristics (e.g., colonies for seabirds).
- Consider if any breeding behaviours make the species susceptible to threats and ensure these behaviours are adequately detailed so they can be referred to in the threats section.

Paragraph 3 – Disturbance ecology

- Provide detail on how the species responds to **relevant** disturbance events (such as fire, flooding, cyclones, natural predators, and anthropogenic events (e.g. deforestation, fireworks, mining quakes, light pollution). If the disturbance has a negative impact on the species, try to focus on the ecological aspects rather than the details of the threat. The intent is to provide enough detail on disturbance responses so these can be easily referred to in the threats section.
- Ensure favourable disturbance responses are documented here. For example, where species require a specific disturbance regime to complete their life cycle. Given the prevalence of fire in the Australian vegetation, it is almost always relevant to discuss the species' susceptibility to fire.
- Provide supporting information by discussing the species' functional traits and how this influences the disturbance response. For example, for plants, outline whether the species is an obligate seeder or resprouting species and how this may impact the response to disturbances. A detailed discussion of fire response syndromes is available in (Auld et al., 2022) and trait-based data is available in AusTraits (Falster et al., 2021).
- In addition to literature, occurrence records (often the habitat, occurrence remarks or event remarks fields) can indicate if the area was recently disturbed or alongside species responses.

Paragraph 4a – Flowering, pollination and dispersal (flora)

- Describe the timing of flowering and fruiting. This is often recorded in the species' occurrence data and the taxonomic description. Relate the date of the record to the reproductive status column.
- If available, provide details on the conditions needed for flowering and fruiting.

- Describe the pollination syndrome for the species. Species-level information is rarely available, so refer to information published for the genus or family, which may be available in general literature or AusTraits (Falster et al., 2021). If this is unavailable, consult experts.
- Describe the dispersal syndrome for the species. Species-level information is rarely available, so refer to information published for the genus or family, which may be available in general literature of AusTraits (Falster et al., 2021). If this is unavailable, consult experts.

Paragraph 4b – Feeding and movement (fauna)

- Summarise the feeding behaviours, diet, and the timing/seasonality associated with these. Include any behaviour that may make the species vulnerable to a threatening process so it can be referred to in the threats section.
- Provide information on daily, seasonal and/or life-cycle related movement patterns.

Additional tips

- Often, much of this information will not be available. If this is the case, ensure it is stated clearly. For example, '*There is no literature available that describes the fire ecology of the species'*.
- If there is no published literature on the species, check at the genus level. Often, it is appropriate to comment on the biology and ecology of other, closely related taxa. For example, '*However, other species in the genus are known to re-sprout after fire from a lignotuber'.*
- For both flora and fauna, try and provide information about dispersal. This will help define subpopulations and some subcriteria (i.e., severe fragmentation). Return to the 'Distribution' section and check the delineation of subpopulations is consistent with the dispersal/movement ecology of the species.
- Use this review to think about how the species' ecology may make it susceptible to threatening processes.

An example is provided in Box 6.

Box 6. Example format and structure for the 'Biology and ecology' section of the nomination form for *Grevillea venusta* (a shrub)[5].

Habitat

Grevillea venusta is found in a range of vegetation types, but almost always in riparian areas. It has been collected from rocky areas at the base of mountains, creekside areas in sandy soil, and on granite in sclerophyll forest and woodland (Queensland Herbarium, 2024).

Grevillea venusta occurs in association with several regional ecosystems, but most commonly 8.3.6c, 8.3.3b, and 8.3.3a. To a lesser extent, it has also been found in 8.12.5b, 8.12.3c, 8.12.10a, 8.11.3b, and 12.12.27 (Qld Globe, 2024). All records of *G. venusta* found within the SBTA have been found on creeks located directly adjacent to regional ecosystem 8.3.3 and 8.3.6. Therefore, it is possible that its association with non-alluvial regional ecosystems (i.e. those occurring on land zone 12 and land zone 11) may be the result of low-precision records

[5] Excerpt adapted from Department of the Environment, Tourism, Science and Innovation (2024). Nomination to change conservation class of *Grevillea venusta* under the Queensland *Nature Conservation Act 1992*. Queensland Department of Environment and Science.

or regional ecosystem mapping scale limitations (Ecosure, 2023). Most observations of the species within the northern subpopulation have been in areas on stony substrate (G. Sinclair, pers. comm. 2024).

These regional ecosystems (with the exception of 8.12.3c and 8.12.10a) are primarily characterised by woodland and forest habitat dominated by either *Eucalyptus tereticornis, Melaleuca leucadendra, E. portuensis, E. exserta, E. fibrosa, Corymbia trachyphloia, C. intermedia,* and *Lophostemon confertus.* Regional ecosystem 8.12.3c (one record) is characterised by evergreen to semi-evergreen notophyll to microphyll vine forest, whereas regional ecosystem 8.12.10a (one record) is dominated by *Leptospermum* and/or *Acacia* spp. and/or *L. confertus* open shrubland to closed scrub.

Broadly, this species' habitat can be defined as a combination of '1.5 -Subtropical/Tropical Dry Forest' and '5.2 Wetlands (inland) – Seasonal/intermittent/irregular rivers, streams, creeks' under the IUCN habitat classification scheme (IUCN, 2022).

Life Cycle and Generation Length

The lifespan and generation length for *G. venusta* are not precisely known. *Grevillea* species may be either short or long-lived, with understorey shrub-form species living for periods of 7 years (i.e. *G. scapigera*) up to 20 (i.e. *G. wilkinsonii*) or even 30 years (i.e. *G. macleayana*) (Makinson, 1993; England et al. 2002; Dixon & Krauss, 2019).

While there have not been studies specific to *G. venusta,* other species of *Grevillea* have been observed to reach sexual maturity around five years (i.e. *G. bedggoodiana*) (Wawrzyczek, 2022). Anecdotal evidence also suggests that *G. venusta* may mature to flower as young as one year in cultivation (G. Sinclair, pers. comm. 2024). As such, it is inferred that the species may reach reproductive ability as young as one year in the wild, under ideal conditions.

If the species' minimum lifespan is estimated to be seven years and the age of maturity is estimated to be one year, then the minimum estimated generation length for *G. venusta* is calculated as four years based on the IUCN formula of "Age at maturity + (0.5*length of reproductive period)" (IUCN SPC, 2022). If the species' maximum lifespan is estimated to be 30 years and the age of maturity is estimated to be 1 year, then the maximum estimated generation length for *G. venusta* is calculated as 15.5 years based on the IUCN formula of "Age at maturity + (0.5*length of reproductive period)" (IUCN SPC, 2022).

Disturbance Ecology

The disturbance ecology of *G. venusta* not been extensively documented, however can be inferred from other species. The predominant disturbance to the species is likely to be fire. Many *Grevillea* species are killed by fire, and populations therefore require appropriate time to complete their life cycle (i.e. from germinant to adult) before exposure to subsequent fires, which can kill juveniles before they have produced seed (Gallagher et al. 2021). Shortened fire intervals that interfere with this process can therefore lead to rapid declines in the effective population size. Other factors may also impact *Grevillea* recovery post-fire, such as high rates of seed predation, which has been observed for *G. caleyi* (Auld & Denham, 2001). The species is also likely to form a persistent seedbank, from which it germinates after disturbance such as fire/flooding; however, high intensity fires may kill seed and deplete the seedbank (Pickup et al. 2003). However, there may be some capacity to resprout after fire as has been found for *G. rhizomatosa* (Croft et al. 2006). Additionally, many species of *Grevillea* require one or more fire-related cues to facilitate germination (Morris, 2000).

Recent monitoring undertaken within the SBTA (in August 2022) indicates that *G. venusta* was killed by fire in several areas, but that dense clusters of individuals persisted or recruited in areas recently impacted by fire (Ecosure, 2023). Dense stands (4,160 plants/ha) were documented in fire impacted areas near Olive Creek (Ecosure, 2023). Approximately 25% (1200) of the estimated 4849 plants at this site were juveniles. By contrast, densities of 650 plants/ha were present in unburnt creekline habitat, where juveniles only comprised ~8% (between 306 to 612) of the estimated 3886 to 7772 plants (Ecosure 2023). This indicates fire may facilitate germination and that the species responds favourably to some fire disturbance. However, shortened fire intervals or recurring high-intensity fires may still negatively impact recruitment and/or habitat quality.

The Regional Ecosystem Description Database indicates that the regional ecosystems supporting *G. venusta* typically favour a low/moderate fire regime with fires at intervals 3 – 6 years (i.e. regional ecosystem 12.3.3) or

8 – 12 years (i.e. regional ecosystem 12.3.6) (Queensland Herbarium, 2023). *Grevillea venusta* has likely adapted to favour a regime that includes fire at semi-regular intervals between 3 and 12 years. However, inappropriate fire regimes could be facilitated by infestations of *Lantana camara* (lantana) and *Megathyrsus maximus var. maximus* (Guinea grass), which may also compete with the species directly for resources (G. Sinclair, pers. comm. 2024).

Grevillea venusta habitat located near and within Byfield State Forest (particularly near Stony Creek) is subject to disturbance associated with timber harvesting (G. Sinclair, pers. comm. 2024). Disturbance may be caused through mechanical damage caused by harvest, or by secondary means such as water quality reduction (Campbell & Doeg, 1989), and introduction of invasive weeds.

The species may be disturbed by inappropriate grazing regimes where uncontrolled grazing occurs, as grazing has been shown to negatively impact seedling recruitment in other *Grevillea* species (i.e. *G. maxwellii*) (Barrett & Cochrane, 2007). However, this has not been identified within the habitat of *G. venusta* to date.

Flowering, Pollination and Dispersal

Grevillea venusta has been recorded in flower from April to September, but most often from August to September (Queensland Herbarium, 2024; G. Sinclair, pers. comm. 2024). While studies relating to the dispersal capabilities of *G. venusta* have not been conducted to date, evidence for other *Grevillea* species indicates that most species within the genus are mostly dispersed by myrmecochory (i.e. by ants) or other invertebrates, with some dispersal also occurring via birds or anemochory (i.e. wind) (Auld & Denham, 1999; Falster et al. 2021). Additionally, nearly all records are located along waterways (often within 3 m), riverine areas or tributaries of larger creeks (Queensland Herbarium, 2024). As such, it is inferred that seed dispersal is also likely to occur over greater areas as a result of hydrochory (i.e. water-mediated dispersal). Other species in the *Grevillea* genus are reported to be pollinated by insects, and it is inferred that the same applies to *G. venusta* (Falster et al. 2021).

Summary of documentation requirements for Section 4. Biology and ecology

- Foraging, breeding and dispersal habitat
- Life cycle and reproduction (including generation length calculation, plausible bounds and justification for formula used)
- Any gaps in our understanding of the species' biology/ecology, and/or a statement that little is known of the species’ biology/ecology.
- Desired but not essential
    - Disturbance ecology
    - Pollination syndrome
    - Dispersal syndrome

Gossia bamagensis is one of a suite of Myrtaceae species that require reassessment using the Common Assessment Methodology to document the rapidly emerging threat of *Austropuccinia psidii* (myrtle rust disease).

Image © Andrew Ford.

5 Threats

5.1 Identification of known threats and impact of the threats

Nominators should then describe the threats to the species. By this stage, nominators should have an informed understanding of the threats relevant to the species. Nominators should first review the collated information and identify a list of possible threats. Nominators should then contact the appropriate expert/s for the species to refine this list of threats.

5.1.1 Review potential threats

Nominators should review possible threats by doing the following:

Investigate the land use map and remnant RE map collated when preparing the distribution section to investigate potential threats. For example, by investigating whether the species:

- Occurs in cleared/regrowth areas. Review the proportion of the relevant RE(s) that have been cleared by referring to the clearing statistics in the RE Description Database search tool (see Section 0).
- Has a distribution that is fragmented by land use change, such that the species occurs in subpopulations that are now isolated.
- Occurs in freehold land, or in other high-risk areas such as urban areas.
- Within watercourses or waterbodies subjected to impoundment or drainage.

Review the ecology section to consider whether the species is likely to be susceptible to decline from the list of potential threats. For example, by considering:

- If the species is susceptible to climate change impacts (e.g., is it restricted to refugial, high-elevation habitat)?
- If the species susceptible to decline from changes to fire regimes (i.e., an obligate seeder that now occurs in an area with more frequent fire regimes; or a fauna species that relies on long-unburnt habitat).
- If the species co-occurs with any invasive weeds.
- If the species occurs within habitat targeted by vertebrate or invertebrate pests (e.g. alluvial soils or lowland waterways frequented by feral pigs).
- Whether the species a known dietary component of vertebrate pests (i.e., in the critical weight range for feral cat/fox predation).
- Whether there any geographical or land use boundaries that are inhibiting dispersal (i.e., highways or infrastructure between mammal subpopulations).

5.1.2 Consult experts to determine threats

After reviewing the possible threats to the species, nominators should consult with the relevant expert(s) to refine this list. Relevant experts may include the collectors of the species (noted in the occurrence records for the species), the species' curator, land managers that work in the region where the species occurs (i.e., Queensland Parks and Wildlife Rangers), or researchers who have published peer-reviewed or grey literature on the species. Efforts should be made to contact a representative list of experts, aiming to capture insight on the status of the species across its distribution. For example, if the species has a scattered distribution, nominators should attempt to contact an expert that knows the species in the north and south of its range. Guidance on questions to ask experts for the purposes of completing a nomination is provided in Appendix 6. Example questions for expert consultation. Once the list of possible threats has been refined to include only those threats that are **relevant** to the species, the threats should be classified.

5.1.3 Threat classification

Threats must be classified using a standard typology. The Queensland Government and Australian Government are both in the process of developing fit-for-purpose typologies for threat assessments. Until these are publicly released, threats should be classified according to the IUCN – CMP Unified Classification of Direct Threats. When the nomination is received by the Queensland Government for completeness prior to consideration by the Species Technical Committee, any updated typology will be applied. Under the IUCN typology, each threat has up to three levels of classification, starting broad and becoming more specific. This system classifies threats according to the source of the threat. Therefore, land clearing attributed to agriculture should be classified separately to land clearing due to urbanisation.

Nominators should attempt to assign a threat class that is as specific as possible (for example, IUCN threat 7.1.1 rather than IUCN threat 7.1). Where further detail is required to explain the threat, place it in brackets after the threat class. Take care to distinguish between 'threats' and 'symptoms'. A threat is the *process* that is causing a decline/impact, while a symptom is an outcome of the threat. For example, lack of recruitment may be symptomatic of inappropriate fire regimes. The Federal list of Key Threatening Processes provides useful additional guidance when describing threats. An example is provided in Table 5. A summary of IUCN threat categories with descriptions is provided in Table 6. Note that historical threats, which are no longer having a significant impact on the species (i.e. are listed as 'not significant' under consequence) are denoted with an *.

Table 5. Example text for the threats table on the nomination form of *Bolemoreus hindwoodi*, Eungella honeyeater[6] (a bird).

Threat 1. **IUCN threat 7.1.1 Natural system modifications; fire and fire suppression; increase in fire frequency/intensity**	
Status	**Evidence**
Mechanism: direct and indirect Timing: past, current, future Confidence: inferred Likelihood: likely	'Fire regimes that cause declines in biodiversity' is a key threatening process listed under the EPBC Act (DCCEEW, 2023). Rainforest habitats of the Wet Tropics are fire-sensitive (Metcalfe and Ford, 2008). Large fires burned 11,217 ha of rainforest in the Eungella–Crediton area in 2018 (Hines et. al., 2020). Where fire severity was high to extreme, complete tree and shrub mortality is likely, as is total loss of seed and seedling banks (Hines et al., 2020). Approximately 17-20% of Eungella honeyeater habitat was impacted

[6] Department of Environment and Science (2024). Nomination to change the conservation class of species *Bolemoreus hindwoodi* under the Queensland *Nature Conservation Act 1992*. Queensland Department of Environment and Science.

Consequence: major Trend: increasing Extent: entire range Risk: very high	by high to extreme fire intensity in 2018 (Table 1). The fires were fuelled by debris from tropical cyclone Debbie (March 2017; Figure 11) combined with low precipitation and extreme heat in the preceding weeks (Hines et al., 2020). Much of the rainforest that burned had been logged in previous decades, and the gaps created had been dominated by the weed lantana (Lantana camara), which likely exacerbated the fire (Hines et al., 2020). Low-severity fires killed extensive areas of rainforest climbers of the genus *Freycinetia* (Hines et al., 2020), an important food source for Eungella honeyeater (P. Julien, pers. comm., 2024). Even very low flame heights in rainforests and scrubs were found to result in widespread tree and shrub defoliation or death, immediately or within the months following the fires (Hines et al., 2020). Damage to these fire-sensitive communities has been assessed as likely to take decades to centuries to recover (Hines et al., 2020). Additionally, these fires burned at a higher severity over large areas of eucalypt communities across regions where the species is known to forage. Higher fire severities were found to be particularly evident in rainforests previously disturbed by land clearing, logging or road construction, especially where weeds were present (Threat 2) (Hines et al., 2020). These disturbances open rainforest, alter microclimate (to become drier and warmer), and lead to changes in floristics (e.g. presence/dominance of *Alphitonia* and *Acacia* spp. lantana), which in combination appear to increase flammability (Hines et al., 2020). Climate change (Threat 3) will further increase the risk of fire incursion into these communities.
Threat 2. **IUCN threat 8.1.1 Invasive and other problematic species, genes and diseases; invasive and non-native / alien species / diseases; unspecified species**	
Mechanism: indirect Timing: past, current, future Confidence: inferred Likelihood: likely Consequence: major Trend: increasing Extent: part of range Risk: very high	Weed incursions may affect the quality of Eungella honeyeater nesting and foraging habitat as invasive weeds can change the floristic and structural characteristics of habitat, thereby changing resource availability. Furthermore, invasive weeds can alter fuel loads and thus fire ecology of habitats (Chambers et al., 2019). Weed incursions by lantana and high biomass grasses are prevalent in the Mackay Highlands (Hines et al., 2020). In this region, invasive weeds are commonly established in areas of human disturbance (e.g., land clearing) and/or natural disturbance (e.g., cyclones). Lantana established in the Crediton region after logging created a discontinuous canopy. Subsequent fire in 1992 resulted in the loss of a complex notophyll vine patch and the increasing dominance of lantana across the fire-affected region (House et al., 1998 in Hines et al., 2020). Subsequently, the fire event in 2018 (Figure 8) resulted in almost complete replacement of the Crediton region's rainforest with weeds (e.g. *Desmodium uncinatum*, *Lantana camara*, *Parthenium hysterophorus*, *Themeda quadrivalvis*, *Solanum* spp.), with the exception of some common rainforest pioneer species (Hines et al., 2020). As such, the establishment of weeds, especially those that interact positively with fire, may lead to the loss of notophyll vine communities that form the Eungella honeyeater's core habitat (see 'Reproduction'). The introduction of noxious weeds through vehicles, plant and equipment will increase with development of new infrastructure in the region. Additional planned activities in the region that will contribute to weed

	invasion include the Pioneer Valley Mountain Bike Trail (Figure 12). This project will consist of approximately 95 km of trails that will traverse the valley between Finch Hatton and Eungella. These tracks are likely to act as a corridor for weed incursion due to both land disturbance during construction and ongoing soil erosion around tracks, as well as the introduction of seeds with riders and their equipment.

5.1.3.1 Climate change as a threat

Nominators can review the risk of climate change for a species by relating its ecology or currently occupied climatic envelope to projected climate changes. Key resources to identify projected climate changes include:

- Queensland Future Climate – Regional Impact Summaries
    - Nominators should identify the region relevant to the species based on the maps provided: Regional Impact Summaries | LongPaddock | Queensland Government.
    - A summary of the **relevant** climatic changes, along with the confidence with which they are projected to occur should be summarised into the threats table. Using this approach in isolation (i.e. without related to peer reviewed literature or the species' biology and ecology), the threat of climate change is only likely to be 'suspected'.
- Queensland Future Climate Dashboard
    - Nominators can use this tool to explore how key climate variables are likely to change in the future (2030, 2050, 2070, 2090) depending on different climate scenarios (RCP 4.5, RCP 8.5).
- Peer-reviewed research.

Table 6. Summary of IUCN threat categories with descriptions (IUCN SPC, 2024). Detailed guidance on the IUCN threat typology should be used in assessments and is available here: IUCN – CMP Unified Classification of Direct Threats.

Threat class	Threat	Description	Examples
1	Residential and commercial development	Threats from human settlements or other non-agricultural land uses with a substantial footprint.	Land clearing for urban settlements.
2	Agriculture and aquaculture	Threats from farming and ranching as a result of agricultural expansion and intensification, including silviculture, mariculture and aquaculture.	Land clearing for agriculture.
3	Energy production and mining	Threats from production of non-biological resources.	Land use change associated with open-cut mining, construction of associated infrastructure.
4	Transportation and service corridors	Threats from long narrow transport corridors and the vehicles that use them.	Clearing for major roads and railways.

5	Biological resource use	Threats from consumptive use of 'wild' biological resources, including both deliberate and unintentional harvesting effects; also persecution or control of specific species.	Illegal collection of orchids/reptiles.
6	Human intrusion and disturbance	Threats from human activities that alter, destroy and disturb habitats and species associated with non-consumptive use of biological resources	Trampling and erosion on recreational tracks, 4wd disturbance.
7	Natural systems modifications	Threats from actions that convert or degrade habitat in service of 'managing' natural or semi-natural systems, often to improve human welfare. For example, fire and fire suppression, dams and water use.	Construction of dams, inappropriate fire regimes.
8	Invasive and other problematic species, genes and diseases	Threats from non-native and native plants, animals, pathogens/microbes, or genetic material that have, or are predicted to have harmful effects on biodiversity following their introduction, spread, and/or an increase in their abundance.	Hybridisation with cultivated plants. Vertebrate pests.
9	Pollution	Threats from introduction of exotic and/or excess materials or energy from point and non-point sources.	Nutrient excess near urban settlements causing proliferation of weeds.
10	Geological events	Threats from catastrophic geological events.	Volcano eruption; tsunami
11	Climate change and severe weather	Threats from long-term climate changes that may be linked to global warming and other severe climatic/weather events that are outside of the natural range of variation or potentially can wipe out susceptible species habitat.	Periods of prolonged drought combined with very hot days leading to an increase in extreme fire weather.

5.1.3.2 Threat attributes and evidence

- Nominators should then assign parameters to each threat. These parameters describe the mechanism, timing, confidence/data quality, likelihood, consequence trend and extent for each threat and the effect on the species (Table 7).
- A summary of key attributes should be provided in Column 2 of the threats table on the nomination form.
- Nominators should take care to understand the definitions related to the 'data quality' threat attributes (observed, estimated, projected, inferred and suspected). These are detailed in the IUCN Guidelines and in Section 9.1 of this document.
- Nominators should then detail the evidence that links to the key parameters in the 'Evidence' column of the threats table. The key attributes do not have to be discussed in order within the

evidence column. Ensure this section is fully referenced and concise (e.g. 250 words per threat as a guide).

- This section will directly feed into the criteria assessment. Ensure threats are well articulated and any declines/reductions are clearly justified with supporting evidence.
- For past threats, the likelihood, consequence, and extent attributes can be applied retrospectively (Table 7).
- For future threats, the likelihood, consequence, and extent attributes should consider the plausible future scenario, if the threat is to eventuate. Nominators should be reasonably certain of the attribute level applied and avoid unrealistic scenarios.

Table 7. List of threat attributes, descriptions and relevant parameter definitions to be entered into column two of the Threat attribute table in the nomination form.

Attribute	Description	Threat attribute parameter
Mechanism	The way the threat causes a decline in the population.	• Direct: via disruption of survival and reproduction • In-direct: via interactions with other threatening processes
Timing	The temporal nature of the threat; can be more than one.	• Historical: was occurring ***more than*** one generation or 10 years in the past (from time at assessment), whichever is shorter. The threat may also be continuing and thus also listed as 'current'. • Current: occurring ***within*** one generation or 10 years in the past or future (from time at assessment), whichever is shorter. • Future: expected to impact the species ***beyond*** one generation or 10 years (from time at assessment), whichever is shorter.
Confidence / data quality	The nature of the evidence about the impact of the threat on the species.	• Observed: based on census data (i.e., all individuals in population counted) • Estimated: based on statistical assumptions (i.e., sample of population) • Projected: based on statistical assumptions and extrapolated into time) • Inferred: based on indirect evidence on variables of a same type • Suspected: based on indirect evidence on variables of a different type
Likelihood	The likelihood of the threat impacting on the whole population or extent of the species or a part thereof (where the threat impacts).	*Note: if the likelihood has changed over time, the current likelihood should be adopted in the threat matrix, although the historic likelihood of the threat can still be specified, i.e. historic (almost certain), current (unlikely) or described in text.* • Almost certain: occurred, or is expected to occur every year • Likely: occurred, or is expected to occur at least once every 5 years • Possible: occurred, or might occur at some time

		• Unlikely: occurred, or is known to have occurred only a few times • Unknown: currently unknown how often the threat will/or did occur
Consequence	The severity of the threat, should it be realised.	*Note: apply to the current situation (i.e., not retrospectively), although the current situation may include cumulative impacts particularly where impacts of the threat are irreversible. If the consequence has changed over time, this can be described in the evidence text.* • Not significant: had, or has no long-term effect on individuals or population • Minor: individuals were/are adversely affected but no effect at population level • Moderate: population was/is stable or beginning to decline • Major: population decline was/is ongoing • Catastrophic: population trajectory was/is close to extinction
Trend	The extent to which the threat will continue to operate on the species.	*Note: apply to the current situation (i.e., not retrospectively). If the trend has changed over time, this can be described in the evidence text.* • Decreasing • Static • Increasing • Unknown
Extent	The spatial context of the threat in terms of the range of the species.	*Note: apply to the current situation (i.e., not retrospectively). If the extent has changed over time, this can be described in the evidence text.* • Entire range • Part of range • Unknown
Risk	Risk matrix rating	• E.g., low, moderate, high or very high risk.

5.1.3.3 Threat risk

Nominators should then use the Risk Matrix to rank the threats according to the risk (Table **8**).

- Threats should be placed into the relevant cell in the Risk Matrix by using the 'consequence' and 'likelihood' threat attributes.
- Nominators should then determine the Risk Rating for each threat (low, moderate, high, very high).
- Threats listed in the threats table should then be re-ordered so they are presented in order from highest to lowest risk.
- Note that a future or past threat can be listed higher on the threat Risk Matrix (and in the threat table) than a current threat.

- Nominators should carefully consider the relevance of including threats that have a risk of 'not significant'. In some circumstances, it is appropriate to include threats that are 'not significant'. For example, it would be informative to include the threat of myrtle rust for a species' of Myrtaceae, even if the threat was 'not significant', as it would demonstrate that this very topical threat has been considered in the nomination. By contrast, it would be unnecessary to include the threat of feral pigs for a species that occurs in an area that is never likely to be impacted by feral pigs.
- Nominators should annotate past threats with an asterisk (*). This is to ensure that high risk threats that are not likely to be operating on the species anymore can be differentiated from current threats with the same risk level when applying concepts such as locations.

Table 8. Completed risk matrix for the Eungella honeyeater (*Bolemoreus hindwoodi*)[7]. List threats in cells according to the consequence and likelihood identified in the threats table.

Likelihood	Consequence				
	Not significant	Minor	Moderate	Major	Catastrophic
Almost certain					
Likely			**IUCN threat 8.1.2** Invasive and other problematic species, genes and diseases; Invasive non-native; Feral pigs (*Sus scrofa*)	**IUCN threat 7.1.1** Natural system modifications; Fire and fire suppression; Increase in fire frequency/intensity **IUCN threat 8.1.1** Invasive and other problematic species, genes and diseases; Invasive non-native; weeds **IUCN threat 11.** Climate change and severe weather; Temperature extremes	
Possible			**IUCN threat 5.3.3** Biological resource use; Logging and wood harvesting;		

[7] Department of Environment and Science (2024). Nomination to change the conservation class of species *Bolemoreus hindwoodi* under the Queensland *Nature Conservation Act 1992*. Queensland Department of Environment and Science.

Likelihood	Consequence				
	Not significant	Minor	Moderate	Major	Catastrophic
			Unintentional effects: subsistence/small scale (species being assessed is not the target)		
Unlikely		**IUCN threat 8.1.2** Invasive and other problematic species, genes and diseases; Invasive disease; *Phytophthora cinnamomi*	**IUCN threat 8.1.2** Invasive and other problematic species, genes and diseases; Invasive disease; Myrtle rust (*Austropuccinia psidii*)	***IUCN threat 2.3.2** Agriculture and aquaculture; Livestock farming and ranching; Small-holder grazing, ranching or farming	
Unknown					

Risk matrix legend/Risk rating:

LOW RISK	MODERATE RISK	HIGH RISK	VERY HIGH RISK

Rhodamnia longisepala is known from a very restricted distribution in the Wet Tropics bioregion of Queensland. The species was reassessed using the Common Assessment Methodology and found to be eligible for listing as Critically Endangered due to having less than 50 mature individuals, and the threat of myrtle rust.

Image © Andrew Ford.

6 Conservation advice: threat abatement and recovery actions

The conservation advice section provides an overview of recovery and threat abatement/mitigation actions that are underway. It also provides an opportunity for nominators to consult with experts and include recommended actions to address current threats. Current and proposed actions should be provided for all threats listed (including future threats) or state threats that lack conservation advice.

- Nominators should first review any existing recovery plans, Federal conservation advice or relevant threat abatement plans for relevant recovery actions to the threats for the species. Where none are available for the species, those available for related or ecologically similar species (e.g. share similar habitat or co-occur within the habitat) may be relevant. These can include plans made by other jurisdictions.
- Identify who is undertaking these activities and how successful the activities have been to date.
- Describe any mitigation measures or approaches that have been developed specifically for the species at identified locations. Identify who is undertaking these activities and how successful the activities have been to date.
- For taxa nominated as Extinct in the Wild, provide details for any naturalised or captive subpopulations and the level of human intervention required to sustain the species.
- Past threats that are static (have ceased) may not require threat abatement and recovery actions if they are not continuing to impact the population.

Present the current and proposed actions following the format in Table **9** and Table **10**. Note that threats should be presented in the order as listed in the previous threats table. Additional examples of recovery actions are provided in Appendix 7. Potential conservation/threat abatement actions, but follow the format of Table **9** and Table **10**.

For each threat, ensure actions are considered that encompass:

- Consideration and consultation for possible partnerships with Traditional Custodians to co-design and deliver management actions, and/or to ensure management approaches align with or consider cultural aspirations for relevant First Nations groups.
- Further targeted field survey requirements, particularly where the species' habitat has been poorly surveyed.
- Re-survey of historical collection sites, particularly where these have not been visited in >10 years.
- Time-series monitoring to determine population trends in relation to key threats.
- Research to better understand the biology and ecology of the species.
- Extension and awareness with relevant stakeholders (i.e., landholders where the species occurs on private land) or specific recreational communities (i.e. fishing community).
- Land management strategies, including developing plans and implementing plans.
- *Ex situ* conservation for species with very limited distributions including consideration of the feasibility of such activities.

Table 9. Format for presenting threat abatement and recovery action advice. Ensure threats are presented in the same order as the threats table.

Threat	Abatement or recovery action underway
[Threat 1 description]	*Threat 1 current action 1* *Threat 1 current action 2* *Threat 1 current action 3*
[Threat 2 description]	*Threat 2 current action 1* *Threat 2 current action 2* *Threat 2 current action 3*
[Threat 3 description]	*Threat 3 current action 1* *Threat 3 current action 2* *Threat 3 current action 3*
Threat	**Abatement or recovery action proposed**
[Threat 1 description]	*Threat 1 proposed action 1* *Threat 1 proposed action 2* *Threat 1 proposed action 3*
[Threat 2 description]	*Threat 2 proposed action 1* *Threat 2 proposed action 2* *Threat 2 proposed action 3*
[Threat 3 description]	*Threat 3 proposed action 1* *Threat 3 proposed action 2* *Threat 3 proposed action 3*

Additional tips

- Ensure the recovery actions are communicated in concise, clear sentences.
- For each threat, ensure actions are listed in order of importance.
- Many key threatening processes also have targeted actions detailed in a Threat Abatement Plan or Threat Abatement Advice – review these and see if they are relevant to the species.
- Review management plans for areas where the species occurs such as within National Parks to see what is happening in that area generally. Indicate if the species is specifically included in the plan, or if there are no considerations for the species survival.
- Review the Species Threats and Profiles Database (SPRAT) for current Australian Government recovery plans for threatened species.
- Review the Action Plans for Birds 2020 (Garnett & Baker, 2021), Action Plan for Australia's Most Imperilled Plants 2021 (Silcock et al., 2022), Action Plan for Australian Mammals 2012 (Woinarski et al., 2014) and Action Plan for Australian Lizards and Snakes 2017 (Mitchell et al., 2019) for guidance on appropriate threat abatement actions.
- Also see the Australian Government Threatened Species Action Plan 2022-2032.
- Many threats will have similar required actions, in this case repetition is completely acceptable.

Table 10. Excerpt of conservation advice: threat abatement and recovery table from nomination form for *Beackea trapeza*[8] (a small shrub).

Threat	Abatement or recovery action underway
IUCN threat 8.1.2 Invasive and other problematic species, genes and diseases; invasive non-native/alien species/diseases; named species (*Sus scrofa* and *Bos* spp.)	Queensland Parks and Wildlife Service are currently implementing a project aimed at the conservation of threatened species within Blackdown Tableland National Park. The Blackdown Tableland National Park Management Statement 2013 states that a Level 2 pest management strategy is in place for the management of invasive species in the park (Queensland Government, 2013). The Commonwealth Government has published threat abatement plans for the threatening process of 'Predation, habitat degradation, competition and disease transmission by feral pigs' (Commonwealth Government, 2017). All people in Queensland have a general biosecurity obligation under Queensland's *Biosecurity Act 2014* to ensure they manage declared invasive fauna species on their land.
IUCN threat 7.1.1 Natural system modifications; increase in fire frequency/intensity; inappropriate fire regimes	There are no threat abatement or recovery actions specific to *B. trapeza* that are being implemented in relation to the management of fire regime intensification. The Blackdown Tableland National Park Management Statement 2013 states that a Level 2 fire management strategy is in place for the park. It is unknown whether actions specified in the strategy are being implemented. Management recommendations relating to fire management specified in the Management Statement include: "Continue to develop, implement and review fire management regimes in accordance with QPWS procedures. Continue to protect cultural resources (historic yards, slab well site and art shelters) from fire damage. Develop a cooperative approach to fire management in consultation with Traditional Owners, park neighbours and state forest lessees adjoining the park to extend good fire management practices across the landscape. Maintain planned burning in all fire-adapted communities represented in the park and adjacent forest areas to provide suitable habitat for plant communities and animal species. Continue to monitor the impacts of planned burns and wildfires on significant vegetation communities." The Commonwealth Government has prepared listing advice for the threatening process 'Fire regimes that cause declines in biodiversity'; however, an associated threat abatement plan has not been published.

[8] Excerpt adapted Department of the Environment, Science and Innovation (2024). Nomination to change conservation class of *Baeckea trapeza* under the Queensland *Nature Conservation Act 1992*. Queensland Department of Environment and Science.

IUCN threat 2.1.3 Agriculture and aquaculture; annual and perennial non-timber crops; agro-industry farming	There are no threat abatement or recovery actions specific to *B. trapeza* that are currently being implemented in relation to the threat of land clearing for agriculture or forestry. The Commonwealth Government has prepared listing advice for the threatening process of 'land clearance'; however, a threat abatement plan has not been prepared due to the various mitigation measures already adopted at state and territory-scales. In Queensland, the *Vegetation Management Act 1999, Planning Act 2016* and *Planning Regulation 2017* afford protection to areas of Category B (remnant) vegetation and vegetation contained within conservation estates (noting that exemptions for small-scale clearing apply). The *Nature Conservation Act 1992* and *Nature Conservation (Plants) Regulation 2020* restrict clearing in High-Risk trigger areas and require implementation of impact management plans for clearing within 100m of a protected flora species.
Threat	**Abatement or recovery action proposed**
IUCN threat 8.1.2 Invasive and other problematic species, genes and diseases; invasive non-native/alien species/diseases; named species (*Sus scrofa* and *Bos* spp.)	Undertake research and monitoring to assess the presence or absence of invasive fauna and extent of damage within the habitat of *B. trapeza.* Introduction of measures to exclude invasive fauna or unintended grazing from the habitat of *B. trapeza,* including the continuation of measures to manage feral pigs. Conduct a detailed survey to quantify the extent of the *B. trapeza* population and confirm whether parts of its habitat are susceptible to damage caused by feral pigs.
IUCN threat 7.1.1 Natural system modifications; increase in fire frequency/intensity; inappropriate fire regimes	Investigate opportunities to partner with or support Traditional Custodians to lead the recovery actions for this species to address the threat of fire regime intensification. Develop an agreement that favours an ecological-based fire strategy with neighbouring landholders to ensure maintenance of an appropriate fire regime. Undertake research to improve the body of knowledge relating to the fire ecology, pollination, habitat requirements, germination requirements and recruitment rates of the species to inform targeted conservation actions. Continued implementation of the Level 2 fire management strategy, including monitoring of the impacts following planned burns and wildfires on areas supporting *B. trapeza.* Undertake regular monitoring at *B. trapeza* subpopulations to collect baseline data relating to damage caused by fire.
IUCN threat 2.1.3 Agriculture and aquaculture; annual and perennial non-timber crops; agro-industry farming	Conduct targeted surveys in areas of potential habitat to confirm presence or absence of other subpopulations. Collaborate with Traditional Custodians to inform locations of other potential *B. trapeza* subpopulations.

Cophixalus exiguus (dainty nursery frog, male pictured here) was reassessed using the Common Assessment Method as Vulnerable due to plausible future threats associated with climate change.

Image © Dr. Conrad Hoskin.

7 Summary of key assessment parameters

Prior to assessing the species against the Criteria, nominators should collate the key assessment parameters into the table provided from the body of the nomination form. Definitions of these key terms follow the 'Guidelines for Using the IUCN Red List Categories and Criteria'. The table encourages nominators to specify 'plausible bounds' for each parameter. Plausible bounds are used to represent and manage uncertainty during the assessment process. An example is provided in Table 11.

- Nominators should state the minimum and maximum plausible values for each parameter, along with the value used in the assessment.
- The value used in the assessment is likely to reflect the 'best guess'. However, it may also reflect the lower plausible value where a precautionary approach is warranted. For example, using the lowest plausible number of mature individuals when assessing a species that is known to be declining, but recent population estimates are not available.
- The estimate used in the assessment can be a range, but in any case, the best estimate should always be included in the range of plausible values.
- The plausible range may be established using various methods, for example based on confidence or probability intervals, expert opinion, or the consensus view of a group of experts. Justify the method used and to represent uncertainty, along with the estimate used in the assessment in the table below.
- Trends may be decreasing, increasing, static or unknown, as per the Threats table. However, where possible 'unknown' should be avoided and the data qualifiers (Section 9.1) should be used to make a best guess (i.e., decreasing – suspected).
- For continuing decline, severe fragmentation and extreme fluctuations, the table cell should contain a statement indicating whether the condition has been met for the species being assessed, alongside a justification against the definition of the term.

Table 11. Example of a key parameters table using plausible bounds, data qualifiers and justification for *Eucalyptus raveretiana*[9].

Metric	Value used	Minimum plausible value	Maximum plausible value	Justification
Number of mature individuals	>139,363	<68,135	>139,363	It has been estimated that the population size is between 68,135 (the lower confidence interval of the smaller estimate) and 139,363 (the upper confidence interval of the larger estimate) (Queensland Herbarium, 2012). This estimate was prepared >10 years ago. Since this time, additional survey in 2019/2020 has indicated that the population may be twice this (Danielsen, 2021), although formal

[9] Excerpt adapted Department of the Environment, Science and Innovation (2024). Nomination to change conservation class of *Eucalyptus raveretiana* under the Queensland Nature Conservation Act 1992. Queensland Department of Environment and Science.

				population survey has not been undertaken. As such, it is inferred for the purposes of this assessment that the population size is >139,363. Circumstances are not known to have changed considerably (i.e. new legislation has not been introduced, new threats have not emerged), although several infrastructure projects have caused the localised losses of mature individuals on several occasions (likely hundreds of individuals). However, it is inferred that the minimum value exceeds the thresholds for listing under both Criterion C and D.
Trend	Decreasing (inferred)			It is almost certain that the population size of *E. raveretiana* has decreased since European colonisation in Australia; however, the rate of decline has likely slowed following the implementation of the Vegetation Management Act 1999. It is well documented that the number of mature individuals has undergone incremental declines attributable to major infrastructure developments in the region in recent years. However, it is unknown if similar declines will occur in the future, although it is suspected that these mechanisms will continue to cause an ongoing decline in the number of mature individuals. It is also inferred that the removal of mature individuals is leading to reduced recruitment at specific sites.
Generation length (years)	167.5	70	167.5	Prior research has inferred a minimum generation length of 70 years for eucalypts (Fensham et al. 2020). This value is accepted as the minimum generation length for *E. raveretiana* in this assessment. If the maximum lifespan is suspected to be 330 years and the earliest age of maturity is suspected to be 5 years, then the maximum generation length for *E. raveretiana* is calculated as 167.5 years based on the IUCN formula of “Age at maturity + (0.5*length of reproductive period)” (IUCN SPC, 2022). It is therefore inferred that the generation length of *E. raveretiana* may be between 70 and 167.5 years. The longer estimate has been considered in this assessment as a precautionary measure.
Extent of occurrence (km^2)	62,349.39	62,349.39	Not assessed	The EOO was estimated at 62,349.39 km^2 using a minimum convex polygon and a combination of expert verified herbarium records and reliable sight based records (IUCN, 2022) (Figure 1). Specifically, this assessment considered 68 expert verified

				herbarium records (Queensland Herbarium, 2024) and 620 reliable sight-based records from previous studies conducted by the Queensland Herbarium (Queensland Herbarium, 2012; QBEIS, 2024) and consultancies (GH&D, 2010; Epic Environmental, 2024). Records considered in this assessment were collected between 1931 and 2024. The habitat of the species has been relatively well surveyed; therefore, it is likely that the estimated EOO represent the actual EOO for the species. A maximum value has not been considered in this assessment as the minimum value exceeds the thresholds for listing under Criterion B.
Trend	Static (suspected)			Based on current information, the EOO is suspected to be static. The species is subject to several threats that are likely to be decreasing the quality of habitat for the species throughout its range. However, the species is long-lived, as these declines have not yet manifested such that there has been a detectable decline in the species' EOO, although this may occur in the near future.
Area of occupancy (km^2)	500 - 2,000	556	500 - 2,000	The AOO was estimated at 556 km^2, calculated using a 2 x 2km grid and a combination of expert verified herbarium records and reliable sight-based records (IUCN, 2022) (Figure 1). Specifically, this assessment considered 68 expert verified herbarium records (Queensland Herbarium, 2024) and 620 reliable sight-based records from previous studies conducted by the Queensland Herbarium (Queensland Herbarium, 2012; QBEIS, 2024) and consultancies (GH&D, 2010; Epic Environmental, 2024). Records considered in this assessment were collected between 1931 and 2024. It is highly likely that the species' AOO exceeds 556 km^2 (the minimum value considered in this assessment). A maximum value of 500 – 2,000 km^2 has therefore been used in this assessment (the thresholds for VU and EN under Criterion B).
Trend	Decreasing (inferred)			It is inferred that the species' AOO may be decreasing due to localised impacts associated with large-scale infrastructure projects (both mining and water related). However, it is not confirmed if these localised declines have been large enough to reduce the species' AOO from any one site, although this may have occurred in some cases (i.e. Sonoma Coal Mine Development).

Number of sub-populations	8	1	>10	*Eucalyptus raveretiana* is known from a relatively large number of collection records. Records for the species occur in close association with watercourses and drainage features, and eight subpopulations have therefore been delineated in accordance with the species' presence in particular drainage basins. River corridors can facilitate high levels of gene flow for riparian flora species (Murray et al. 2019a). Such processes can result in regular gene flow within and between catchments (Murray et al. 2019b). As such, it is possible that the species' population consists of one widespread subpopulation; particularly as the southern distribution and parts of the northern distribution occur within the Fitzroy River drainage basin. However, this is unlikely as the species is not known to be dispersed via water flow. There may be a maximum of >10 subpopulations if gene flow is restricted between drainage sub-basins (rather than drainage basins).
Trend	Static (suspected)			Based on current information, the number of subpopulations is suspected to be static. The species is subject to several threats that are likely to be decreasing the quality of habitat for the species; however, the species is long-lived, and it is likely that all subpopulations will persist for the foreseeable future.
Number of locations	>20	8	>20	The species faces varying threats within each of the sites at which it occurs. In many instances, these threats will cause localised impacts only (i.e. localised land clearing for infrastructure development, mining, transport infrastructure, erosion etc.). Consideration of site-specific threats would result in a large number of locations for the species (i.e. >20), which exceeds the thresholds for listing under Criterion B or D. Some threats may occur at the catchment scale (i.e. riparian weed invasion and hydrological modification), and therefore a minimum number of locations has been determined based on the species' occurrence within drainage sub-basins (i.e. 8). While there is a possibility that these threats may contribute to a continuing decline over a short timeframe for the species (i.e. 1 – 2 generations, equating to 70 and 335 years) further research is required to determine the likelihood of this occurring.
Trend	Static (suspected)			It is suspected that the number of locations is static. While invasive weeds may impact the species

<table>
<tr><td></td><td></td><td>throughout its range, the effects of this threat on the number of locations has not yet been realised, and it may not cause a decline in the number of locations in the long term.</td></tr>
<tr><td>Continuing decline</td><td colspan="2">Eucalyptus raveretiana is assessed as undergoing continuing decline for the purposes of this assessment. It is inferred that the species’ habitat has undergone decline due the threat of historical land clearing (see threat 1). This decline may have historically impacted 23 – 44% of the species’ habitat (see ‘additional information’). It is likely that the threat of land clearing continues to impact the species and its habitat today (albeit at a much slower rate; likely ~0.20% per year). In present day, localised land clearing occurs for mining and infrastructure projects (see threat 2 and threat 3) and occurs over small areas under exemptions listed under the Vegetation Management Act 1999. It is inferred that these threats have caused (and continue to cause) a continuing decline in the species’ extent of habitat, number of mature individuals and AOO.

It is also inferred that invasive weeds have established a considerable portion of the species’ habitat, causing a decline in habitat quality, and potentially limiting recruitment opportunities. This decline is likely exacerbated by the threats of inappropriate grazing regimes, erosion and sedimentation, forestry operations as well as water and road infrastructure development.</td></tr>
<tr><td>Severe fragmentation</td><td colspan="2">The species occurs in linear habitat associated with watercourses, most of which are hydrologically connected. There is therefore no evidence that >50% of the species’ AOO occurs in habitat patches that are too small to support a minimum viable population. Therefore, the species is not considered severely fragmented in this assessment.</td></tr>
<tr><td>Extreme fluctuations</td><td colspan="2">The species is a long-lived eucalypt, and it is therefore unlikely that E. raveretiana experiences extreme fluctuations in EOO, AOO, number of subpopulations or locations.</td></tr>
</table>

8 Standard of scientific evidence and adequacy of survey

A statement of the standard of scientific evidence and adequacy of survey is included in all nominations to indicate whether there is sufficient evidence to support the nomination. Based on the information collated so far, nominators should indicate whether the evidence is sufficient. If the evidence is sufficient, the standard text provided in Box 7 should be transposed to the nomination form.

If there is insufficient information, the species would be classified as Data Deficient. As this category is not present within the *NC Act,* this translates to a status of Least Concern. Thus, it is preferrable to state that the survey has been adequate to support a listing assessment, particularly in following the precautionary approach recommended in the IUCN guidelines (IUCN SPC, 2024). Therefore, the standard text presented in Box 7 becomes mandatory for assessments where the nominator is recommending a listing status of VU, EN, CR, EW or EX.

Additional text has been developed to recognise species that would be classified as Data Deficient were this category available within the *NC Act*. This text should be included in addition to the standard text when the following requirements are met:

- not collected in more than 20 years or 3 generations, whichever is greatest; and
- with no current information on populations or potential threats.

Nominators should ensure that shortfalls in survey adequacy are incorporated into the nomination by using the relevant data qualifiers. Where substantial assumptions in key parameters are made, it is likely the data qualifier will be suspected at most. Refer to Appendix 8. Data qualifier examples for key parameters for examples on applying data qualifiers.

Box 7. Standard statement on survey adequacy for the Standard of scientific evidence section on the nomination form.

> The survey effort is considered adequate and there is sufficient scientific evidence to support the assessment.
>
> OR
>
> The data available for this taxon are very limited and it would qualify as Data Deficient under the IUCN guidelines (IUCN SPC, 2024). However, given this category is not available under the *Nature Conservation Act 1992*, and the IUCN guidelines recommend “that assessors should adopt a precautionary but realistic attitude, and to resist an evidentiary attitude to uncertainty when applying the criteria (i.e., have low risk tolerance)” (IUCN SPC, 2024, pg. 25, Section 3.2.4 Dealing with uncertainty), the Species Technical Committee has taken a precautionary approach and will classify a taxon on the basis of the known information and expert ecological knowledge. Further population and ecological surveys and monitoring of the taxon are recommended.

9 Eligibility against the criteria

The IUCN Red List Guidelines are the authority for applying the criteria and include detailed text and examples on their application. Additional guidance developed by the Interjurisdictional CAM Working Group is developed to clarify concepts and included throughout this document where relevant.

- *Every criterion must be addressed independently.* Under every criterion, every sub-criterion should be addressed sequentially, as per the examples. If nominators cannot make an assessment for a specific criterion due to lack of information (as is often the case), this should be stated.
- Sometimes, it is easy to start with the most familiar criterion rather than working through them sequentially. It can also be helpful to start by making notes in each box.
- Ensure any references to key parameters are also presented and justified in the previous sections of the nomination form. That is, there should be *no new information* presented in the criteria assessment section, just a synthesis of what has already been outlined.
- Explanations should be kept concise and limited to key details required for the STC to make a decision. It is appropriate to cross-reference the Key Parameters Table for more information or other parts of the assessment. Duplication of justification between criteria can be avoided by cross-referencing (see Section 9.3: Criterion B).
- Nominators should ensure they justify how/why the species meets the key definitions.
- To be eligible for listing under a particular subcriteria (i.e., B1, B2, C2 etc.), a species must meet every threshold to be listed as a particular category. For example:
    - If a species meets EN under B1 (EOO <5,000km^2), and EN under (a) (≤5 locations) but has no continuing decline in any of b(i-v) or extreme fluctuations in any of c(i-iv), then it is Least Concern under Criterion B1.
    - If a species meets EN under B1 and has a continuing decline in b(i-v) but does not experience extreme fluctuations in any of c(i-iv) and only meets VU under (a) due to having 7 locations, it can only be listed as VU as it does not meet every threshold for EN under B1.
    - If a species meets the number of mature individuals for EN under C (<2,500), but only meets VU under C2a(i), as it has 500 mature individuals in each subpopulation, it can only be listed as VU under C2. This is because it does not meet every threshold for EN.
- Conversely, the overall eligibility status for a set of criteria (i.e., A, B, C, D or E) is the highest category for which the species qualifies under any subcriteria. For example, if a species meets VU under C1, but EN under C2, the species is assessed overall as EN under Criterion C.
- The overall eligibility status for the species is the highest category for which it is eligible under any criteria. This can be more than one criterion.
    - If the species meets VU under A2, and EN under B1, then overall it is eligible for nomination as EN under B1.
    - If the species meets VU under A2 and VU under C2, then overall, it is eligible for nomination as VU under A2; C2.

9.1 Dealing with uncertainty

Although the IUCN Criteria are quantitative, quantitative data are not always available for species that require assessment. This can create uncertainty when applying the quantitative thresholds of the IUCN categories and Criteria. There are two primary ways of dealing with this uncertainty when undertaking assessments:

- Using data qualifiers to describe the quality of the data being used; and
- Adopting a precautionary approach when making decisions about how data meet relevant thresholds.

9.1.1 Data quality

The IUCN Red List criteria incorporate several levels of data quality, so that taxa without comprehensive data can be assessed. Data qualifiers are used in three key sections of the nomination form:

- When describing key parameters throughout the nomination (population size, EOO, AOO, number of subpopulations, etc.)
- In the threats section to describe the data quality relating to a threat.
- In the Criteria assessment section to support an assessment outcome.

The relative order of data quality is observed > estimated > projected > inferred > suspected. Applying data qualifiers in practice can be somewhat subjective at times, as adequate guidance and examples are still being developed. However, the general rule is that data of higher quality (observed, estimated, projected) involves far fewer assumptions than data of lower quality (inferred and suspected). While observed data has the fewest assumptions, suspected data has the most assumptions. For comprehensive examples of how to apply data qualifiers to key metrics, and common threats, refer to Appendix 8. Data qualifier examples for key parameters and Appendix 9. Data qualifier examples for common threats.

9.1.1.1 Observed data

Data that has been *observed* refers to information that is based on well-documented observations (IUCN SPC, 2024). *Observed data is always quantitative.* For example:

- Population size based on a census.
- Population reduction from two census periods (3 generations ago and current).
- Continuing decline of habitat derived from a survey of all known habitat, or aerial photography of all known habitat.
- Continuing decline based on census data from multiple census periods.

Observed data *is not:*

- A researcher recording (visually observing) erosion around the roots of a sample of plants in a much larger population. Observed data would be quantitatively measuring the number of plants in an entire population impacted by different quantitative measures of erosion.
- A researcher observing myrtle rust infecting the leaves of the nominate species. Observed data would be quantitatively scoring the damage % to all individuals by myrtle rust in a population (via census).

9.1.1.2 Estimated data

Data that has been *estimated* refers to information based on calculations that may include statistical assumptions about sampling or biological assumptions about the relationship between an observed variable and the variable of interest (IUCN SPC, 2024). *Estimated data is always quantitative.* For example:

- Transect counts of singing male birds combined with assumptions about sex ratios to calculate the number of mature individuals.
- Population reduction or continuing decline in number of mature individuals derived from the estimated number at two different time points.

9.1.1.3 Projected data

As with estimated data, *projected* data refers to information based on calculations that may include statistical assumptions about sampling or biological assumptions about the relationship between an observed variable and the variable of interest (IUCN SPC, 2024). However, *projected data is extrapolated towards the future or in space.* Importantly, *projected data is always quantitative and* differs from a *future inference.* For example:

- Population reduction from census data extrapolated into the future using statistical methods.
- Continuing decline in the area or extent of habitat predicted by a statistical model of land cover change, which is based on analysis of past land cover change from remote-sensed data.

Projected data *is not:*

- Continuing decline in mature individuals based on mining activity that is confirmed to occur in the next 5 years (this is an inferred future decline/reduction). Projected data would be a quantitative measure of the number of mature individuals projected to be impacted by the mining activity over the next 5 years.

9.1.1.4 Inferred data

Data that has been *inferred* refers to information in the same type of units but not a direct measure (IUCN SPC, 2024). Inferred data can involve a combination of quantitative and qualitative data. For example:

- Population reduction inferred from a change in catch statistics.
- Continuing decline in mature individuals inferred from trade estimates.
- Continuing decline in AOO inferred from rate of habitat loss.

9.1.1.5 Suspected data

Data that is *suspected* refers to information that is based on variables in different types of units (IUCN SPC, 2024). Any reasonably supported suspicion, based on circumstantial evidence can be considered suspected data. Suspected data is always qualitative. For example:

- Percentage (%) population reduction based on decline in habitat quality or on incidence of a disease or circumstantial evidence.
- Population reduction based on information on trends in harvest, habitat quality, sightings (e.g., from structured expert elicitation).
- Anecdotal information about a population trend.

9.1.1.6 Minimum data quality requirements

Consequential differences in listing outcomes occur when selecting observed/estimated/projected OR inferred OR suspected, as the latter two are not permissible under various criteria (Table 12).

Table 12. Minimum data quality requirements for criteria A-E. If the data qualifier for the listed parameter is of lower quality than required, it cannot meet the criterion, even if the numerical value meets the threshold for that criterion (adapted from IUCN SPC, 2024).

Criterion	Parameter	Minimum data quality
A	Population reduction	Suspected
B	AOO	Estimated
B	EOO	Estimated
B1b, B2b	Continuing decline in EOO; AOO; area, extent and/or quality of habitat; number of locations or subpopulations; number of mature individuals	Inferred
C, D	Number of mature individuals	Estimated
C1	Estimated continuing decline	Estimated
C2	Continuing decline in number of mature individuals	Inferred
C2a(i)	Size of largest subpopulation	Estimated
E	Extinction probability	Estimated

9.1.2 The precautionary principle

In preparing a nomination, nominators should reflect on and have a sound understanding of their personal risk tolerance. A precautionary approach will classify a species as threatened unless there is strong indication that it is not threatened. Conversely, an evidentiary approach will classify a species as not threatened, unless there is strong indication that it is threatened. A spectrum of approaches exists between these extremes.

Figure 3. Conceptual diagram illustrating evidentiary vs. precautionary approaches in listing assessments.

The IUCN guidelines recommend that a precautionary, but realistic attitude is applied, while resisting an evidentiary attitude when applying the criteria. Despite this, uncertainty will remain in how much precaution should be applied. The general rule is to document decisions, and support these by stating whether a precautionary attitude has been considered. Thus, uncertainty should be actively considered throughout the criteria assessment section. Some examples of applying a precautionary, but realistic attitude include:

- Using the lower plausible bounds for a population size under Criterion C and D if the species has been relatively well surveyed, despite some areas of unsurveyed potential habitat.
- Using the upper plausible bounds for the number of mature individuals if the species has been very poorly surveyed, and there are substantial areas of potential habitat to be surveyed.
- Using the upper plausible bounds for generation length (and thus to define a 'very short time' under Criterion D) if the species is a long-lived perennial and faces imminent threats of climate change.
- Using the lower plausible bounds for population size, EOO and AOO if the species is experiencing continuing decline due to a range of serious, inferred threats.

9.2 Criterion A

Criterion A is used to assess taxa in the context of a *population reduction* based on a variety of data sources including a direct observation, abundance indices, a decline in EOO/AOO and/or habitat quality, exploitation, and/or impacts of introduced or competing taxa. Species with a population reduction due to any of these factors may meet the category thresholds if the reduction occurs within a given timeframe (Table 13). Nominators should attempt to apply this criterion where there is sufficient evidence (suspected to observed) of a population reduction and the generation length of the species.

Table 13. Category thresholds for Criterion A - adapted from IUCN SPC (2024).

Population size reduction (reduction in total numbers) measured over the longer of 10 years or 3 generations based on any of A1 to A4				
	Critically Endangered (CR)	**Endangered (EN)**	**Vulnerable (VU)**	**Near Threatened (NT)**
A1	**≥ 90%**	**≥ 70%**	**≥ 50%**	**≥ 20%**
A2, A3, A4	**≥ 80%**	**≥ 50%**	**≥ 30%**	**≥ 20%**

A1 Population reduction observed, estimated, inferred or suspected in the past and the causes of the reduction are clearly reversible AND understood AND ceased.

A2 Population reduction observed, estimated, inferred or suspected in the past where the causes of the reduction may not have ceased OR may not be understood OR may not be reversible.

A3 Population reduction, projected or suspected to be met in the future (up to a maximum of 100 years) [*(a) cannot be used for A3*]

A4 An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.

based on any of (a) to (e)

(a) direct observation [*except A3*]

(b) an index of abundance appropriate to the taxon

(c) a decline in the area of occupancy, extent of occurrence and/or quality of habitat

(d) actual or potential levels of exploitation

(e) the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites

9.2.1 Population reduction

A population reduction is defined as a decline in the number of mature individuals, which does not need to be continuing (although it may be). This can be based on several data sources including:

(a) a direct observation,

(b) abundance index,

(c) decline in AOO, EOO or habitat,

(d) exploitation, and/or

(e) pathogen impacts.

9.2.1.1 Data qualifiers under Criterion A

Only some data qualifiers can be used for each data source (a-e) under Criterion A (Table 14). For example, only data from a direct observation can meet the data quality for ‘observed’ as it is directly measuring population size, therefore can directly correspond to a population size reduction. Other metrics that use data relating directly to population size (i.e., field surveys of individuals) can be used with a data qualifier of observed, estimated, or projected.

If the reduction is based on data that is not directly measuring the population size, for example, a decline in AOO or EOO, the data qualifier under Criterion A can only be suspected, even if the decline in EOO or AOO was estimated. This is because the data source (i.e., the EOO and AOO) represent a variable of a different type, and thus assumptions must be made about the correlation between this data source and the population size (i.e., how many mature individuals were present in the part of the EOO or AOO that has declined). That is, if a reduction in EOO has been estimated, assessors can only suspect this corresponds to a reduction in population numbers, as they do not have data for the proportion of individuals present within the reduction area.

Table 14. Data qualifiers that can be used with each data source under Criterion A - adapted from IUCN SPC (2024).

Subcriteria under Criterion A	Data qualifier	Relevant criteria
(a) direct observation	observed, estimated	A1, A2, A4
(b) index of abundance	estimated	A1, A2, A4
	projected	A3, A4
	inferred	A1-4
(c) AOO, EOO, habitat quality	suspected	A1-4
(d) actual or potential exploitation	inferred, suspected	A1-4
(e) introduced taxa, hybridisation, pathogens, pollutants, competitors, parasites	inferred, suspected	A1-4

9.2.1.2 Generation length

Generation length is defined as the average age of parents of the current cohort (i.e., newborn individuals). This is used to scale time-based measures in the criteria against the reproductive rates (capacity for a species to replace itself) of a species. There are several ways to estimate this. A commonly used formula is:

*Age of first reproduction + (z * length of reproductive period)*

To utilise this formula, nominators will need to know (i) when the species becomes sexually mature, (ii) when the species stops reproducing/senesces, and elect a (iii) z value. The z value is a number between 0 and 1, which is usually $\leq$0.5. Greater z values are used for species with relative fecundity skewed towards older age classes, and lower z values for species with higher mortality during reproductive years. For some species, published literature exists where generation lengths using z values have been determined (Bird et al., 2020; Mancini et al., 2025; Pacifici et al., 2013).

For plants with seed banks:

Juvenile period + ½ life of seeds in seed bank, OR median time to germination

Seed bank half-lives commonly range from <1-10 years.

9.2.1.3 Challenges

- Often there is not enough information to estimate generation length. However, an attempt should be made to infer or suspect the generation length by reviewing similar species in the genus with similar reproductive strategies. Ensure the level of uncertainty around the estimate is clearly stated.
- For plants that are strongly associated with a RE or threatened ecological community, the level of decline in this ecosystem can often be used as a proxy for population reduction.

9.2.1.4 Response structure for Criterion A

- Summary sentence
    - In the format provided in Box 8.
- Generation length
    - State the generation length for the species, including data qualifier and any plausible bounds.
    - State the period over which a reduction is assessed (i.e., 10 years or 3 generations).
- Population reduction timing
    - State whether a reduction has occurred.
    - State the timing of the reduction (if known) and relevant subcriteria (A1-4).
- Population reduction basis
    - State what the population reduction is based on (a-e).
    - Describe the cause of the reduction (i.e., the relevant threat(s)). Note different threats may be relevant to different subcriteria (i.e., a future reduction due to mining under A3, but a past reduction due to land clearing under A1 or A2).
    - Check that the data qualifier is suitable (see Section 9.2.1.1).
    - State the thresholds that are met and the consequent category the species is eligible under.

An example is provided in Box 8.

Box 8. Example response to Criterion A for *Eucalyptus raveretiana* (a tree)[10], *Leichhardtia coronata*[11] (a plant), *Acacia forsteri*[12] (a plant) and *Adclarkia dawsonensis* (a land snail)[13].

***Eucalyptus raveretiana* meets the thresholds for listing as Vulnerable under A2+3(c).**

Generation length

A generation length of 70 - 167.5 years is used in this assessment, equating to a three-generation period of 210 - 503 years.

A2 Population reduction within 10 years or 3 generations (past)

A past population reduction is suspected based on a decline in the EOO and quality of habitat for the species (A2c) due to historical broadscale land clearing and ongoing incremental land clearing.

- Regional ecosystem 11.3.25 (the primary habitat of *E. raveretiana*) has been reduced from its preclearing extent by ~ 35% (Pre-clearing = 813,000 ha; Remnant 2021 = 531,000 ha), thus can be used as a proxy for a population reduction for *E. raveretiana.*
- A minimum (and conservative) reduction of 23% was estimated by present day stream length remnant vegetation cover reduction from pre-clearing extent (Appendix B) (Fensham pers. comm. 2020; Fensham et al. 2020). However, this assessment included some REs that potentially do not support *E. raveretiana.*
- A maximum (and precautionary, but not realistic) reduction of 54.7% found by Franklin and Preece (2014).
- For this assessment, an analysis of the regulated vegetation regional ecosystem supporting map indicates that the primary regional ecosystems in which *E. raveretiana* occurs (i.e. 11.3.25, 11.3.25a-h, 11.3.4, 11.3.11, 11.3.1, 11.3.27, 9.3.1, 8.3.3, 8.3.3a, 8.3.13) have declined by 28 - 44% (refer Appendix A).
    - Unlike the Fensham et al. (2020) analysis, this analysis measured the reduction in REs known to provide habitat for the species, rather than all REs within the species' EOO that occur along streams.
    - Further, this analysis included the area within 50m of each side of the channel. The species occurs across several wide (<100m) watercourses and therefore a buffer of 50m (both sides) should account for the full stream width in most instances. This distance also accords with the definition of riparian buffer zone under the Reef 2050 Water Quality Improvement Plan which measures losses of riparian woody vegetation in the catchments of the Great Barrier Reef (including those within the distribution of *E. raveretiana)* and aligns with areas identified as Category R vegetation (i.e. high value regrowth in riparian areas) for the purposes of the *Vegetation Management Act 1999.* Areas within this buffer are considered essential habitat for this species in this analysis. Clearing within this area may cause edge effects even if the trees are retained.
    - Due to scale limitations in the mapping of remnant vegetation in Queensland, where broadscale clearing has occurred adjacent to but not within adjoining streams, those streams

[10] Excerpt adapted from Department of Environment and Science. (2024). Nomination to change the conservation class of *Leichhardtia coronata* under the *Queensland Nature Conservation Act 1992*. Queensland Department of Environment and Science.

[11] Excerpt adapted from Department of Environment and Science. (2023). Nomination to change the conservation class of *Leichhardtia coronata* under the *Queensland Nature Conservation Act 1992*. Queensland Department of Environment and Science.

[12] Excerpt adapted from Collingwood T.D. (2022). Nomination to change the conservation class of *Acacia forsteri* under the *Queensland Nature Conservation Act 1992*. Queensland Department of Environment and Science

[13] Excerpt adapted from Department of Environment and Science. (2023). Nomination to change the conservation class of *Adclarkia dawsonensis* under the Queensland *Nature Conservation Act 1992*. Queensland Department of Environment and Science.

(if less than 50-75 m wide and in particular where the riparian zone is not easily discernible in aerial imagery) will be mapped as non-remnant. Such non-remnant areas can contain *E. raveretiana* individuals unaffected (directly) by the clearing and that continue to contain suitable habitat (Danielsen, 2021). Therefore, 44% is considered the maximum plausible reduction.

With respect to the above, it is inferred that the species has lost a minimum of 28% of its habitat over the last three generations and possibly as much as 44%. It is most likely that the true value is somewhere in the middle of this range but exceeding 30% given range contractions that may have pre-dated an accurate understanding of the species' distribution (the actual EOO is likely to have been larger than is presently represented by herbarium specimens). It is therefore precautionary for the species be listed as VU under Criterion A2(c) for a decline in its area of habitat exceeding 30% over the last 3 generations.

A3 Population reduction within 10 years or 3 generations (future)

The species also meets the thresholds for listing as VU under Criterion A3(c) based on a suspected reduction in EOO and habitat quality of 30-50% being met in the near future. Between 2013 and 2017, the Burdekin Catchment (which incorporates the Burdekin, Don and Houghton drainage basins), Mackay Whitsunday Catchment (which incorporates the Proserpine, O'Connell, Pioneer and Plane drainage basins) and Fitzroy Catchments experienced losses of riparian vegetation at rates of 0.39%, 0.61% and 1.19%, respectively (Queensland Government, 2021b). These rates of decline increased since the previous reporting period from 2009 – 2013 (Queensland Government, 2021b). This suggests that habitat loss is continuing at a rate of ~0.1% - 0.29% per year. Therefore, based on a past reduction of at least 28% (although it is probably higher), and an ongoing clearing rate of 0.29% per year, the 30% threshold would be exceeded within the next 7 years.

Note: Even if the lowest plausible reduction value (i.e. 23% estimated by Fensham et al. 2020) is used, the species is still eligible for VU under A3(c). Current rates of clearing of riparian vegetation within the habitat of the species are ongoing, thus the threshold of 30% would be met in 24 years (using the current rate of 0.29%). This is highly likely to be within the three-generation time period for the species. Using the maximum estimate of past population decline (i.e. 44%) the species could exceed a 50% reduction in the future (while accounting for historical losses); however, the temporality of this loss and whether it occurs within a 100-year time frame needs closer examination.

***Leichhardtia coronata* meets the thresholds for listing as <u>Vulnerable</u> under Criterion A4c.**

Generation length

The age of maturity, and therefore, the generation length and population trends for this species is unknown. Based on rudimentary estimates of age to maturity and longevity, the species is suspected to have a generation length of ~51-76.5 years. Therefore, a reduction is assessed over ~153-230 years (three generations) except for when the species is assessed under subcriterion A4 that permits a maximum period of 100 years into the future.

(A1-4) Population reduction within 10 years or three generations

Widespread clearing and degradation of lowland and hillside eucalypt forests in Southeast Queensland during the 19th and 20th centuries for residential, commercial, mining and agricultural purposes is inferred to have caused a population reduction in the past for the species (Field et al. 2012). However, widespread habitat clearing, and degradation was curtailed by the establishment of the national parks, state forests and other nature conservation areas as well as the protections afforded to remnant vegetation under the *Nature Conservation Act 1992* and the *Vegetation Management Act 1999.* However, the reduction in population size may not have ceased due to ongoing clearing and development (Moonie et al. 2023), as well as the potential for future population reductions for residential and commercial land supply over coming decades (Figure 7-9). While the impact of future development on freehold land on population size is difficult to predict, a reduction in the area of occupancy is suspected when accounting for that rapid and continuing growth of human population and subsequent urban sprawl across this species distribution (Field et al. 2012).

A suspected population reduction based on a decline in area of occupancy (c) can be calculated by assessing all collections since 1985 on freehold land that are in close proximity to residential and commercial developments or overlapping with mining exploration areas. Thus, there are 67 collections where the threat of development may not have ceased and is suspected to cause a reduction from 1985 to 2120 (up to a maximum 100 years into the future under A4). These 67 collections have an AOO of $124km^2$, which amounts to a suspected 47.69% reduction in AOO, thereby meeting the threshold for subcriterion A4c.
Acacia forsteri **is <u>Data Deficient</u> under Criterion A.** **Generation length** Generation length for the species is not precisely known (see Biology and Ecology). **(A1-4) Population reduction within 10 years or three generations** There are no data available to quantify past, current or future population reductions. However, the species is likely to have undergone a range reduction associated with land clearing in the east of its distribution (see Threats). There are insufficient data available to assess population reductions relative to generation length.
Adclarkia dawsonensis **is assessed as <u>Data Deficient</u> under Criterion A.** **Generation length** The exact life span and generation length for the species is unknown. Other camaenids in Australia are estimated to have life spans of 10-20 years and it is reasonable to suspect *A. dawsonensis* has a similar life span (Queensland Department of Environment and Heritage Protection 2017). Based on similar species in the genus and field observations, it is likely that the species reaches sexual maturity after two years in ideal conditions (BAAM 2009; SKM 2009; JKR 2010; Stanisic et al. 2022). The length of reproductive period for the species in unknown, therefore there are insufficient data to estimate generation length for this species. **(A1-4) Population reduction within 10 years or three generations** A population reduction has been inferred in the past (A2) due to a (c) decline in quality of habitat from the threats of flooding and land clearing (see Threats). The threats of flooding and land clearing have not ceased, but are understood and reversible. However, there is insufficient data to quantify the magnitude and timing of the reduction. Additional monitoring data is required to determine the population trends within a given time. A population reduction was inferred for the past and the future (A4) due to a (c) decline in quality of habitat from the threats of flooding and land clearing (see Threats). The threats of flooding and land clearing have not ceased, but are understood and reversible. However, there is insufficient data to quantify the magnitude and timing of the reduction. Additional monitoring data is required to determine the population trends within a given time for the species. Therefore, there are insufficient data to determine a population reduction relative to generation length for this species.

Summary of documentation requirements for Criterion A

- A summary sentence at the top of the response box, providing the highest criteria and category the species is eligible for.
- Available information against each of the four sub-criteria (A1, A2, A3, A4) with respect to the specific criterion thresholds and parameters.
- The species' eligibility for listing against each of the subcriteria (or a statement that the species is Least Concern/ Data Deficient against that criterion).
- The generation length of the species and associated data qualifier.
- The three generation time period for the species, and the timeframe the reduction is being assessed over (i.e. the longer of 3 generations or 10 years).
- The rate of population size reduction (%) and the method of calculation (e.g. statistical method, population model).
- Appropriate justification, for example:
  - the assumed pattern of decline (e.g. exponential, linear, accelerated, more complex);
  - how decline is extrapolated;
  - how information has been combined from widely distributed or multiple; subpopulations;
  - assumptions of the model used (if fitted), justified by life history, habitat biology, threats, pattern of exploitation etc.;
  - what data have been included/excluded, and why.
- When using a model to *project* reduction under A3, the best estimate should be used, otherwise a clear rationale for using the lower or upper bound.
- Whether the reduction is past and/or future.
- The timeframe for the reduction relative to generation length.
- The data qualifier for the reduction (i.e. observed, estimated, projected, inferred or suspected).
- The basis for quantifying/calculating the reduction, based on any of (a) - (e), noting that (a) cannot be used for A3.
- The causes of the reduction (i.e. threatening factors), including the scale and mechanism of their action, and whether or not these are reversible; understood; and ceased.
- A concluding sentence that summaries eligibility under any subcriteria (not just the overall/highest criteria).

9.3 Criterion B

Criterion B is used to assess species in the context of spatial distribution, an ongoing decline and/or an inherent susceptibility to decline. A species with a *restricted geographic range that is declining or has an inherent susceptibility to decline* due to a fragmented or fluctuating distribution, may meet the category thresholds (Table 15). Nominators should attempt to apply this criterion where high-quality spatial records for the species are available, along with evidence of continuing decline or extreme fluctuations.

Important: Criterion B is the most commonly mis-applied criterion. Care should be undertaken to understand all definitions, and that B1 ***and/or*** *B2 are coupled with at least two of (a), (b) and/or (c).*

Table 15. Category thresholds for Criterion B (adapted from IUCN SPC, 2024).

Geographic distribution is precarious for either extent of occurrence AND/OR area of occupancy				
	Critically Endangered (CR)	**Endangered (EN)**	**Vulnerable (VU)**	**Near Threatened (NT)**
B1. Extent of occurrence (EOO)	**< 100 km²**	**< 5,000 km²**	**< 20,000 km²**	**< 40,000 km²**
B2. Area of occupancy (AOO)	**< 10 km²**	**< 500 km²**	**< 2,000 km²**	**< 4,000 km²**
AND at least 2 of the following 3 conditions for CR, EN, or VU				**AND** (b) for NT
(a) Severely fragmented OR Number of locations	**= 1**	**≤ 5**	**≤ 10**	**Not applicable**
(b) Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals				**≥ 10% within the longer of 10 years or 3 generations**
(c) Extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals				**Not applicable**

9.3.1 Extent of occurrence

Extent of Occurrence (EOO) refers to "*the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon, excluding cases of vagrancy*" (IUCN SPC, 2024).

- EOO is calculated as the minimum convex hull that includes all the eligible, validated occurrences for a species (see Section 3.3).
- EOO measures spatial spread of risk and the overall geographic spread of the localities at which the species occurs.
- If the EOO is less than AOO, EOO should be increased to equal AOO to ensure consistency with the definition of AOO as an area within EOO.

9.3.2 Area of occupancy

The Area of Occupancy (AOO) is a scaled metric that represents the area of suitable habitat known, inferred, or projected to be currently occupied by the species (IUCN SPC, 2024). It is generally estimated by with a 2 x 2km grid to enable comparison with the criteria thresholds. *AOO is not designed to be a fine scale estimate of the actual area occupied by the species – if this is calculated in the nomination it should be referred to by a different term, such as patch size or occupied area of habitat.* The AOO is calculated by summing the area contained within the total number of 2 x 2km grid cells occupied by the species (see Section 3.3).

- AOO measures ‘insurance effect’ (spatial spread of risk).
- AOO often correlates to population size (i.e. small AOO tends to indicate small population size).

9.3.3 Severely fragmented

Severely fragmented refers to the situation in *which “increased extinction risk to the taxon results from the fact that most of its individuals are found in small and relatively isolated subpopulations (in certain circumstances this may be inferred from habitat information). These small subpopulations may go extinct, with a reduced probability of recolonisation”* (IUCN SPC, 2024). To qualify as severely fragmented, a species’ subpopulations must be both *small and isolated.* Population fragmentation is not the same as, but can be inferred from, habitat fragmentation. It must be assessed at scale appropriate to biological isolation as determine by the dispersal capacity of propagules such that recolonisation of extirpated patches could occur.

Information required to assess if a species is severely fragmented includes:

- The distribution of AOO (i.e., detailed maps of occupied habitat),
- Some aspect of the dispersal ability of the propagules of the species (e.g., average dispersal distance of seed/juveniles), and
- Average population density in occupied habitat (e.g., information on territory size, home range size, etc.)

Then, a species can be considered severely fragmented if most (>50%) of its total AOO is in habitat patches that are:

- Smaller than would be required to support a viable population, and
- Separated from other habitat patches by a large distance relative to dispersal capacity of the species (see below).

Summary of documentation requirements for ‘severely fragmented’

- What percentage, if >50% of the species’ total AOO consists of habitat patches that are too small to support a viable population and are separated from other habitat patches by a large distance relative to the dispersal capacity of the species.
- The habitat area estimated to be required to support a viable population.
- The threshold used to define ‘small’ subpopulations that are not considered to be viable and how it was estimated.
- The degree of isolation of patches.
- The dispersal distance of the species.
- The history of subpopulation sizes or persistence, as it is likely that subpopulations that have persisted for multiple generations at small sizes are viable.

9.3.4 Locations

Locations refer to a geographically or ecologically distinct area in which a single threatening event can rapidly affect all individuals of the species present. Importantly, nominators should only use the term ‘location(s)’ in assessments with specific reference to the definition. Choose terms such as ‘occurrence’, ‘sites’ or ‘subpopulations’ when describing general localities or areas where the species occurs. The standard rules for delineating locations are:

- All areas within the species' distribution must be considered.
- It is defined by the most serious plausible threat (i.e., the highest in the risk matrix).
- The timeframe for the threat impact must be short (i.e., 1-2 generations or 3-5 years, whichever is longer).
- Locations should be defined for every species, unless there are no plausible threats. If the threats are only suspected and future, locations should be based on these threats.

To assess locations, nominators will need to

- Define the time scale (the longer of 1-2 generations or 3-5 years)
- Reframe the definition of locations as a question: *'what is the area over which the threat could impact the species within 1-2 generations / 3-5 years?'*

Some examples

- Feral cats occur throughout the distribution of the species and are known to heavily target the species when hunting. Therefore, this threat could impact the species in all areas within one generation (10 years). Therefore, the species occurs in one location.
- Feral cats occur throughout the distribution of the species but are intensively managed in the National Park where it occurs. Therefore, it is unlikely feral cats would have a rapid impact in the NP area over one generation (10-years). Therefore, the species occurs in two locations.
- Feral cats have much lower hunting success in the rainforest habitat where the species occurs compared with the open woodland streams. The impacts are not likely to be rapid in the rainforest habitat over 10 years (one generation). Therefore, the species occurs in 2 locations.

9.3.4.1 Challenging applications of locations

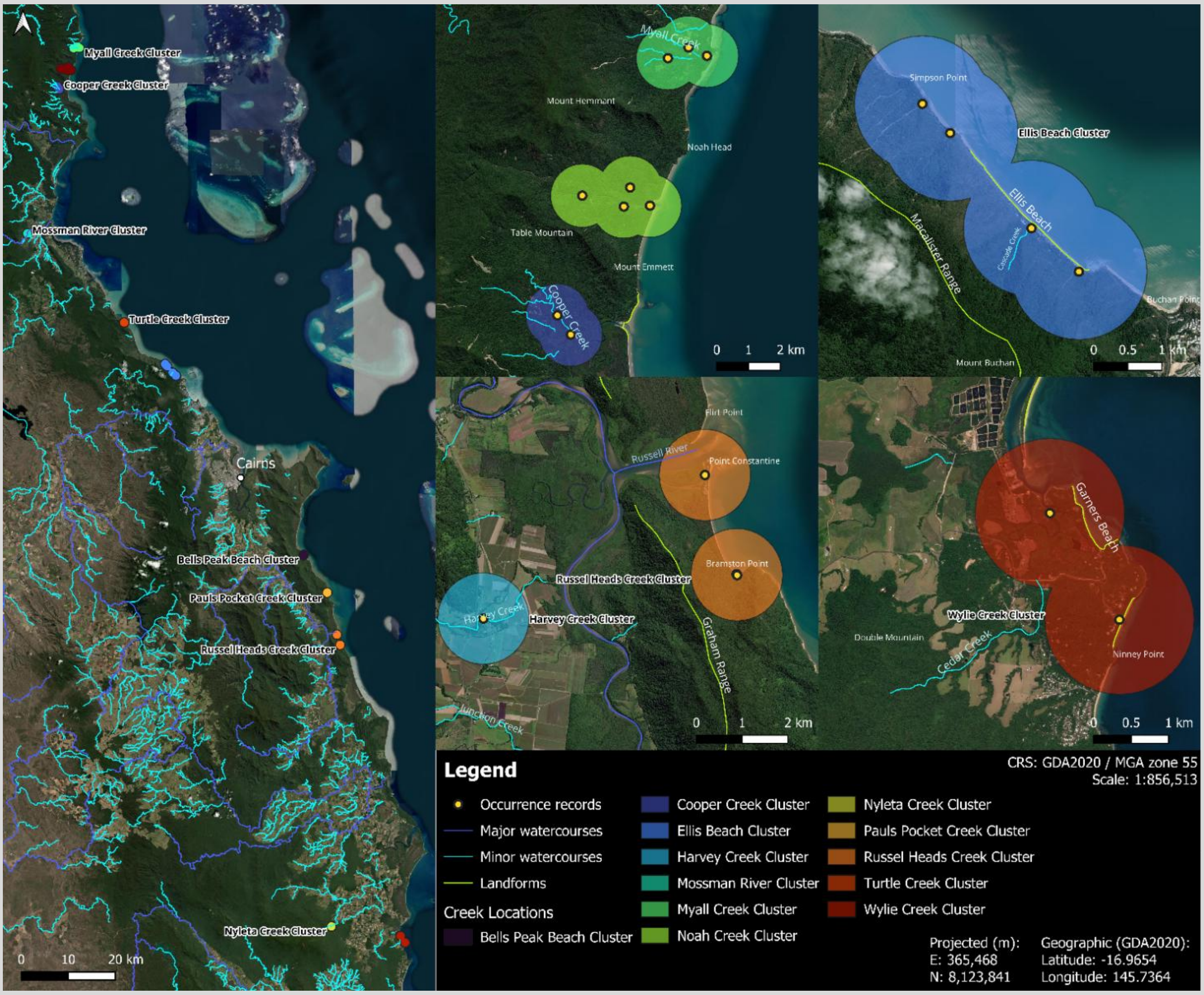
There are a number of scenarios when locations need to be defined using additional rules. These are described in detail in IUCN SPC (2024) and summarised here.

- **Multiple threats:** when there are 2+ serious threats over the entire range of the species, nominators should apply the one that results in the smallest number of locations (see Appendix 10).
- **Distinct threats over range:** Where the most serious plausible threat is different across the species' range, nominators should use separate threats for each area (see Appendix 11).
- **Cumulative impacts:** where the most serious plausible threat is habitat loss that occurs gradually and cumulatively via many small-scale events, locations should be defined by the area over which the population will be severely reduced within a single generation or 3 years, whichever is longer (see Appendix 12).
- **Part population unaffected:** where part of the population is not impacted by a threat, nominators should:
  - Base the number of locations on the most likely threat that may affect the currently unaffected areas in the future; or
  - Consider not using locations if area impacted is <50%; or
  - Use subpopulations as a surrogate for locations in the unimpacted areas; or

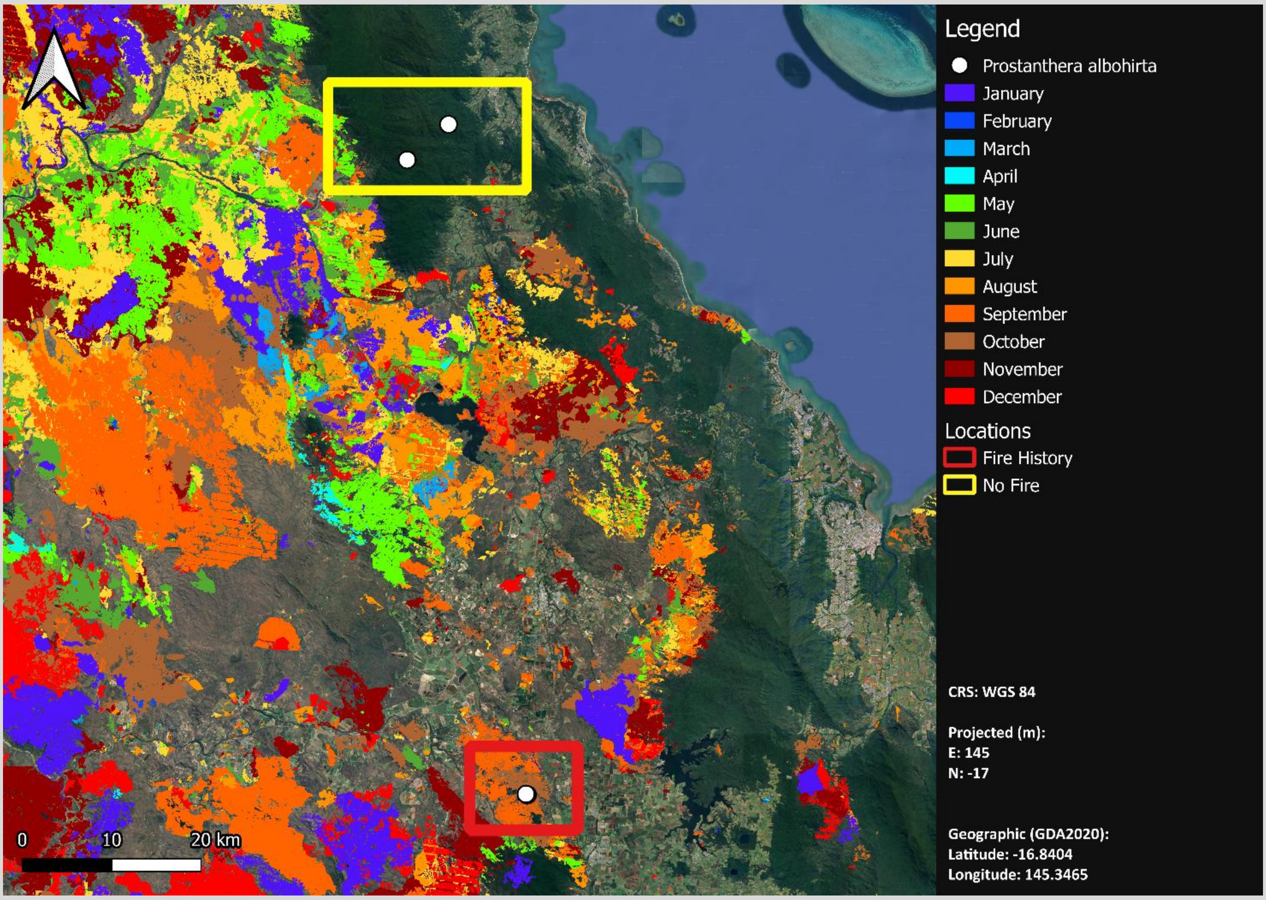
- Transpose the smallest location from the impact areas to the non-impacted areas (see Appendix 11).

If the number of locations cannot be easily communicated, a supporting figure that displays the locations must be included. This typically applies when the number of locations is:

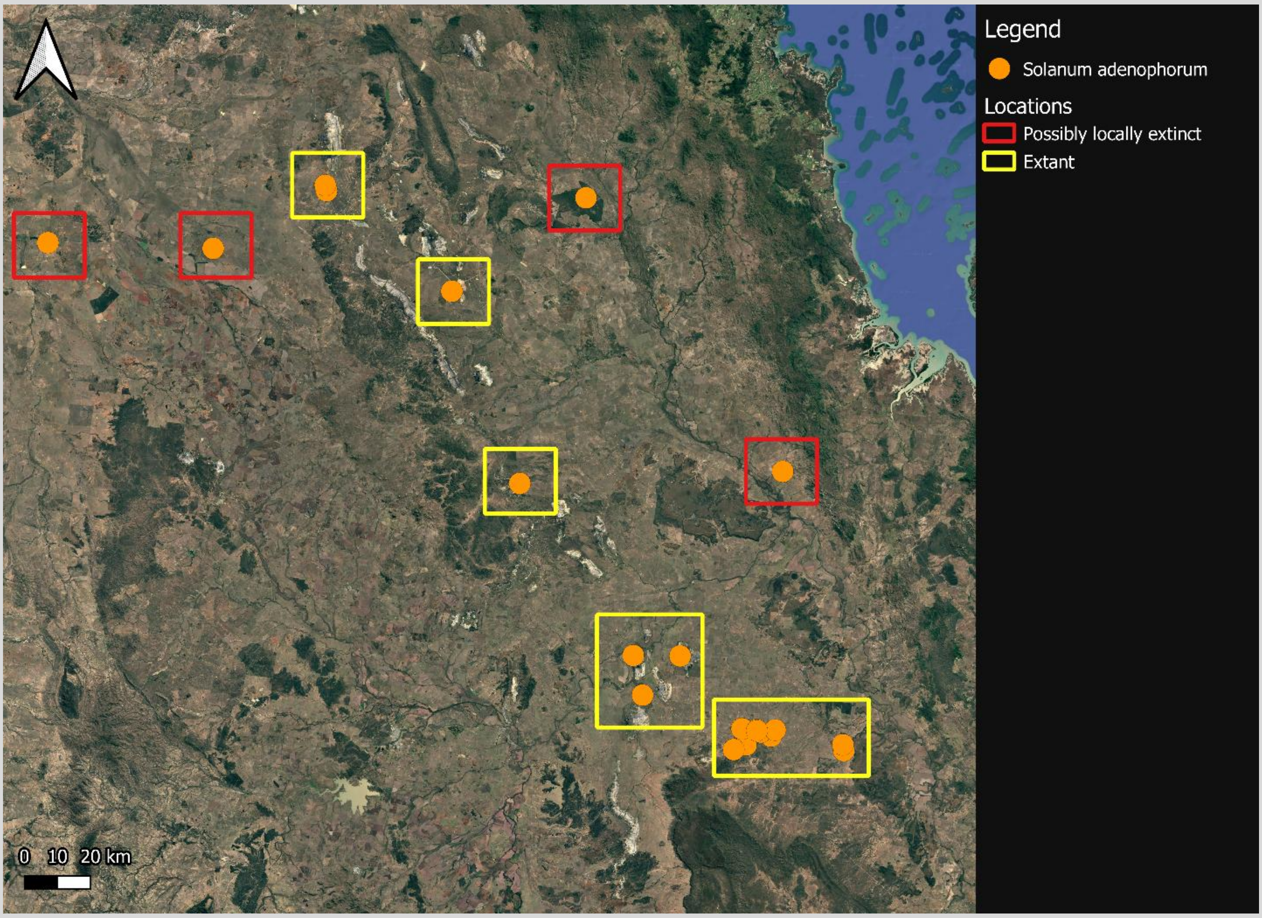
- not clearly delineated by subpopulations/land-tenure etc; or
- linked to fire history/watercourse or other natural feature which may have irregular boundaries or is not clearly captured by spatial layers (Example 1; Example 2); or
- linked to multiple threats throughout the species' distribution, or
- includes locations where the species may be locally extinct (Example 3).



Example 1. Locations determined according to species' presence in different stream systems (blue lines). The most serious plausible threat for this species is tilapia invasion. This species occurs in twelve different stream systems with no upstream hydrological connectivity.



Example 2. Example of locations determined according to fire extent. The most serious plausible threat for this species is adverse fire regimes; however, one fire may cause rapid and severe impacts to one subpopulation, while the other is not impacted by this threat (yellow rectangle).



Example 3. Example which considers possibly locally extinct (red) and extant (yellow) locations, resulting in a minimum number of five locations and a maximum of nine locations.

Some examples of application from (Silcock et al., 2022):

Where the main threatening process operates at a landscape scale, the number of locations is defined as the number of discrete management units applicable to the threatening process. The delineation of management units may relate to the ability of the species to disperse between areas affected by the threat, the capacity for the threat to transition between units, or areas where different management practices are utilised to mitigate the threat.

- Taxa threatened by the airborne pathogen myrtle rust, where all subpopulations occur within the climatic range of the pathogen, are assessed as a single location.
- Often, where climate change is considered the major threat, all subpopulations are affected and considered a single location.
- Phytophthora (*Phytophthora* spp.) dieback is soil-borne, and fronts may move gradually through an area of contiguous, susceptible vegetation. However, spread to an uninfected area separated by an ecological barrier (e.g., farmland or urbanisation) would require a specific transport vector. Such geographically separated subpopulations would be considered multiple locations in relation to the threat of phytophthora.

Summary of documentation requirements for 'locations'

- The most serious plausible threat from the risk matrix (or the relevant threats used to count locations).
- The generation length, so that 'rapid' can be defined.
- The proportion of the distribution/population affected by the threat(s).
- The nature of the effects (i.e., will it rapidly affect all individuals of the species present?).
- The timeframe over which the threat(s) occur(s) and how that could be considered 'rapid' in the context of the life history of the species.

9.3.5 Continuing decline

Continuing decline refers to a recent, current or future decline that is liable to continue in the absence of threat management. This may be *observed, estimated, inferred or projected*, depending on the criteria/subcriteria.

- Future declines do not have to have commenced, but there must be a reasonable certainty they will. Such future declines can be projected (i.e. based on quantitative data) but can also be inferred. Inferred future declines must be clearly documented and justified, including realistic reasoning for why it is likely to occur. Merely plausible or suspected future declines do not meet the data quality requirements under Criterion B or C.
- Continuing declines differ from reductions, as they are liable to continue in the absence of remedial action.

Summary of documentation requirements for 'continuing decline'

- Whether the decline is recent, current or future.
- A statement that the decline is likely to continue, without remedial action, with reference to the cause(s) of the decline.
- For B1b or B2b, the element(s) met under condition (b), i.e. any of (i) - (v), including explanation of how relevant terms were defined/applied (e.g. habitat, locations, subpopulations, mature individuals).
- For C1, the rate of decline (%) and timeframe (i.e. the longer of 3 generations or 10 years), including appropriate justification with reference to generation length.
- What data/information has been included/excluded, and why.
- Whether the decline is observed, estimated, inferred or projected, as appropriate.

9.3.6 Extreme fluctuations

Extreme fluctuations occur when the population size or distribution varies widely or rapidly, typically by a 10-fold increase/decrease. A fluctuation must represent a true change in the population, not just a flux between life stages (such as obligate seeding species following fire). Extreme fluctuations occur when:

- Population trajectories show a repeated pattern of increases and decreases by an order of magnitude.
- Taxa have life histories prone to boom-bust dynamics (e.g., granivorous mammals of arid climates, plants that respond to stand replacing disturbances – e.g. serotinous obligate seeders).

Summary of documentation requirements for 'extreme fluctuations'

- How the extreme fluctuations are demonstrated/measured, with reference to population trajectories and/or life history traits (and where appropriate, the degree isolation and synchronicity across subpopulations).
- What data have been included/excluded, and why.
- Magnitude of the fluctuations (noting it must be ≥ 10-fold) and timeframe over which they are measured.
- The pattern or nature of the fluctuations (regular/sporadic).
- Clear justification that the ≥ 10-fold fluctuation demonstrates change in the total population (rather than a flux between different life stages).

9.3.7 Response structure for Criterion B

- Summary sentence
  - In the format provided in Box 8.
- EOO and AOO
  - State the EOO and AOO. State which threshold they meet.
  - State whether the calculated EOO and AOO are close to the threshold, and if so, whether a different threshold would be more appropriate. For example, if the species has been under-surveyed and qualifies for the CR AOO threshold, but is close to the EN AOO threshold, Nominators may reasonably recommend that the EN threshold is used.
- Severely fragmented
  - State whether the species meets the definition of severely fragmented. If it does, provide a clear justification.
- Number of locations
  - State the number of locations
  - State and justify the method used to delineate locations. Appropriate methods include using the most serious plausible threat, using the threat that results in the smallest number of locations, or using multiple threats where the species has different threats across its range.
  - Where the number of locations is uncertain, a range of values can be presented using plausible bounds. If the values do not fit within a category threshold, a decision of the appropriate category should be justified by applying a realistic but precautionary attitude.
- Continuing decline

  - State whether there is a continuing decline for the species and the associated data qualifier (suspected, inferred, estimated, projected, observed). Justify the cause of the continuing decline by briefly describing the threats.
  - State the subcriteria (i-v) that are subject to a continuing decline.
- Extreme fluctuations
  - State whether the species is subject to extreme fluctuations. If extreme fluctuations are present, justify these against the definition provided in IUCN SPC (2024).

An example is provided in Box 9.

Box 9. Example application of Criterion B for *Parsonsia sankowskyana* (a perennial vine)[14] and *Bolemoreus hindwoodi* (a honeyeater bird)[15].

***Parsonsia sankowskyana* is assessed as Critically Endangered under Criterion B1ab(i-v).**

(B1+2) EOO and AOO

The species has an EOO of 32.8 km^2 and AOO of 12 km^2 (see Distribution). Therefore, the species meets the threshold for CR for B1 and EN for B2. It is unlikely that the species is more widespread, and it is well within the threshold for CR under B1. Therefore, the threshold for CR has been used in this assessment.

(a) Severely fragmented

There are two subpopulations of the species, comprising three sites. All (100%) of these sites occur in small habitat patches or cleared vegetation amongst a heavily cleared landscape. The two subpopulations are separated by >50km, indicating that gene flow between sites is limited. Further, the total population size is estimated to be <50, indicating that the subpopulations are too small to be viable. As the species occurs in small, isolated habitat patches separated by large distances, with evidence that >50% of the subpopulations occur in habitat patches that are too small to support a minimum viable population, the species is considered severely fragmented in this assessment.

(a) Number of locations

The number of locations is based on the most plausible serious threat (residential and commercial development). All subpopulations are considered to be simultaneously impacted by residential and commercial development and thus constitute one location for the purpose of this assessment.

(b) Continuing decline

Almost all of the known occurrences for the species are on private property undergoing significant residential and commercial developments within recent years. These residential developments have left the potential habitat available for the species fragmented, occurring in small pockets that are likely to small to support a viable population. Further, surveys for the species in the last 15 years were unable to detect the species along any roads within the area, in areas that the species was known to occur previously (G. Sankowsky, pers. comm. 2023). A king tide event in 2020 led to the inundation of private properties across the Hervey Bay and Craignish region, encompassing the area in which *P. sankowskyana* occurs (Fraser Coast Regional Council 2021). These threats are likely to be causing decline in the habitat that the species can inhabit. These conditions indicate that

[14] Excerpt adapted from Department of Environment and Science (2023). Nomination to change the conservation class of *Parsonsia sankowskyana* under the Queensland *Nature Conservation Act 1992*. Queensland Department of Environment and Science.

[15] Excerpt adapted from Department of the Environment, Tourism, Science and Innovation. (2024). Nomination to change the conservation class of *Bolemoreus hindwoodi* under the Queensland *Nature Conservation Act 1992*. Queensland Department of Environment and Science.

there is continuing decline inferred in the species' extent of occurrence, area of occupancy, habitat quality, number of subpopulations and the number of mature individuals due to ongoing threats, thereby meeting sub-criterion (b)(i-v).

(c) Extreme fluctuations

It is unknown whether *P. sankowskyana* experiences extreme fluctuations. Given the species is a perennial vine with a persistent seedbank, extreme fluctuations in EOO, AOO, number of subpopulations or locations are unlikely and not accepted in this assessment.

Bolemoreus hindwoodi **meets the thresholds for listing as <u>Endangered</u> under Criterion B1+2ab(ii, iii, v).**

(B1+2) EOO and AOO

The species has an EOO of 898 km2 and AOO of 288 km2 (see 'Distribution'). These estimates may increase with further surveys; however, both EOO and AOO are unlikely to exceed the thresholds for listing as EN. Therefore, the species is within the thresholds for EN for B1 and B2.

(a) Severely fragmented

Although the species has three disjunct core habitat patches (Figure 8), individuals are known to travel long distances (see 'Feeding and movement') and there is no evidence that >50% of the subpopulations occur in habitat patches that are too small to support a minimum viable population. Therefore, the species is not considered severely fragmented in this assessment.

(a) Number of locations

When assessed against the most serious plausible threat, increasing fire intensity/severity, Eungella honeyeater is considered to occur at 4-10 locations. In 2018, approximately 5-8% of the species habitat was impacted by extreme fires, with a further ~5-6% impacted by very high and ~6-8% impacted by high severity fires; totalling ~17-20% of habitat impacted by fire of sufficient severity to cause complete tree and shrub mortality (Figure 8; Table 1). Damage to these fire-sensitive communities has been assessed as likely to take decades to centuries to recover (Hines et al., 2020). It is considered probable that fires of this intensity in the core habitat of Eungella honeyeater will increase in area covered due to interactions with climate change and other threatening processes (e.g., weeds that carry fire). As such, it is assumed that each fire event can impact >10% of the population's core habitat, and habitat recovery will not occur between events, equating to ≤10 locations. The minimum number of locations is assessed as four, accounting for three regions of core habitat that could each be affected by a single fire event, and the non-resident region.

(b) Continuing decline

A continuing decline has been estimated and inferred for the species based on the threat of increasing fire intensity combined with the threats of climate change and weed invasion.

It is considered probable that high-intensity fire in the core habitat of Eungella honeyeater will increase in intensity and area covered due to interactions with climate change (increasing intensity of extreme fire weather and cyclones) and other threatening processes (e.g., weeds that carry fire, which are established in the habitat of the species). The threat is inferred to cause a continuing decline in (ii) AOO, (iii) habitat quality and (v) number of mature individuals (estimated), thereby meeting subcriteria (b)(ii,iii,v).

(c) Extreme fluctuations

There is no evidence of extreme fluctuations in the number of mature individuals that represent a tenfold increase or decrease in the total population for this species (IUCN SPC, 2022).

Eungella honeyeater is eligible for listing as 'Vulnerable' under Criteria B1+2ab(ii,iii,v) as the geographic distribution is precarious (both EOO and AOO), the species occurs across a small number of threat-based locations (<10), and the species also has an inferred continuing decline in (ii) AOO, (iii) habitat quality and (v) number of mature individuals.

Summary of documentation requirements for Criterion B

- A summary sentence at the top of the response box, providing the highest criteria and category the species is eligible for.
- Available information against each of the five sub-criteria (AOO/EOO, severe fragmentation, locations, continuing decline, extreme fluctuations) with respect to the specific criterion and data quality thresholds and parameters.
- The species' eligibility for listing against each of the subcriteria (or a statement that the species is Least Concern/ Data Deficient against that criterion).
- A statement on whether severe fragmentation applies and the associated data qualifier (see documentation requirements in Section 9.3.3)
- A statement outlining the number of locations and how they were derived (see documentation requirements in Section 9.3.4)
- A statement on whether continuing decline applies and the associated data qualifier (see documentation requirements in Section 9.3.5).
- A statement on whether extreme fluctuations applies and the associated data qualifier (see documentation requirements in Section 9.3.6)
- A concluding sentence that summaries eligibility under any subcriteria (not just the overall/highest criteria).

9.4 Criterion C

Criterion C is used to assess taxa in the context of population size and decline. Taxa with a *small population size and continuing decline* in the 'number of mature individuals' may meet the thresholds for listing under this criterion (Table **16**). Nominators should attempt to apply Criterion C when there is sufficient information about the population size and evidence of decline in the number of mature individuals.

Important: Only continuing decline in 'the number of mature individuals' is permissible under Criterion C, rather than AOO, EOO, locations/subpopulations and area, extent and/or quality of habitat as in Criterion B. For projected or inferred future declines, there must be a high degree of certainty that they will take place; that is, merely plausible or suspected future declines do not meet the minimum data quality requirements under Criterion B or C.

Table 16. Category thresholds for Criterion C - adapted from IUCN SPC (2024).

Small population size and decline		Critically Endangered (CR)	Endangered (EN)	Vulnerable (VU)	Near Threatened (NT)
Estimated number of mature individuals		< 250	< 2,500	< 10,000	< 20,000
AND either (C1) or (C2) is true					**AND** (C1) is true
C1 An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in the future		25% in 3 years or 1 generation (whichever is longer)	20% in 5 years or 2 generations (whichever is longer)	10% in 10 years or 3 generations (whichever is longer)	10% in 10 years or 3 generations (whichever is longer)
C2 An observed, estimated, projected or inferred continuing decline AND its geographic distribution is precarious for its survival based on at least 1 of (a) or (b):					
(a)	(i) Number of mature individuals in each subpopulation	≤ 50	≤ 250	≤ 1,000	Not applicable
	OR				
	(ii) % of mature individuals in one subpopulation =	90 – 100%	95 – 100%	100%	Not applicable
(b) Extreme fluctuations in the number of mature individuals		Applicable	Applicable	Applicable	Not applicable

9.4.1 Number of mature individuals

The 'number of mature individuals' refers to the number of individuals known, estimated or inferred to be capable of reproduction.

- Individuals that will never be capable of reproducing should be excluded (i.e., densities too low, imbalanced sex-ratios).
- Use lower plausible bounds where fluctuations occur to adhere to precautionary approach.
- For clonal taxa, use reproductive units (i.e., ramets) that can survive alone.
- Re-introduced taxa must be self-sustaining (produced viable offspring).

9.4.2 Continuing decline

See definition under Criterion B (Section 9.3.5).

9.4.3 Generation length

See definition under Criterion A (Section 9.2.1.2).

9.4.4 Subpopulations

Subpopulations refers to geographically distinct groups in the population between which there is limited demographic or genetic exchange (typically one successful migrant individual or gamete per year or less). The method used to delineate subpopulations will vary between species. It is important to have an understanding of the species' dispersal capacity and reproductive mechanisms (e.g., water dispersed seeds). As an example:

- For a species of tree, a subpopulation can be defined as a spatially distinct segment of the population that experiences insignificant or reproductively unsuccessful migration of seed or pollen from other subpopulations. For example, species inhabiting separate mountain tops would likely be classified as separate subpopulations. If the mountains were close enough together and the species was dispersed (either pollen or fruit) by highly mobile species (such as bats or birds), they could reasonably be considered a single subpopulation.
- For a species of shrub that has water dispersed seed, catchments or drainage basins may be a useful scale to delineate subpopulations.
- For a freshwater fish, subpopulations may be defined by catchments, between which would be low rates of gene transfer.
- For freshwater fish or plants that occur in very isolated habitat such as springs, subpopulations may be defined by each distinct spring, unless overland flow facilitates dispersal between the springs each year.
- For terrestrial taxa that inhabit islands, subpopulations may be defined by each discrete island, as migration between these islands is likely to be limited by the ocean. This delineation is not likely to be applicable to birds, which may regularly travel between islands. Similarly, plants with buoyant, desiccation-resistant seed may be able to regularly exchange gametes between the islands.

9.4.5 Extreme fluctuations

See definition under Criterion B (Section 9.3.6).

9.4.6 Response structure for Criterion C

- Summary sentence
  - In the format provided in Box 10.
- Number of mature individuals
  - State the number of mature individuals. Where plausible bounds are used, comment on whether the lower or upper bounds should be used in the assessment. Lower bounds are typically used where a precautionary approach is warranted given the presence of threatening processes. Upper plausible bounds are typically used if further survey is required and threats are minimal.
- Continuing decline
  - State whether there is a continuing decline for the species and the associated data qualifier (suspected, inferred, estimated, projected, observed). Justify the cause of the continuing decline by briefly describing the threats.
- Subpopulation size and proportion

- State the number of mature individuals in each subpopulation.
- State the proportion (%) of mature individuals in each subpopulation.

- Extreme fluctuations
    - State whether the species is subject to extreme fluctuations. If extreme fluctuations are present, justify these against the definition provided in IUCN SPC (2024).

An example of how to justify assessment under Criterion C is provided in Box 10.

Box 10. Example application of Criterion C. *Parsonsia sankowskyana*[16] (a perennial vine) and *Bolemoerus hindwoodi* (a honeyeater bird)[17] can be assessed under Criterion C as there are sufficient data available on population size and continuing decline is evident. While *Adclarkia dawsonensis*[18] (a land snail) meets the requirements under Criterion C for continuing decline, the population size is unknown and so it cannot be assessed.

***Bolemoreus hindwoodi* meets the thresholds for listing as <u>Vulnerable</u> under Criteria C2a(ii).**

(C) Number of mature individuals

The number of mature individuals for *Bolemoreus hindwoodi* is 2,500-3,000 mature individuals (minimum 2,200 and maximum 4,700). Therefore, the species falls within the thresholds for VU and may possibly be eligible for EN soon if declines in the number of mature individuals continue.

C1 Continuing decline in mature individuals within 10 years or three generations (%)

Further research is required to quantify a rate of decline for this species, and as such this species is data deficient under subcriterion C1.

C2 Continuing decline in mature individuals

A continuing decline in the number of mature individuals has been estimated and inferred for the species based on the threat of increasing fire intensity in conjunction with the threats of climate change and weed invasion. It is considered probable that high intensity fire in the core habitat of Eungella honeyeater will increase in area covered due to interactions with climate change (increasing intensity of extreme fire weather and cyclones) and other threatening processes (e.g., weeds that carry fire). The threat is inferred to cause a continuing decline in the number of mature individuals, thereby meeting subcriterion C2.

(a) Number and proportion of mature individuals in each subpopulation

The species most likely occurs in one subpopulation (see 'Subpopulations'), thus the proportion of mature individuals in each subpopulation is 100%.

There are an estimated 2,500-3,000 mature individuals in the single subpopulation.

Therefore, the species is within the thresholds for VU under subcriterion C2a(ii).

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[16] Excerpt adapted from Department of Environment and Science (2023). Nomination to change the conservation class of *Parsonsia sankowskyana* under the Queensland *Nature Conservation Act 1992*. Queensland Department of Environment and Science.

[17] Excerpt adapted from Department of the Environment, Tourism, Science and Innovation. (2024). Nomination to change the conservation class of *Bolemoreus hindwoodi* under the Queensland *Nature Conservation Act 1992*. Queensland Department of Environment and Science.

[18] Excerpt adapted form Department of Environment and Science (2023). Nomination to change the conservation class of *Adclarkia dawsonensis* under the Queensland *Nature Conservation Act 1992*. Queensland Department of Environment and Science.

(b) Extreme fluctuations

There is no evidence of extreme fluctuations in the number of mature individuals that represent a tenfold increase or decrease in the total population for this species (IUCN SPC, 2022).

Bolemoreus hindwoodi is eligible for listing as 'Vulnerable' under Criteria C2a(ii) as the species has a small and declining population size, and its geographic distribution is precarious as all individuals occur in a single subpopulation.

Adclarkia dawsonensis **is assessed as <u>Data Deficient</u> under Criterion C.**

(C) Number of mature individuals

Current population data is not sufficient to estimate population size for *A. dawsonensis*.

(C1+2) Continuing decline in mature individuals (% AND/OR at any rate)

A continuing decline has been inferred for the species based on the threats of flooding, land clearing, feral pigs and domestic livestock. These threats directly impact the species by removal of critical habitat and mortality by crushing. The sheer number of threats occurring across the entire range of the population are likely to have an ongoing impact on the species.

(a) Number and proportion of mature individuals in each subpopulation

The number and proportion of mature individuals in each subpopulation is unknown.

(b) Extreme fluctuations

It is unknown whether *A. dawsonensis* experiences extreme fluctuations. There is no evidence of extreme fluctuations in the distribution area or the number of mature individuals that represent a tenfold increase or decrease in the total population for this species (IUCN SPC 2022).

Summary of documentation requirements for Criterion C

- A summary sentence at the top of the response box, providing the highest criteria and category the species is eligible for.
- The number of mature individuals, the associated data qualifier and whether the species meets or exceeds the corresponding thresholds.
- A statement on whether continuing decline ***in mature individuals*** applies and the associated data qualifier (see documentation requirements in Sections 0 and 9.4.2).
- Whether a rate of continuing decline can be projected relative to the generation length under C1. This should include an explanation of how projected decline was calculated and documentation of assumptions. The generation length must be stated (see Section 9.4.3).
- The number of mature individuals estimated to occur in each subpopulation (see Section 9.4.4), and whether the species meets or exceeds the corresponding thresholds (C2a(i)).
- The proportion of mature individuals estimated to occur in each subpopulation, and whether the species meets or exceeds the corresponding thresholds (C2a(ii)).
- The species' eligibility for listing against each of the subcriteria (or a statement that the species is Least Concern/ Data Deficient against that criterion).
- A statement on whether extreme fluctuations applies and the associated data qualifier (C2b; see documentation requirements in Section 9.4.5)
- A concluding sentence that summaries eligibility under any subcriteria (not just the overall/highest criteria).

9.5 Criterion D

Criterion D is used to assess species in the context of population size or extent. Those species with very *small population sizes*, or populations that are *restricted* in the context of potential threatening processes may meet the category thresholds for subcriteria D1 or D2, respectively (Table 17).

A species qualifies for listing under D1 if the population size is estimated to number fewer than 3000[19] mature individuals. This subcriterion is intended to capture those taxa with acute restriction in their population size, even if they are not declining.

A species qualifies for listing under D2 if the population is sufficiently restricted (in either AOO or locations) *and* has a plausible future threat that could drive the species to become threatened (Vulnerable, Endangered or Critically Endangered) or Extinct in a short time. The subcriterion is intended to capture taxa with restricted distributions such that the population is prone to the effects of human activities or stochastic events in an uncertain future. The focus of subcriterion D2 is *the risk that the species could rapidly become eligible for a higher threatened category.*

Taxa with very restricted ranges or small populations that do not meet the data quality requirements under Criteria A-C may often meet the threshold for Vulnerable under Criterion D2. Rather than having current evidence for continuing decline (or a likely, inferred future decline), a 'plausible future threat' can be used to assess the species. For a listing of Vulnerable, the plausible future threat must have the potential to drive the species to CR or EX in a 'very short time'. For a listing of Near Threatened, the plausible future threat must have the potential to drive the species to EN or VU in a 'very short time'.

Important: The spatial thresholds (AOO and number of locations) are provided as indicators only, not as literal thresholds. The emphasis of criterion D is the possibility the species could be rapidly driven to a higher threat category, rather than the spatial thresholds alone. Thus, if a species occurs close to a threshold, an argument can be made as to why it is eligible for that category on the basis that it could become rapidly threatened in the future.

[19] Thresholds for Near Threatened are under revision at time of publication.

Table 17. Category thresholds for Criterion D - adapted from IUCN SPC (2024).

Very small population				
	Critically Endangered (CR)	**Endangered (EN)**	**Vulnerable (VU)**	**Near Threatened (NT)**
D. Number of mature individuals	**< 50**	**< 250**	**D1. < 1,000**	**D1. < 3,000**
OR				
D2. [Only applies to the VU and NT categories] Restricted area of occupancy or number of locations with a plausible future threat that could drive the taxon to CR or EX in a very short time (for VU), or EN or VU in a very short time (for NT).	**Not applicable**	**Not applicable**	**D2. Typically (but not limited to): AOO < 20 km² or number of locations ≤ 5**	**D2. Typically (but not limited to): AOO < 40 km² or number of locations ≤ 10**

9.5.1 Number of mature individuals

Refer to definition under Criterion C (Section 9.4.1).

9.5.2 Area of occupancy

Refer to definition under Criterion B (Section 9.3.2).

9.5.3 Locations

Refer to definition under Criterion B (Section 9.3.4).

9.5.4 Plausible future threat(s)

A plausible threat is defined as the effects of human activities or stochastic events in an uncertain future. Plausible threats include *both natural and anthropogenic events*. There must be a substantial possibility of these activities or events occurring. The following examples would *not* suffice as plausible future threats:

- Unlikely events, such as the eruption of an inactive volcano.
- Non-specific events that were not observed in similar species (e.g. an unspecified disease epidemic).
- Events unlikely to cause extinction (e.g., because the species has survived many cyclones, or is likely to adapt to climate change, or fire regimes that have not deviated from historical norms).
- Events unlikely to occur rapidly enough to result in a CR or EX listing in a very short time *after the event occurs* (or VU or EN for NT).

- Generalised threats such as climate-change that are not specifically justified according to the mechanism, timing and likelihood of impact to the species.

The serious plausible future threat used under Criterion D2 should generally be a threat that is not currently acting on the population. However, a current threat can also be applied as a serious plausible future threat where it is likely to substantially change or intensify, such that it would cause the species to become rapidly eligible for listing as Critically Endangered or Extinct. If the serious plausible threat(s) used under Criterion D2 are also applied as current threats (i.e. under Criterion B or C for continuing decline), the justification under Criterion D2 must clearly articulate how / why the threat(s) are likely to substantially change or intensify relative to the current situation and threat trajectory.

9.5.5 Very short time

A '*very short time'* is defined as the longer of 1-2 generations or 3-5 years *after the threatening event occurs.* That is, to meet VU under D2, the species would deteriorate to meet the listing thresholds for CR or EX *under any criteria,* after the potential threat occurred within the longer of 1-2 generations or 3-5 years.

An example of how to justify assessment under Criterion D is provided in Box 11.

9.5.6 Response structure for Criterion D

- Summary sentence
    - In the format provided in Box 11.
- Number of mature individuals (D1)
    - State the number of mature individuals. Where plausible bounds are used, comment on whether the lower or upper bounds should be used in the assessment. Lower bounds are typically used where a precautionary approach is warranted given the presence of threatening processes. Upper plausible bounds are typically used if further survey is required and threats are minimal.
- AOO (D2)
    - State the AOO. State which threshold is met.
- Number of locations (D2)
    - State the number of locations.
    - State and justify the method used to delineate locations. Appropriate methods include using the most serious plausible threat, using the threat that results in the smallest number of locations, or using multiple threats where the species has different threats across its range.
    - Where the number of locations is uncertain, a range of values can be presented using plausible bounds. If the values do not fit within a category threshold, a decision of the appropriate category should be justified.
- Plausible future threat that could drive the taxon to CR or EX (for VU), or EN or VU (for NT) in a very short time (D2)
    - State if there is a plausible future threat to the species.

- Define a ‘very short time’ (the longer of 1-2 generations or 3 years).
- Justify how the species could become eligible for any category after this plausible threatening event occurred.

Box 11. Example application of subcriteria D1 and D2. *Bergera crenulata*[20] (a small tree) can be assessed for both D1 and D2, but has a higher listing at D1. *Arthraxon australiensis*[21] (a grass) can only be assessed at D2 due to an unknown number of mature individuals. *Bolemoreus hindwoodi*[22] (a honeyeater bird) can only be assessed under Criterion D2 due to a population estimate that exceeds the D1 threshold.

***Bergera crenulata* meets the thresholds for listing as <u>Critically Endangered</u> under Criterion D.** **D+D1 Number of mature individuals** The population size of *B. crenulata* is estimated to comprise <50 mature individuals, as only one mature, wild tree is known. The species has been relatively well-surveyed and known subpopulations almost always comprise very small groups (i.e., <20) (see Distribution). **D2 AOO and number of locations** The species has an AOO of 4km^2. When assessed against the serious plausible threat that results in the smallest number of locations (low genetic diversity) the species is assessed to occur across one location. Currently all subpopulations have small sizes of <5 mature individuals. **D2 Serious plausible threat that could rapidly drive the taxon to CR/EX (for VU) or VU/EN (for NT)** There are several plausible threats that could drive the species to EX in a very short time. A short time for this species is suspected to be at least 32 years (i.e. the longer of 3-5 years or 1-2 generations), based on an estimated minimum generation length of 15.5 years. The species has several inferred threats with a catastrophic outcome (i.e. species is close to extinction), including roadside maintenance, habitat degradation from grazing, and invasive weeds as well as low genetic diversity. It is highly plausible that these threats could cause a continuing decline/ reduction within this timeframe such that it would become eligible as EX.
***Arthraxon australiensis* meets the thresholds for listing as <u>Vulnerable</u> under Criterion D2.** **D+D1 Number of mature individuals** The population of A. australiensis is unknown. The species has been poorly surveyed with substantial areas of potential habitat nearby current records. Further surveys required to assess the species against Criterion D1. **D2 AOO and number of locations**

[20] Excerpt adapted from Department of the Environment, Tourism, Science and Innovation (2024). Nomination to change conservation class of *Bergera crenulata* under the Queensland *Nature Conservation Act 1992*. Queensland Department of Environment and Science.

[21] Excerpt adapted from Department of the Environment, Tourism, Science and Innovation (2024). Nomination to change conservation class of *Arthraxon australiensis* under the Queensland Nature Conservation Act 1992. Queensland Department of Environment and Science.

[22] Excerpt adapted from Department of the Environment, Tourism, Science and Innovation (2024). Nomination to change conservation class of *Bolemoreus hindwoodi* under the Queensland Nature Conservation Act 1992. Queensland Department of Environment and Science.

The species has an AOO of 12km^2. Two locations are defined for the species. There are multiple serious threats to the species, but these do not operate over the entire distribution of the species. One location for the species has been defined based on the most serious plausible threat of grazing which impacts the mainland subpopulation. A second location is defined based on the most serious plausible threat of invasive weeds which impacts the subpopulation on Kiriri (Hammond) Island. **D2 Serious plausible threat that could rapidly drive the taxon to CR/EX (for VU) or VU/EN (for NT)** There are several plausible threats that could drive the species to CR in a very short time. A short time for this species is suspected to be 3-5 years (i.e. the longer of 3-5 years or 1-2 generations), based on an estimated generation length of <1 year. The species has several suspected threats including land clearing for residential development, inappropriate fire regimes, invasive weeds, grazing and feral pigs. There is also a future plausible threat of increased severe storms and flooding due to climate, which is projected to cause inundation where the Kirriri subpopulation occurs. If this were to occur it is plausible the Kirriri Island subpopulation may become locally extinct and the species would become eligible for CR under Criterion B1+2ab(iii-iv).
Bolemoreus hindwoodi **meets the thresholds for listing as <u>Near Threatened</u> under Criteria D2.** **D+D1 Number of mature individuals** The estimate of the number of mature individuals for Eungella honeyeater is between 2,200 and 4,700 mature individuals, with a best estimate of 2,500-3,000. Therefore, the species exceeds the threshold for listing under Criteria D1. **D2 AOO and number of locations** The species has an AOO of 288 km^2. When assessed against the most serious plausible threat, increasing fire intensity/severity, Eungella honeyeater is considered to occur at 4-10 locations. In 2018, approximately 5-8% of the species habitat was impacted by extreme fires, with a further ~5-6% impacted by very high and ~6-8% impacted by high severity fires; totalling ~17-20% of habitat impacted by fire of sufficient severity to cause complete tree and shrub mortality (Figure 8; Table 1). Damage to these fire-sensitive communities has been assessed as likely to take decades to centuries to recover (Hines et al., 2020). It is considered probable that fires of this intensity in the core habitat of Eungella honeyeater will increase in area covered due to interactions with climate change and other threatening processes (e.g., weeds that carry fire). As such, it is assumed that each fire event can impact >10% of the population's core habitat, and habitat recovery will not occur between events, equating to ≤10 locations. The minimum number of locations is assessed as four, based on there being three regions of core habitat that could each be affected by a single fire event and the non-resident region. **D2 Serious plausible threat that could rapidly drive the taxon to CR/EX (for VU) or VU/EN (for NT)** There are several plausible threats that could drive the species to EN in a very short time. A short time for this species is suspected to be 3-6 years (i.e. the longer of 3-5 years or 1-2 generations), based on an estimated generation length of 3 years. The species has several inferred threats including the threat of increasing fire intensity in combination with invasive weeds that carry fire. It is highly plausible that these threats could cause a continuing decline within this timeframe such that it would become eligible as EN under Criteria C2a(ii). Further, if fires became more extensive in the region in the future, the number of locations could be reduced to <5, meaning the species would also qualify as EN under Criteria B1+2. *Bolemoreus hindwoodi* is eligible for listing as 'Near Threatened' under Criterion 2 as the species occurs across a small number of threat-based locations.

Summary of documentation requirements for Criterion D

- The number of mature individuals and corresponding data qualifier (see Section 9.4.1), and a statement of eligibility under D1.
- The AOO (see Section 9.3.2) and the number of threat-based locations (see Section 9.3.4), and a statement of eligibility against D2.
- The threat(s) that are deemed significant, and plausible in the future (see Section 9.5.4). If these are current threats, including those applied under other criteria, a clear justification of how and why they could plausibly and substantially change in the future.
- The generation length of the species (see Section 9.4.3).
- Whether the threat is likely to lead to population decline toward eligibility for listing as Critically Endangered or Extinct within a short time relative to the generation length of the species (see Section 9.5.5).
- The criteria the species is likely to become eligible under should the future plausible threat(s) occur.
- A statement of eligibility under criterion D2.
- An overall statement of eligibility under Criteria D.

9.6 Criterion E

Criterion E is used to assess taxa using a *quantitative analysis* related to the probability of extinction in the wild. Those taxa with a high probability of extinction, measured as a loss within a given timeframe, may meet the category (Table 18). The process is typically quite involved and is usually related to a peer-reviewed publication. There are few examples of Criterion E application in Queensland, but it has been applied for *Grevillea caleyi* in New South Wales (Regan & Auld, 2004). Criterion E requires nominators to calculate extinction risk for up to three time periods:

- 100 years (for NT and VU)
- The longer of 20 years or five generations (up to 100 years)
- The longer of 10 years or three generations (up to 100 years).

An example of how to justify assessment under Criterion E is provided inBox 12.

Table 18. Category thresholds for Criterion E - adapted from IUCN SPC (2024).

Quantitative Analysis				
	Critically Endangered (CR)	Endangered (EN)	Vulnerable (VU)	Near Threatened (NT)
Indicating the probability of extinction in the wild to be:	≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)	≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)	≥ 10% within 100 years	≥ 5% within 100 years

Box 12. Example application of Criterion E – *Grevillea caleyi*[23] (a spreading shrub) has quantitative data available to be assessed under Criterion E. Whereas, *Delma mitella*[24] (a legless lizard) does not have quantitative data available.

***Grevillea caleyi* meets the thresholds for listing as <u>Critically Endangered</u> under Criterion E.** **Probability of extinction** (**E**) *"Regan and Auld (2004) suggest that extinction risk currently varies from 60% (low fire frequency 15-30 years between fires) to 96% (high fire frequency – five years between fires) in 50 years due to the risk of wildfire burning over any planned fires. Most decline is predicted to occur in the first 25-30 years of the models developed by Regan and Auld (2004). A generation in* G. caleyi *is thought to between 8-15 years (and 3 generations 24-45 years). However, given that generations are triggered by fire events (and do not occur independently of fire) and that the average fire return interval in the habitat is approximately 7-17 years (Bradstock and Kenny 2003), 3 generations is most likely to be 21-60 years. Although uncertain, this suggests that the probability of extinction is likely to be ≥ 50% in 3 generations. Consequently,* Grevillea caleyi *would meet Criterion E as Critically Endangered".*
***Delma mitella* is assessed as Data Deficient under Criterion E.** Population viability analysis has not been undertaken for *D. mitella*. Therefore, there is insufficient information to determine the eligibility of the species for listing in any category under this criterion.

Summary of documentation requirements for Criterion E

- Probability of extinction (%) over the relevant time period(s).
- The generation length of the species and associated data qualifier.
- The time period(s) over which extinction probability is assessed, with reference to the criterion thresholds and the generation length of the species, up to 100 years.
- The quantitative analysis technique used (e.g. PVA), with supporting documentation and explanation of the data used, assumptions and uncertainties.

[23] Excerpt adapted from (Threatened Species Scientific Committee, 2018).

[24] Excerpt adapted from Department of Environment, Science and Innovation (2024). Nomination to change conservation class of *Delma mitella* under the Queensland Nature Conservation Act 1992. Queensland Department of Environment and Science.

10 Summary of eligibility

To complete this section, nominators should

- Write the category and the subcriteria for which the species qualifies next to the relevant criteria headings as in Box 13.
- Then, write the highest category and criteria for which the species qualifies (this can be more than one) as the overall eligible listing class, as in Box 14.
- In the case where, following assessment against all criteria, a taxon has no higher eligible category above Data Deficient, then the highest category must be reported as Least Concern (see Section 8).
- Refer to the IUCN Red List Guidelines for correct notation of eligible categories and criteria, for example: C1+2a(i); B1ab(i-v).

Box 13. Nominators should write the eligible category and subcriteria next to each category.

Summary of wildlife class/category and criteria under which the species is eligible for listing as CR/EN/VU/NT
Criterion A: **Vulnerable A2bd**
Criterion B: **Critically Endangered B1ab(v)**
Criterion C: **Critically Endangered C1**
Criterion D: **Endangered D**
Criterion E: **Data Deficient**

Box 14. Nominators should write the overall category and criteria that the species is eligible for listing as. This should include only the highest eligibility category. If the species is eligible for this category under multiple criteria, these should be listed.

Overall eligible listing wildlife class/category and criteria
CR B1ab(v); C1

11 Conservation status

11.1 Current listing class/category

Select the appropriate category for the *NC Act* and the *EPBC Act.*

- The current status under the *NC Act* will be listed on WildNet.
- The current status under the *EPBC Act* will be listed on the SPRAT database.
- Do not include the details of any non-statutory listing class /categories.

Review all previous listings for the species (historic and current) and follow the text format displayed in Box 15.

Box 15. Example text format for the Initial listing section of the nomination form.

[*Species name*] was listed as [Category] under Criterion [xxxx] on [DATE] due to [reasons]. The species was then de-listed in [DATE] due to a significant expansion in range and population size, resulting in the number of mature individuals, EOO and AOO exceeding the thresholds for Vulnerable. OR The species was then uplisted in [DATE] due to a significant reduction in range and population size, resulting in the number of mature individuals, EOO and AOO meeting the thresholds for Endangered under Criterion B1+2ab(iii,v). OR The initial listing information is not available for this species.

11.2 Nominated wildlife class/category

Nominators should state the proposed category and criteria for listing under the *NC Act*, along with a paraphrased justification for why the species meets the thresholds for this category (Box 16).

Box 16. Example text format for the nominated wildlife class/category section of the form.

[Species name] has been assessed under the CAM-compliant methodology and meets the thresholds for listing as [Category] under Criterion [XX], because [reason X, Y, Z].

11.3 Reason and eligibility for transfer to another class

Nominators should review the historic, current and nominated listing class to determine whether there is a change in class, and the reason for the change or lack of change (Box 17). Note this section applies to the ‘wildlife class’ (status under the *NC Act* in Queensland), rather than to changes to the ‘listing category’ (status under the Australian Government *EPBC Act*). Nominators should detail the following:

- State whether the species is eligible for a transfer based on the current ‘wildlife class’ and the overall ‘wildlife class’.
- If there is a change, state whether this change is ‘genuine’ or ‘non-genuine’ and provide justification.

    - Genuine change refers to an actual change in the status of the species due changes in threats or management actions.
    - Non-genuine change typically refers an erroneous prior listing, species/nomenclatural change or changes that have resulted to the availability of new information (i.e. recent collection records resulting in a range expansion that was previously unknown).
- If there is no change, state why this is so (i.e. the threats remain stable).

The following rules apply to category transfers:

- For genuine changes to a lower threat category, at least five years must have passed since the data show the species no longer meet the criteria for the category in which it is currently listed (this is not necessarily the date of previous assessment).
- If the original classification was erroneous or based on a nongenuine change, the species may be transferred immediately to the category it is currently eligible for listing under.

Nominators will need to justify any category transfers against the abovementioned rules.

Box 17. Example text format for the reason and eligibility for transfer section of the nomination form.

[Species] is eligible for transfer to a higher wildlife class. *Species* was listed as VU under Criterion D2 in 2009 due to a restricted range and future plausible threat of climate change. The species is now eligible for CR under Criterion B due to the emerging threat of montane drying (climate change), with the species experiencing a continuing decline, alongside very restricted range (EOO and AOO = 4km^2) and small number of locations (1). This represents a genuine (recent) change in wildlife class.

11.4 Reason and eligibility for transfer to EX/EW

If a species is eligible for a category transfer to EX or EW, nominators should select the relevant check box.

- For transfer to EX, there must be evidence of exhaustive surveys undertaken in all known or likely habitat throughout its historical range, at appropriate times (diurnal, seasonal, annual), and over a timeframe appropriate to its life cycle or form.
- For transfer to EW, the abovementioned rule must be met, along with either:
    - Evidence that the species exists in cultivation, in captivity or as a naturalised population(s) well outside the past range; AND/OR
    - Evidence that remaining subpopulations are not ‘wild’.

Nominators should provide a justification for how these rules have been met in the ‘Details’ section.

11.5 Impact of transferring a threatened species to NT/LC

Only complete this section if the nomination is for transfer of a species to Near Threatened or Least Concern from a class of nationally threatened wildlife (Extinct, Extinct in the Wild, Critically Endangered, Endangered or Vulnerable). Provide details of the expected impact on the species if conservation actions were ceased following its transfer from a threatened wildlife class.

12 Cultural significance

Refer to the information gathered regarding the Traditional Custodians for the land on which the species occurs from the map created in the Distribution section (Section 0). Alternatively, the Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS) website https://aiatsis.gov.au/explore/map-indigenous-australia can provide useful information regarding the Traditional Custodians and link to maps of Indigenous Australia. Note that it is not appropriate to reproduce (screenshot) the AIATSIS map for use in the nomination. Rather, nominators should provide a link to the website within the text as appropriate.

It may be appropriate to enter the text from the statement in Box 18 if the cultural significance of the species is unknown/uncertain.

Box 18. Example text for the Indigenous cultural significance section of the nomination form.

> The cultural, customary and spiritual significance of species and the ecological communities they form are diverse and varied for Indigenous peoples and their stewardship of Country. This section describes some examples of this significance but is not intended to be comprehensive or applicable to, or speak for, Indigenous peoples. Such knowledge may be held by Indigenous peoples who are the custodians of this knowledge and have the rights to decide how this knowledge is shared and used.
>
> The distribution of this species overlaps with the country of the X and Y People. Despite this, the cultural and customary significance of the species is not publicly available. Further consultation with the Traditional Custodians of these lands will benefit the conservation of the species by providing awareness of traditional knowledge and management practices on Country.
>
> This statement of significance is not intended to be comprehensive, applicable to, or speak for, all Indigenous Australians. It is acknowledged that Indigenous peoples who are the custodians of this knowledge have the rights to decide how it is shared and used.

13 Other considerations

13.1 Additional information

Insert an abbreviated table of records used to calculate the EOO and AOO here. Ensure the source of the records is attributed. See Appendix 2. Example of retained and excluded herbarium specimen records for an example. Records should be organised into two tables; one for those used in the assessment, and another for those excluded from the assessment.

The coordinate information for confidential or sensitive species should be included in the table and clearly marked as sensitive. Documents are reviewed for sensitive information which is then redacted before publishing.

13.2 Images of the species

Often, species experts will have personal photographs saved of the species. These can be very helpful for future science communication purposes. Ask the expert reviewers if they have any photographs they are willing to share for governmental use. Make sure they are attributed correctly and that the author agrees to the data sharing agreement licencing stated on the nomination form.

14 Nomination reference list

Ensure a comprehensive reference list is included with consistent formatting as per the specifications of APA 7th edition (single-spaced bibliography).

15 Suggested citation

- All nominations submitted to and endorsed by the Species Technical Committee will be cited with the Department as the author.
- Nominators should edit the suggested citation to include the date and the species name as per Box 19.

Box 19. Required citation format.

Department of the Environment, Tourism, Science and Innovation (YYYY). Nomination to change conservation class of *Genus species* under the *Queensland Nature Conservation Act 1992*. Queensland Department of Environment, Technology, Science and Innovation.

16 Nominator and reviewer details

Enter the details of the nominator and reviewer. These details are subject to the provisions of the *Privacy Act 1988* and will not be divulged to third parties, except for state and territory governments and scientific committees that have agreed to collaborate on national threatened species assessments using a CAM. If there are multiple nominators, please copy and paste the tables and fill out for each nominator.

Throughout the process of compiling the nomination, nominators should have identified some experts for the species. These will be people who have collected the species, or whose names feature strongly in publications regarding the species. Reach out to them and ask if they would be willing to review the nomination. This is not always possible or feasible. In this case, ask for guidance. Enter the details of all expert reviews as well as the nominator.

17 Consistency checklist

The following sections must be checked for consistency prior to submission.

- EOO is consistent between Distribution, Key Parameters Table (KPT), and Criterion B.
- AOO is consistent between Distribution, KPT, Criterion B, and Criterion D.
- Number of mature individuals is consistent between Distribution, KPT, Criterion C, and Criterion D.
- Number of subpopulations is consistent between Distribution, KPT, and Criterion C.
- Severe fragmentation text is consistent between KPT and Criterion B.
- Extreme fluctuations text is consistent between KPT, Criterion B, and Criterion D.
- Number of locations is consistent between KTP, Criterion B, and Criterion D.
- Most serious plausible threat used to define locations aligns with the highest risk threat in the threats table, unless a different serious threat results in the smallest number of locations. If the latter is the case, this is clearly stated in the justification of locations.
- The ‘consequence’ and ‘likelihood’ threat parameters are consistent between the threats table and the risk matrix.
- The ‘risk’ threat parameters are consistent with the risk matrix outcome.
- The threats are listed from highest to lowest risk based on the risk matrix. The threat abatement section lists threats in the same order.

Homoranthus porteri is known from a restricted distribution on the Country of the Bar-Barrum and Jirrbal People, on the boundary between the Wet Tropics and Einasleigh Uplands bioregions in northern Queensland. The species is currently listed as Vulnerable but requires reassessment using the Common Assessment Methodology to incorporate the emerging threat of wind farm construction.

Image © Andrew Ford.

18 References

Auld, T. D., Keith, D. A., Gallagher, R. V., Tozer, M., Ooi, M. K. J., Le Breton, T., Allen, S., Yates, C., Van Leeuwen, S., Williams, R. J., & Mackenzie, B. D. E. (2022). Frameworks for identifying priority plants and ecosystems most impacted by major fires. *Australian Journal of Botany*, *70*(7), 455–493. https://doi.org/10.1071/BT22009

Bird, J. P., Martin, R., Akçakaya, H. R., Gilroy, J., Burfield, I. J., Garnett, S. T., Symes, A., Taylor, J., Şekercioğlu, Ç. H., & Butchart, S. H. (2020). Generation lengths of the world's birds and their implications for extinction risk. *Conservation Biology*, *34*(5), Article 5. https://doi.org/10.1111/cobi.13486

Cogger, H. G. (2018). *Reptiles and Amphibians of Australia*. CSIRO Publishing.

Commonwealth of Australia. (2015). *Arrive Clean, Leave Clean: Help prevent the spread of invasive plant diseases and weeds threatening our native plants, animals and ecosystems*. https://www.dcceew.gov.au/sites/default/files/documents/arrive-clean-leave-clean.pdf

Commonwealth of Australia. (2016). *Threat Abatement Plan for infection of amphibians with chytrid fungus resulting in chytridiomycosis (2016)*. https://www.dcceew.gov.au/sites/default/files/documents/tap-chytrid-fungus-2016.pdf

DAWE. (2021). *Guidance for populating the conservation advice template. Unpublished.*

Falster, D., Gallagher, R., Wenk, E. H., Wright, I. J., Indiarto, D., Andrew, S. C., Baxter, C., Lawson, J., Allen, S., & Fuchs, A. (2021). AusTraits, a curated plant trait database for the Australian flora. *Scientific Data*, *8*(1), 254.

Garnett, S. T., & Baker, B. G. B. (2021). *The Action Plan for Australian Birds 2020*. CSIRO Publishing.

Guisan, A., & Zimmermann, N. E. (2000). Predictive habitat distribution models in ecology. *Ecological Modelling*, *135*(2–3), 147–186.

IUCN SPC. (2024). *Guidelines for using the IUCN Red List categories and criteria. Version 16.* Prepared by the Standards and Petitions Committee. https://www.iucnredlist.org/documents/RedListGuidelines.pdf

IUCN SSC Red List Technical Working Group. (2024, January). *Mapping Standards and Data Quality for IUCN Red List Spatial Data. Version 1.20 (January 2024)*. The IUCN Red List of Threatened Species. file:///C:/Users/collingwoodt1/Downloads/Mapping_Standards_Version_1.20_Jan2024%20(1).pdf

Makinson, R. O., Pegg, G. S., & Carnegie, A. J. (2020). *Myrtle Rust in Australia – a national action plan*. Australian Plant Biosecurity Science Foundation.

Mancini, G., Santini, L., Cazalis, V., Ficetola, G. F., Meiri, S., Roll, U., Silvestri, S., Pincheira-Donoso, D., & Di Marco, M. (2025). Generation length of the world's amphibians and reptiles. *Ecography*, *2025*(7), e07527. https://doi.org/10.1111/ecog.07527

McRae, B. H., Dickson, B. G., Keitt, T. H., & Shah, V. B. (2008). Using circuit theory to model connectivity in ecology, evolution, and conservation. *Ecology*, *89*(10), 2712–2724.

Mitchell, N., Cox, N., Bowles, P., Tingley, R., Macdonald, S., Shea, G., Keogh, J. S., Woinarski, J., & Chapple, D. (2019). *The action plan for Australian lizards and snakes 2017*. CSIRO Publishing.

Pacifici, M., Santini, L., Di Marco, M., Baisero, D., Francucci, L., Grottolo Marasini, G., Visconti, P., & Rondinini, C. (2013). Generation length for mammals. *Nature Conservation*, *5*, 89–94. https://doi.org/10.3897/natureconservation.5.5734

Phillips, S. J., Anderson, R. P., & Schapire, R. E. (2006). Maximum entropy modeling of species geographic distributions. *Ecological Modelling*, *190*(3), 231–259. https://doi.org/10.1016/j.ecolmodel.2005.03.026

Podger, F. D., James, S. H., & Mulcahy, M. J. (2001). Phytophthora cinnamomi *and disease caused by it. A protocol for identifying 'Protectable Areas' and their priority for management.* (Draft Report Prepared for Department of Parks and Wildlife).

Queensland Herbarium and Biodiversity Science. (2025). *Census of the Queensland Flora and Fungi 2024*. Queensland Department of Environment, Tourism, Science and Innovation, Queensland Government.

Regan, H. M., & Auld, T. (2004). Using population viability analysis for management of an endangered Australian shrub, Grevillea caleyi. *Species Conservation and Management: Case Studies*.

Silcock, J., Collingwood, T. D., Llorens, T., & Fensham, R. J. (2022). *Action plan for Australia's Imperilled Plants 2021*. https://www.nespthreatenedspecies.edu.au/media/wksjzmcs/2-4-action-plan-for-australia-s-imperilled-plants-2021.pdf

Threatened Species Scientific Committee. (2018). *Conservation Advice* Grevillea caleyi *(Caley's grevillea). In effect under the EPBC Act from 11-May-2018.* Canberra: Department of the Environment and Energy. http://www.environment.gov.au/biodiversity/threatened/species/pubs/9683-conservation-advice-11052018.pdf.

Woinarski, J. C. Z., Burbidge, A. A., & Harrison, P. L. (2014). *The action plan for Australian mammals 2012*. CSIRO Publishing.

19 Key resources

Table 19. Key resources for use in threatened species nominations.

Resource	Web link
Action Plans with example recovery actions	Imperilled Plants 2021 https://www.nespthreatenedspecies.edu.au/publications-and-tools/action-plan-for-australia-s-imperilled-plants-2021 Lizards and snakes 2017 https://www.publish.csiro.au/book/7823/ Birds 2020 https://www.publish.csiro.au/book/7905/ Mammals 2012 https://www.publish.csiro.au/book/7010/
APNI (Australian Plant Name Index)	https://biodiversity.org.au/nsl/services/search/names
auNSL	https://biodiversity.org.au/nsl/
Australian cyclone interactive GIS map	https://www.arcgis.com/home/webmap/viewer.html?url=https://gisservices.information.qld.gov.au/arcgis/rest/services/EventsIncidents/CycloneHistorical/MapServer&source=sd
AusTraits	https://austraits.org/
Austrobaileya	https://www.jstor.org/journal/aust
AVH (Australasian Virtual Herbarium)	https://avh.chah.org.au/
Atlas of Living Australia	https://www.ala.org.au/
Queensland Flora and Fungi census	https://www.qld.gov.au/environment/plants-animals/plants/herbarium/flora-fungi-census
Climate change cluster reports	https://www.climatechangeinaustralia.gov.au/en/communication-resources/reports/ (scroll to bottom of page for cluster report links)
CSIRO cluster report NRM regions – including shapefiles	https://www.climatechangeinaustralia.gov.au/en/overview/methodology/nrm-regions/
DCCEWW - Common Assessment Method	https://www.dcceew.gov.au/environment/biodiversity/threatened/cam#national-scale
GeoResGlobe	https://georesglobe.information.qld.gov.au/
iNaturalist	https://www.inaturalist.org/users/sign_in
Interactive World Forest Map	https://www.globalforestwatch.org/map/

IUCN threat classification scheme	https://www.iucnredlist.org/resources/classification-schemes
Key threatening processes	http://www.environment.gov.au/cgi-bin/sprat/public/publicgetkeythreats.pl
LongPaddock Climate Dashboard	https://longpaddock.qld.gov.au/qld-future-climate/dashboard/
Long paddock regional impact studies	https://www.longpaddock.qld.gov.au/qld-future-climate/regional-sum/
Nomination form	https://www.qld.gov.au/environment/plants-animals/conservation/threatened-wildlife/threatened-species/conservation-status/species-technical-committee
Northern Australia Fire Information (NAFI)	https://www.firenorth.org.au/nafi3/
QBEIS database (formerly CORVEG)	https://portal.tern.org.au/metadata/TERN/7aabc55e-22eb-47ba-8fc1-8ce709669090 https://ecoplots.tern.org.au/search?datatype=observations&searchmode=data&dataset=corveg
Queensland Globe	https://qldglobe.information.qld.gov.au/
Queensland Spatial Catalogue	https://qldspatial.information.qld.gov.au/catalogue/custom/index.page
Red List Criteria Summary Sheet	https://www.iucnredlist.org/resources/summary-sheet
The Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS) map of Indigenous Australia	https://aiatsis.gov.au/explore/map-indigenous-australia
Threat Abatement Plans	https://www.dcceew.gov.au/environment/biodiversity/threatened/threat-abatement-plans/approved
WildNet	https://apps.des.qld.gov.au/species-search/
WildNet sensitive species	https://www.data.qld.gov.au/dataset/queensland-confidential-species

20 Appendices

Appendix 1. Downloading species occurrence data

To download flora records from AVH (includes non-sensitive BRI records):

- In “simple search” type the species name and select “download” (Figure 4).
- Follow the prompts to “login” to the Atlas of Living Australia.
- Select “occurrence records”.
- Rename the “File name” with a date and the species name (i.e. YYYYMMDD_Genus-species-subspecies)
- Select “Full Darwin Core” for the download format.
- Select “.csv” as the output file format.
- In Step 2, select the relevant industry/application.
- A link to the folder will be provided via email.
- Download and “unzip” the folder by right clicking and selecting “extract all”. Save in the species’ folder.

To download flora records from QBEIS/CORVEG (includes non-sensitive BRI records):

- QBEIS records are available via TERN here or here.
- Access the EcoPlots API or Portal and download the data (Figure 5).

To download fauna and flora records from WildNet:

- Go to WildNet – Species Profile Search.
- Enter the species name and search, click the species profile from the search results.
- Check the taxonomy/name is current (Figure 6; Figure 7).
- Then, download the list of records as a .csv (Figure 6; Figure 7).

To download flora and fauna records from ALA:

- Go to Atlas of Living Australia.
- Enter the species name and search, click the species profile from the search results.
- In the “Overview” tab, select “View and download occurrence records”, located under the map showing occurrence records.
- On this page information for each record can be examined individually by clicking on the record and/or download all records on the database for the species by clicking “Download”.
- Create log in details or use alternative sign in options.

- Follow prompts for download – select occurrence records, select “Full Darwin Core” for download format. select “CSV” for output file format.
- Save data to species folder.

In addition to cleaning data as per Section 3.2.4, check for and delete duplicates from WildNet Database and remove data from sources other than Queensland Museum and Australian Museum.

To download iNaturalist records for a flora or fauna species:

- Type the species’ name in the search bar.
- Select ‘Filters’.
- Select ‘Download’.
- Under Item 4, select ‘Create Export’.
    - Records must be reviewed thoroughly, and it should be ensured that the geolocations of records are not ‘obscured’. ‘Obscured’ records and those with poor (i.e. <2,000m precision) geolocation accuracy should be removed.
- *Note: iNaturalist records should be cited in the following format:*
    - *iNaturalist community (iNaturalist). (year). Observations of [Species name] from Queensland, Australia. Exported from https://www.inaturalist.org on [date].*

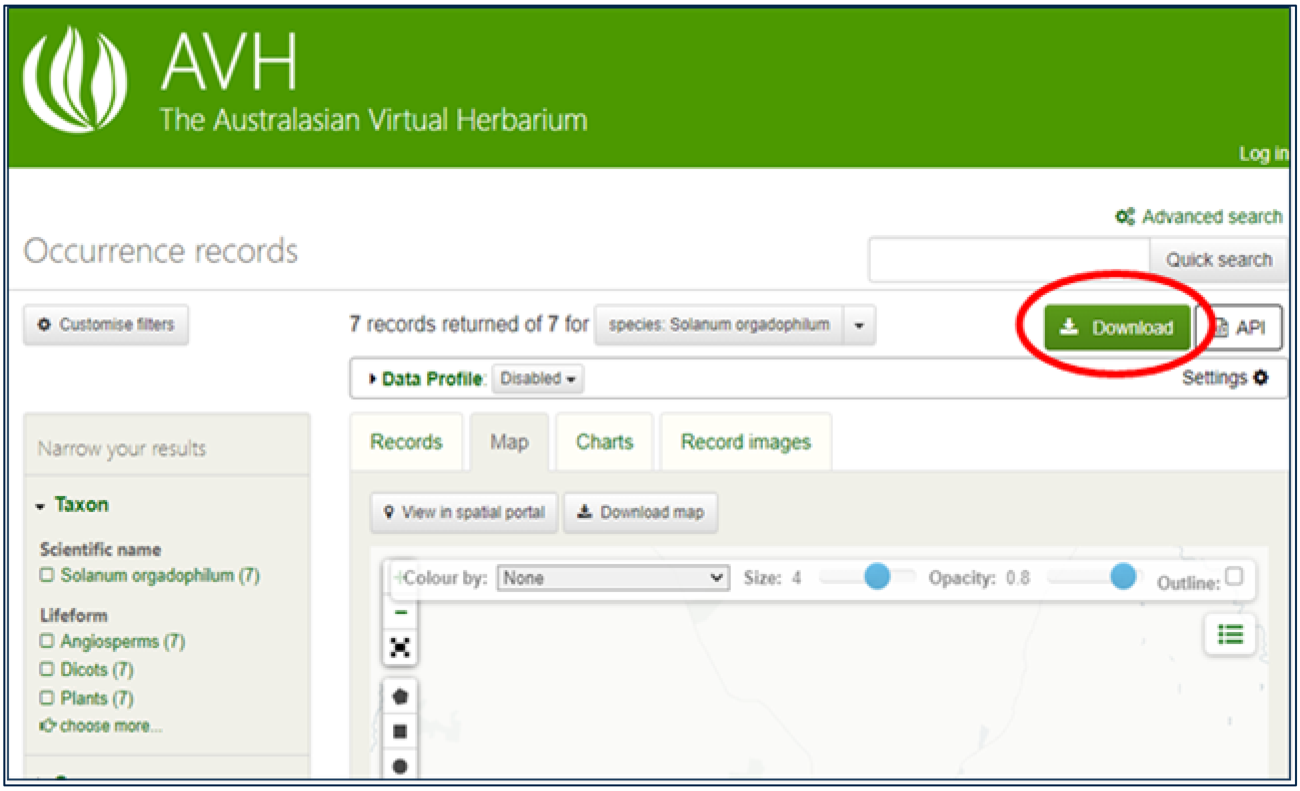


Figure 4. Screenshot of the AVH website interface, showing the ‘download’ button (red ellipse).

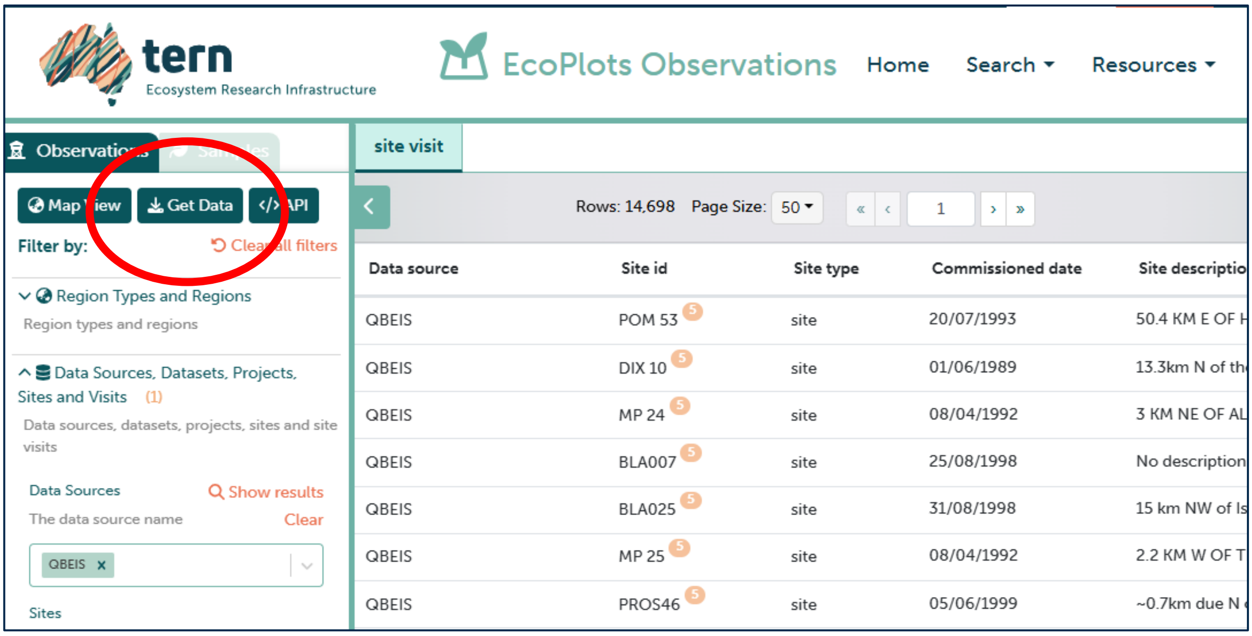


Figure 5. Screenshot of web page to download QBEIS data from TERN. Nominators should 'add' the Queensland CORVEG Database to the data cart (red ellipse) and follow the prompts to download.

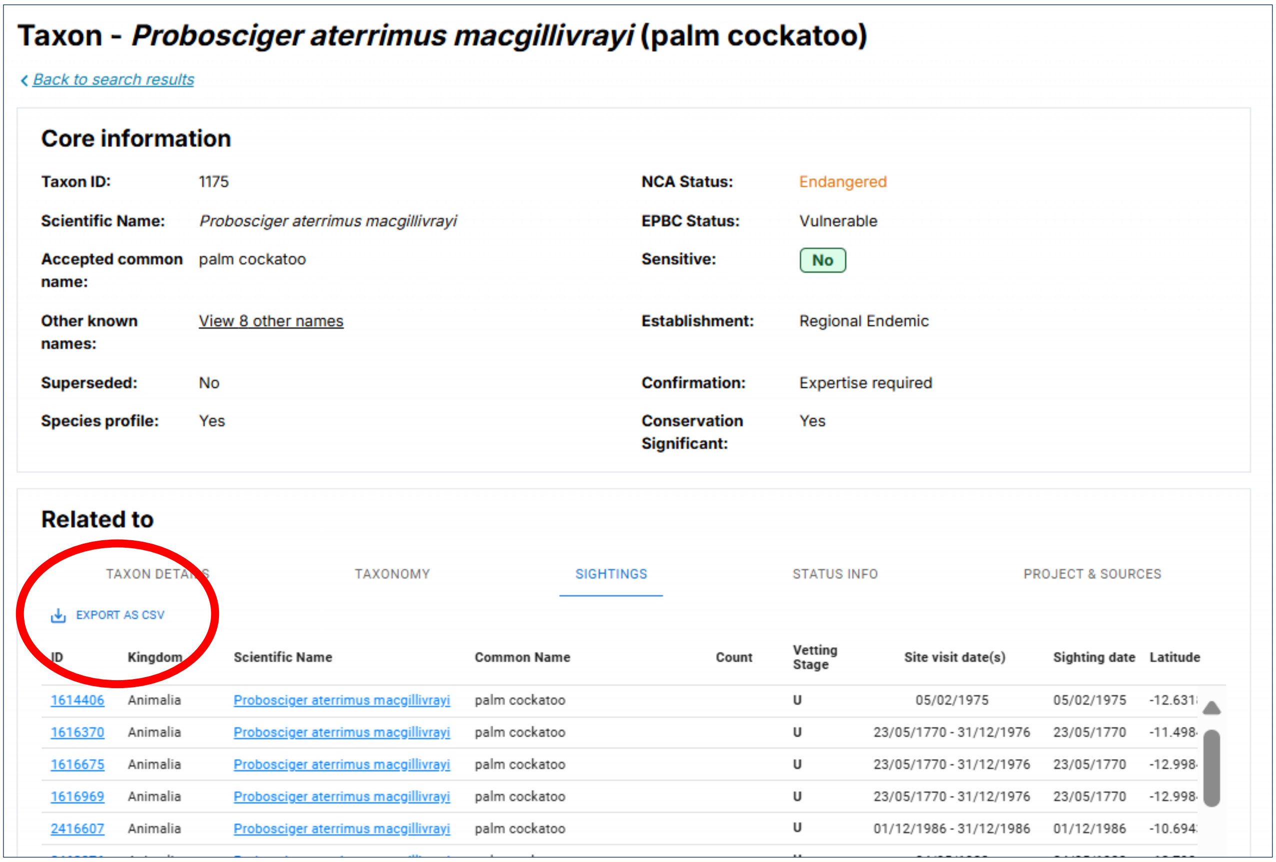
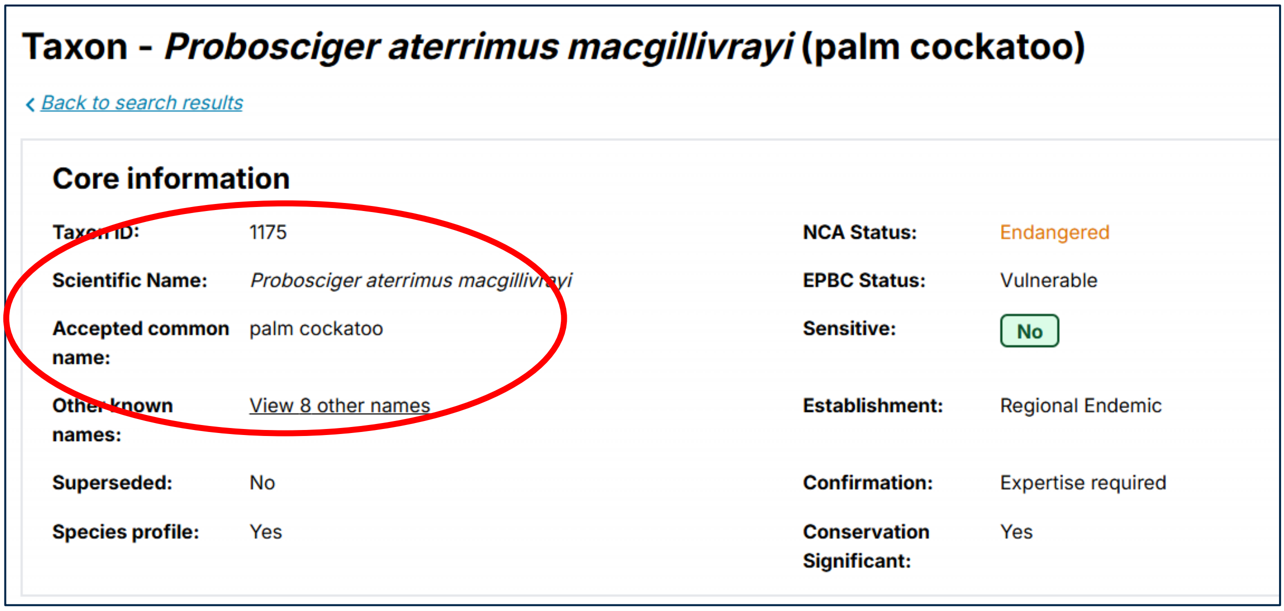


Figure 6. Screenshot of Species profile (WildNet) webpage, showing download button for WildNet records in red ellipse.



Taxon - *Probosciger aterrimus macgillivrayi* (palm cockatoo)

‹ *Back to search results*

Core information

Taxon ID:	1175	**NCA Status:**	Endangered
Scientific Name:	*Probosciger aterrimus macgillivrayi*	**EPBC Status:**	Vulnerable
Accepted common name:	palm cockatoo	**Sensitive:**	No
Other known names:	View 8 other names	**Establishment:**	Regional Endemic
Superseded:	No	**Confirmation:**	Expertise required
Species profile:	Yes	**Conservation Significant:**	Yes

Figure 7. Screenshot of Species profile (WildNet) webpage, showing the accepted Scientific name and author, synonyms and alternate (common) names (red ellipses) for a fauna species.

Appendix 2. Example of retained and excluded herbarium specimen records

Retained herbarium specimen records for *Acacia argentina* extracted from Australasian Virtual Herbarium.

Removal of duplicates (see excluded record table below) leaves four specimen records for *A. argentina*. Note that valuable information on population size is present in the ‘Event Remarks’ column. Information about habitat type should also be reviewed and detailed in the biology/ecology section of the nomination form.

Catalog Number	Record Number	Recorded By	Event Date	Latitude	Longitude	Datum	Precision	Reproductive Condition	locality	Occurrence Remarks	habitat	Event Remarks
BRI AQ0588589	PIF19673	Forster, P.I.	24/09/1996	-25.3261	150.0199	GDA2020	100	Flowers and fruit	Jarwood Station (GPS 25 19 40 150 01 08).	Blue-silver leaved shrub to 1.5m high, yellow flowers, young fruit.	Woodland of Eucalyptus melanophloia.	Very common in area. Type specimen-Austrobaileya 7:348(2006)
BRI AQ0588593	PIF19649	Forster, P.I.	23/09/1996	-25.2148	149.4574	GDA2020	100	Flowers and fruit	Gwambagwine, Ruined Castle Creek catchment (GPS 25 12 59 149 27 23).	Shrub to 3m high, silver-blue foliage, yellow flowers, young fruit.	Woodland of Corymbia bunites, Eucalyptus fibrosa and Angophora leiocarpa on sandstone.	Very common in area.
BRI AQ0639552	FC2	Carter, F.	1/07/1995	-25.2195	149.4513	GDA2020	100	Flowers	Ruined Castle Creek catchment, Murphy Range, Gwambagwine (GPS 25 13 16 149 27 01).	Shrub to 4m high, yellow flowers.	Open forest/woodland Eucalyptus watsoniana, Angophora leiocarpa, Lysicarpus angustifolius, Acacia spp., Triodia sp. and Xanthorrhoea sp.	Common in area.

Catalog Number	Record Number	Recorded By	Event Date	Latitude	Longitude	Datum	Precision	Reproductive Condition	locality	Occurrence Remarks	habitat	Event Remarks
BRI AQ0588599	PIF19740	Forster, P.I.	24/09/1996	-25.3239	150.0238	GDA2020	100	Flowers and fruit	Precipice National Park, catchment of Precipice Creek (GPS 25 19 32 150 01 22).	Shrub to 2m high, blue-silver foliage.	Woodland of Eucalyptus acmenoides, E. crebra and Angophora leiocarpa on sandstone cliff lines along seasonal watercourse.	

Excluded records for *Acacia argentina*

Catalog Number	Record Number	Recorded By	Event Date	Latitude	Longitude	Datum	Precision	Reason excluded
NSW 842940	19649	Forster, P.I.	23/09/1996	-25.2147	149.4575	GDA2020	100	Duplicate
MEL 2327287A	19649	Forster, P.I.	23/09/1996	-25.2	149.45	GDA2020	10000	Duplicate; poor precision
CANB 687998.1	19673	Forster, P.I.	24/09/1996	-25.327	150.0188	GDA2020	50	Duplicate
NSW 842724	19673	Forster, P.I.	24/09/1996	-25.3261	150.02	GDA2020	100	Duplicate
AD 203216	19673	Forster, P.I.	24/09/1996	-25.3263	150.0197	GDA2020	15	Duplicate
DNA D0186190	19673	Forster, I. Paul	24/09/1996	-25.3247	150.0207	GDA1994		Duplicate; no precision
MEL 2313184A	19673	Forster, P.I.	24/09/1996	-25.3278	150.0189	GDA1994	1000	Duplicate
MEL 2327281A	19740	Forster, P.I.	24/09/1996	-25.3167	150.0167	GDA2020	10000	Duplicate; poor precision

Appendix 3. Calculation of EOO and AOO in ALA Spatial

Follow these steps to estimate the EOO and AOO in the ALA Spatial Portal:

- Save the final ‘cleaned’ version of occurrence records in .csv format using the column headers outlined in Section 3.2.4.
- Ensure the scientificName, eventDate, decimalLatitude,decimalLongitude, and geodetic datum column names are correct prior to importing cleaned records or alternatively change them when processing data in the ALA Spatial Portal.
- Ensure all occurrences are in the GDA2020 (EPSG:7844) coordinate reference system. These may need to be manually transformed which can be done with an online calculator.
- Select ‘Import’ → ’Points’. Then, for step 1. Load data here - select ‘Load File‘ → ’Select File‘ (Figure 8; Figure 9).
- For step 2. Check the initial interpretation, ensure the column headers are readable, select “Column headers” for the first line, and conduct a final check of the data before proceeding to step 3. Process sample and upload to sandbox. Input the species and select “Upload your data” (Figure 10).
- In the toolbar, select the first icon (magnifying glass) for the newly added species data layer to zoom to the extent of records. Select the colour red for these points.
- To calculate EOO and AOO, select the ‘Tools’ dropdown tab > ’Calculate AOO and EOO‘. The default settings will be 1. ‘Apply to area’ = ’World‘ → 2. ‘Select species’ = ’your species occurrence points‘ → 3. ‘AOO grid resolution’ = ’0.02‘ → 4. ‘Alpha value’ = ’2‘. Do not change these settings, and then select ’Next‘. This will start a process and zip download containing all metrics and relevant spatial files.
- Deselect ’Points Radius‘ and ’Alpha Hull‘ layer in left toolbar and change EOO colour to white and AOO colour to black. EOO and AOO metrics can be viewed by selecting the information icon for each respective layer. Select map options and change base map to ’Hybrid‘ before selecting “Download map” (Figure 11).
- Insert this map into the Distribution section of the nomination form labelled as Figure 1 (see Box 5 for a comparable map generated with GIS software).

If the EOO is less than the AOO, the EOO should be changed to make it equal to the AOO to ensure it is consistent with the definition of the AOO as an area within the EOO (IUCN SPC, 2024).

EOO cannot be calculated with less than three data points as it will typically be less than 0. In this case, the AOO is used as the EOO, as EOO cannot be smaller than the AOO.

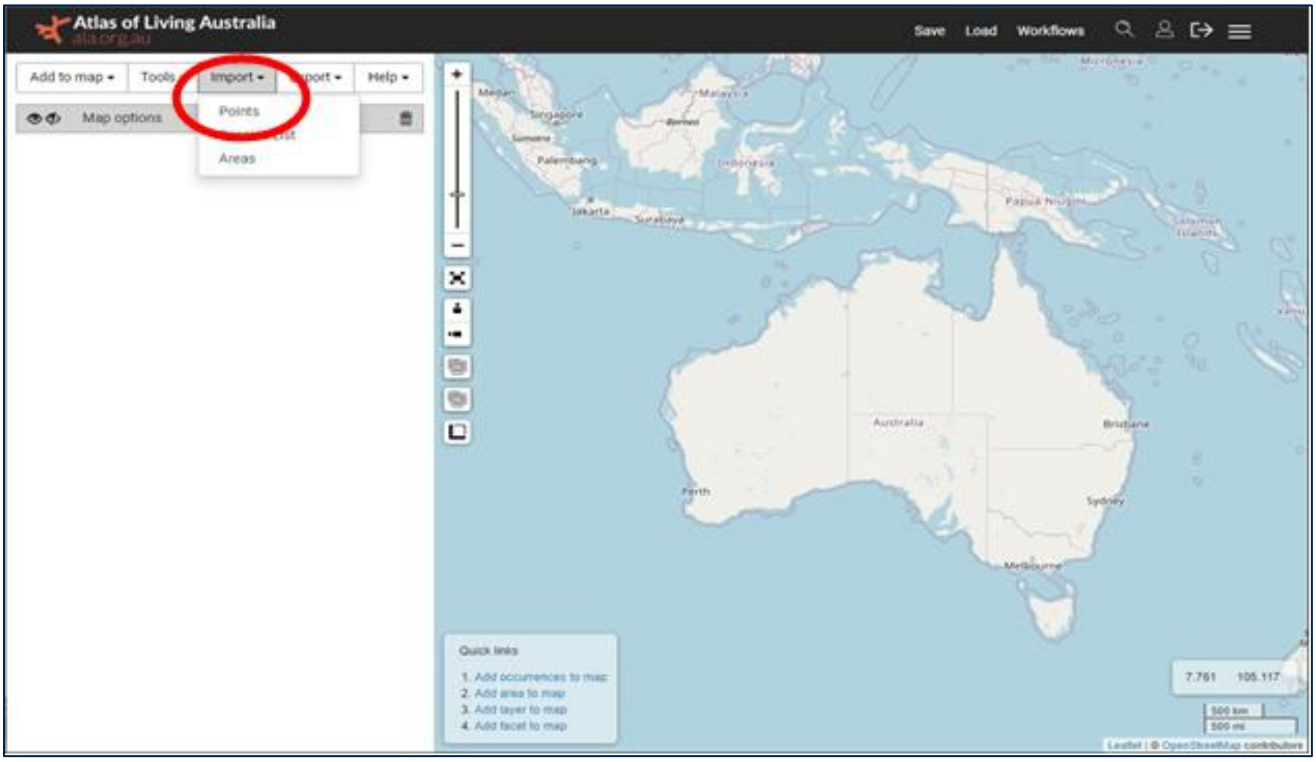


Figure 8. Screenshot of the ALA Spatial Portal. Nominators must import points by loading cleaned records saved as a .csv to calculate EOO and AOO (red ellipse).

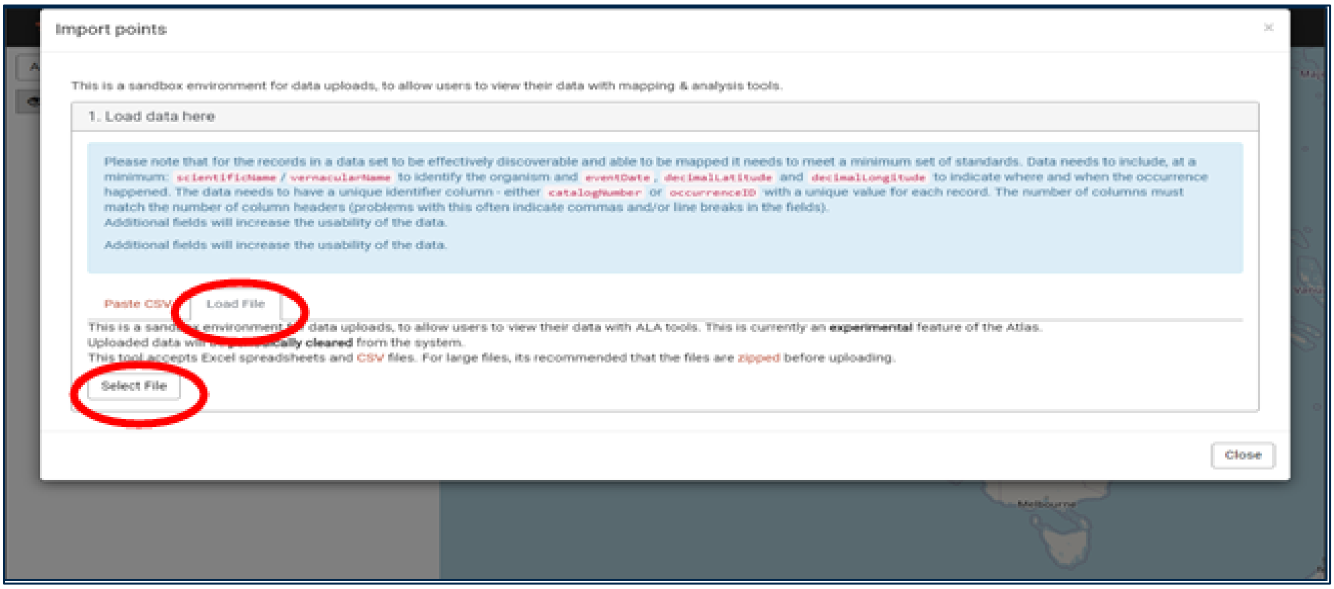


Figure 9. Screenshot of the ALA Spatial Portal. Nominators must import points by loading cleaned records saved as a .csv to calculate EOO and AOO (red ellipses).

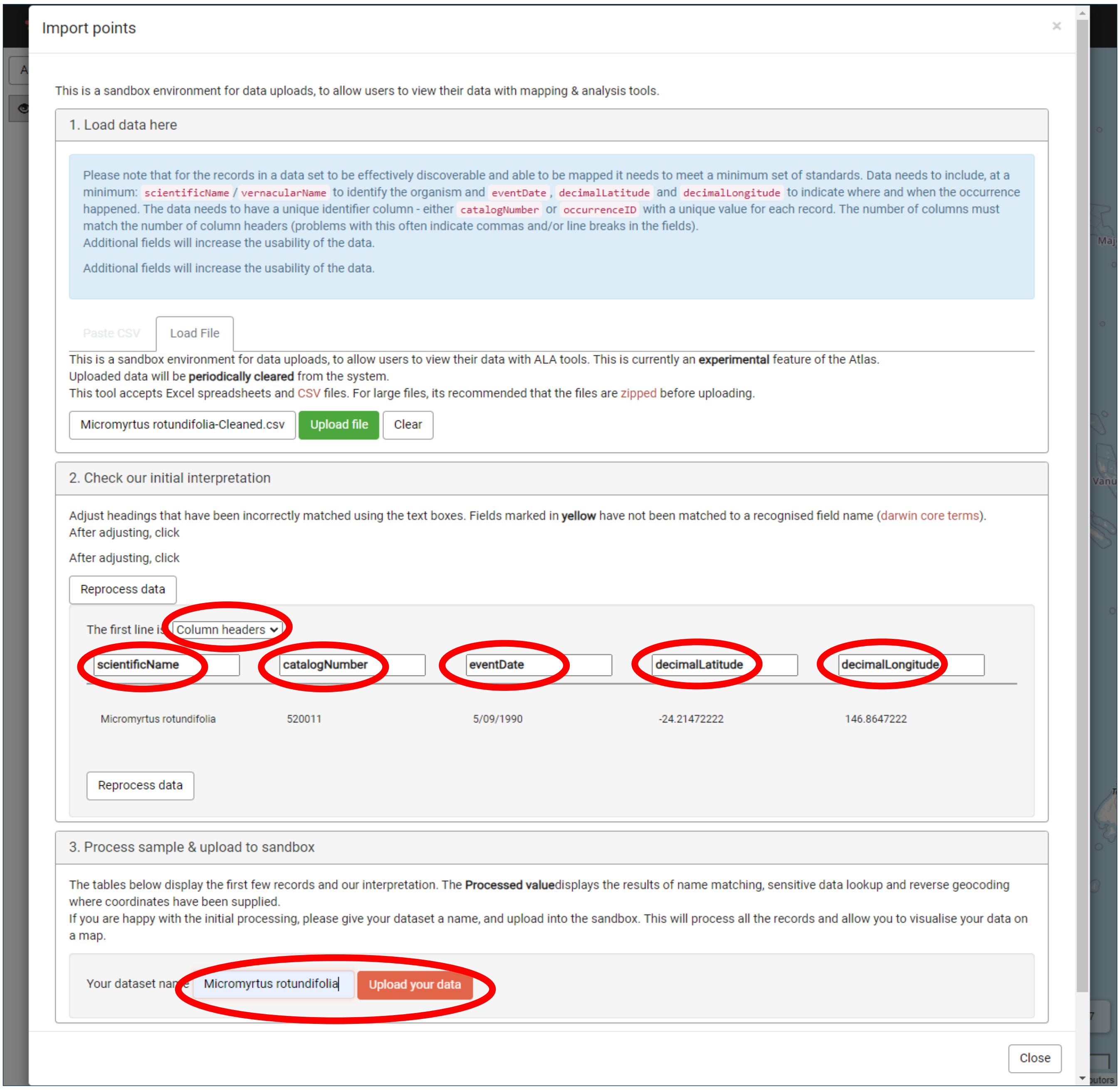


Figure 10. Screenshot of ALA Spatial Portal showing how to import cleaned occurrence data (red ellipse – bottom). Ensure data spreadsheet is in .csv format, required column headers are included and select first line is 'column headers'. Insert the species and upload the data.

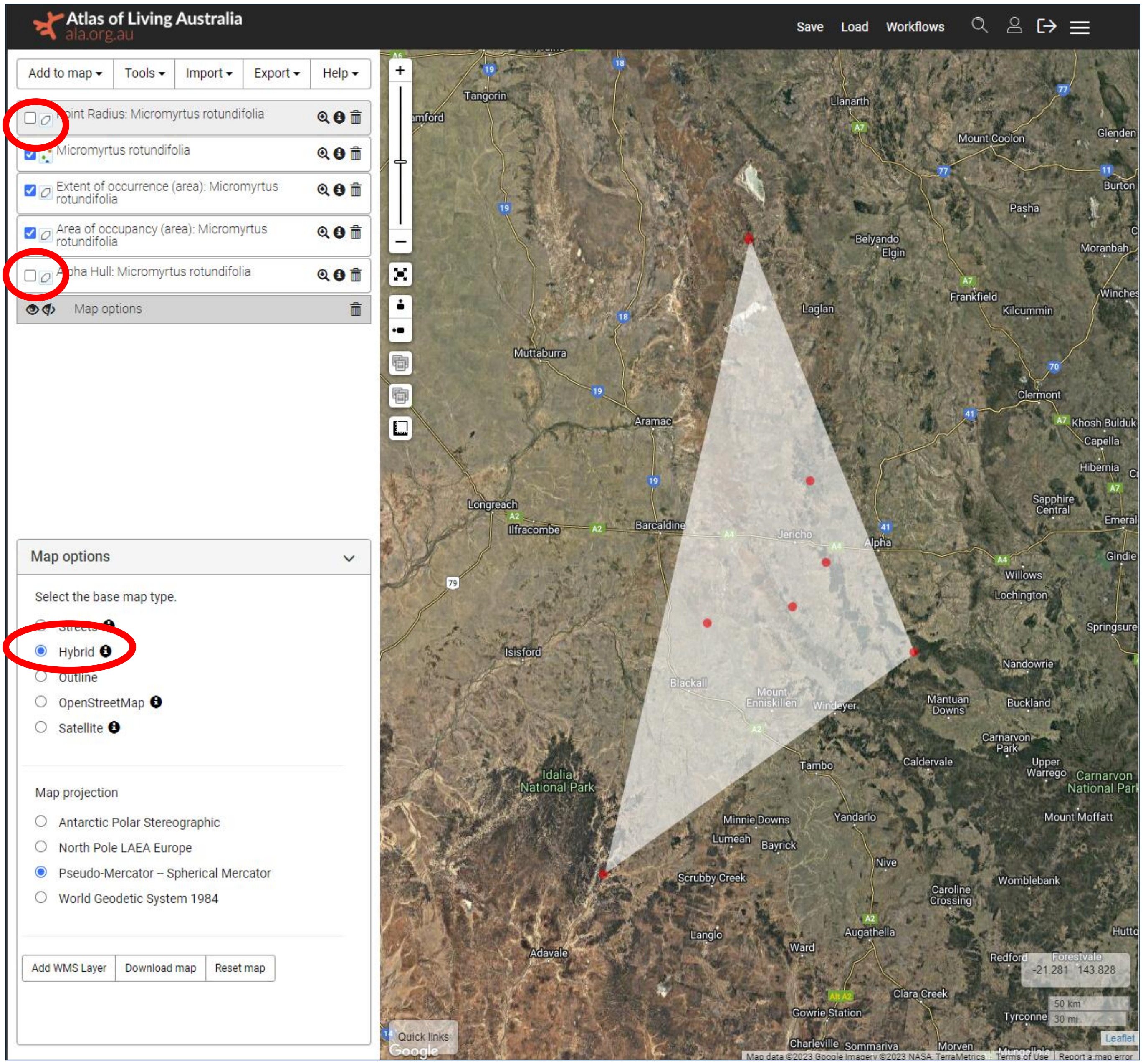


Figure 11. Screenshot of distribution map in ALA Spatial Portal, with red points overlayed on white minimum convex hull EOO and black AOO 2 x 2km grid cells for transfer into the nomination form. Deselect points radius and alpha hull and select 'hybrid' in map options, as shown in the red ellipses. Download map and metrics for inclusion in nomination form.

Appendix 4. Calculating EOO and AOO in QGIS

Understanding coordinate reference systems

Occurrence data recorded at different time periods are likely to have GPS coordinates in different coordinate systems (geodetic datum). A coordinate system represents the mathematical model defining the position of the earths sphere at a specific time. Geographic coordinate systems represent locations on the Earth's surface using a three-dimensional spherical model, defined by latitude and longitude coordinates. Common datums reported in occurrence data include WGS84, GDA94 and GDA2020. In contrast, a projected coordinate system translates this spherical surface onto a flat, two-dimensional plane with metric coordinates. Projected coordinate systems are required to calculate AOO and EOO accurately because geographic systems use angular measurements (degrees). Without projection, area calculations would be inaccurate due to the distortion of spherical geometry.

It is important that when visualising occurrence data that all point data is in the same datum, and when making any calculations for EOO and AOO that point data is projected.

Calculating EOO and AOO

Standardise geographic coordinate reference system

1. Review the geodetic datum of points within the occurrence data CSV file
    - This information may be listed under columns named 'geodeticDatum' (ALA), 'Datum' (WildNet), 'locality_datum' (BRI). Note that iNaturalist and QBEIS do not record this information, but use WGS84 and GDA2020, respectively.
2. Load occurrence data into QGIS
    - Open QGIS and go to 'Layer' → 'Add Layer' → 'Add Delimited Text Layer'.
    - Select the CSV file and specify the 'X and Y fields' (decimalLongitude and decimalLatitude).
    - For the 'Geometry CRS', choose the CRS that corresponds to the majority of the coordinates in the CSV file (e.g., WGS 84 = EPSG:4326). This will be the initial CRS for the layer.
    - Click 'Add' to load the layer into QGIS.
3. Separate the data into separate layers by CRS
    - Open the 'Attribute Table' for the layer (right-click the layer in the 'Layers' panel and select 'Open Attribute Table').
    - Identify the rows corresponding to each CRS (e.g., WGS84 = EPSG:4326, GDA94 = EPSG:4283, GDA2020 = EPSG: 7843). If the CRS is not explicitly listed in the CSV, it can usually be determined from metadata or other information.
    - Use the 'Select by Expression' tool to select rows for each CRS according to the datum column header
        - e.g. the expression using 'geodeticDatum' header: "geodeticDatum" = EPSG:4326
    - Once the rows for a specific CRS are selected, right-click the layer in the Layers panel and choose 'Export' → 'Save Selected Features As'.
    - Save the selected features as a new layer and assign the correct CRS for that subset (e.g., WGS84 = EPSG:4326, GDA94 = EPSG:4283, GDA2020 = EPSG:7844).
    - Repeat this process for each CRS in the dataset

4. Reproject all layers to a common CRS
   - For each layer, right-click and select 'Export' → 'Save Features As'
   - In the 'CRS' dropdown, choose the common CRS you want to use for all data (e.g., GDA2020 = EPSG:7844 or WGS84 = EPSG:4326).
   - Save the reprojected layer with a new name.
   - Repeat this process for all layers.
5. Merge the reprojected layers
   - Go to 'Processing' → 'Toolbox' and search for 'Merge Vector Layers'.
   - Add all the reprojected layers to the input list.
   - Choose an output file name and location, then click 'Run'.
   - The result will be a single layer with all the data in the same CRS.

The geodetic datum of the occurrence data is now consistently applied as GDA2020. This data can be used for mapping and visualisation using coordinates in degrees. However, it cannot be used to calculate EOO and AOO (or other distance values). For this, the occurrence data layer must be reprojected once more into the projected coordinate system (PCS) – see next step.

Reproject data into a Projected Coordinate System

In Queensland, there are four potential PCS datums, including Map Grid of Australia (MGA) zones (Figure 12), that can be used depending on the distribution of the species: MGA54 (EPSG:7854), MGA55 (EPSG:7855), MGA56 (EPSG:7856), and the Australian Albers Equal Area projection on GDA2020 (EPSG:9473). In general, MGA projections cover a smaller area and will be more precise for species that have distributions restricted to one or two regions. In contrast, Albers Equal Area covers the entire continent, so the model has more error, but is more suitable for species that have broader distribution.

Zone/CRS	Longitude range	QLD Bioregions
MGA54 (EPSG:7854)	138°E – 144°E	Western Queensland
MGA55 (EPSG:7855)	144°E – 150°E	Central Queensland – largest coverage
MGA56 (EPSG:7856)	150°E – 156°E	Coastal & SE Queensland
Albers Equal Area (EPSG:9473)	108°E – 156°E	All

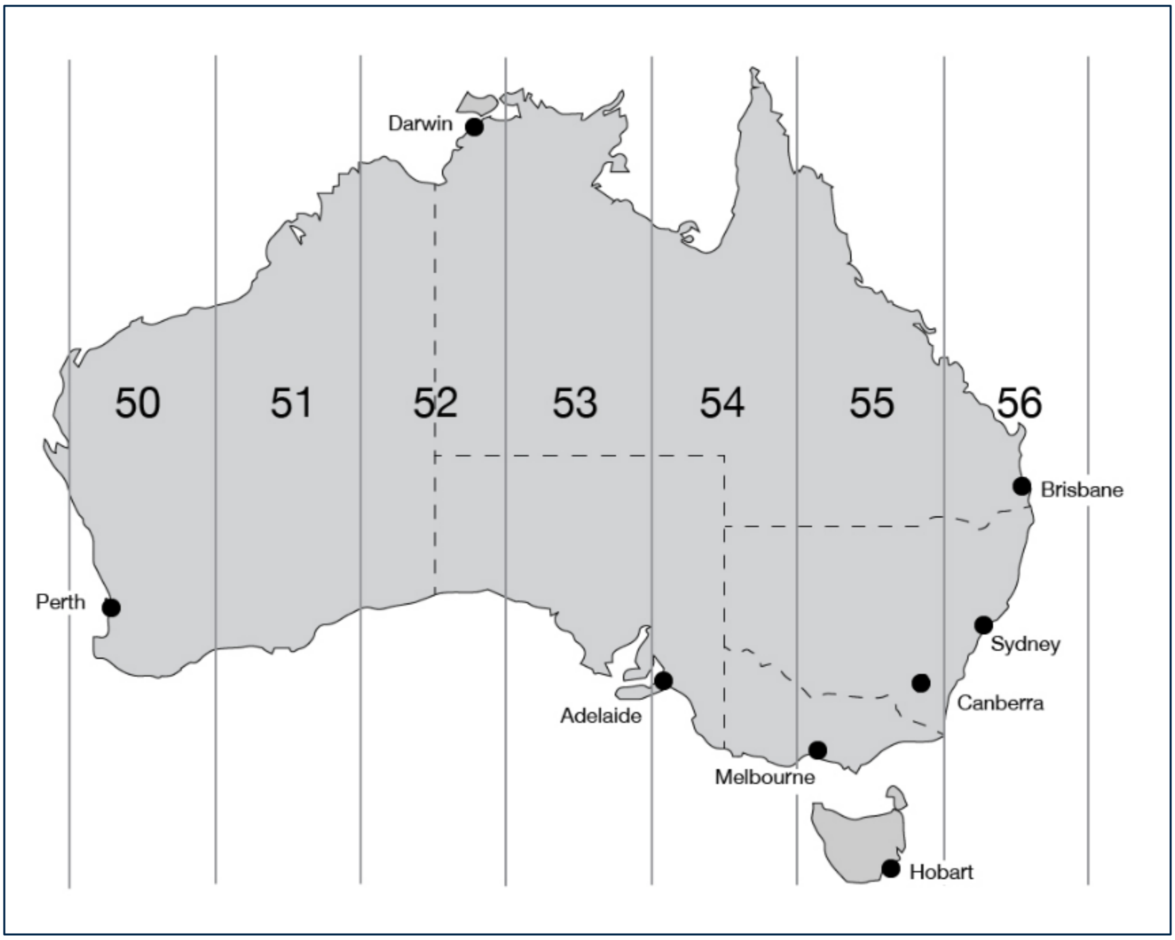


Figure 12. Map Grid of Australia showing grid zones. Sourced from https://parametricmonkey.com/2020/04/08/understanding-australias-coordinate-systems/

6. Visually define the spatial extent of the species
    - Access a basic world map layer in QGIS by expanding the ‘XYZ Tiles’ section in the ‘Browser Panel’: OpenStreetMap, Google Satellite, or others.
    - Ensure the world map layer sits below the occurrence data layer (drag to re-order).
    - Determine the general distribution of the species, and more specifically whether the occurrences exist within a single, two or more MGA zones
        - If ≥70% of points fall in one zone → use that zone
        - If ~50/50 across two zones → either is acceptable
        - If distribution spans multiple zones widely (east–west) →use Australian Albers
7. Project data into selected PCS
    - For the merged reprojected layer (step 5) select ‘Export’ → ‘Save Features As’
    - Set the CRS to the selected projected CRS (click the globe icon to search).
    - Open a new QGIS project and go to ‘Layer’ → ‘Add Layer’ → ‘Add Vector Layer’ or drag and drop the exported .shp or .gpkg file generated above to work in Eastings and Northings.
    - To confirm/verify the CRS right-click ‘Layer’ → ‘Properties’ → ‘Information’ or alternatively it is displayed in the bottom right corner of the project field.

Calculate EOO

8. In the top tab go to 'Processing' → 'Toolbox' (or click the Toolbox icon in the top bar). In the search bar, type "minimum bounding geometry" (Figure 13).
    - 'Input layer' = the projected species records;
    - 'Geometry type' = Convex Hull;
    - 'Bounding geometry' = save to file called "EOO"
    - Select 'Run' to create a scratch layer of EOO (Figure 14).
9. 'Save layer' as a shapefile: Right click the created 'Layer' → 'Export' → 'Save Features As'.
10. Click three dots next to file name bar and save layer in the species mapping folder → create folder 'EOO' → file format 'ESRI shapefile', name 'EOO.shp'. Set the 'CRS' to projected CRS (if not already). Press OK.
11. Delete the scratch layer to avoid confusion.
12. Style the EOO layer as follows: right-click on EOO layer → 'Properties' → 'Symbology' → 'Single symbology' → 'Fill' = light grey; 'Opacity' = 80%
13. Calculate EOO in km^2:
    - Select the EOO polygon layer and open 'Attribute table' (select layer, F6) and click on the 'Field Calculator' icon (Figure 15).
        - 'Output field name' = Area_km2
        - 'Output field type' = Decimal number (real)
        - 'Precision' = 4
        - 'Expression' = $area/1000000 (if working in m) OR $area (if working in km). Ensure these align with the units set earlier. When copying the value, commas may be added to the numbers; these must be deleted or it will generate an error.
    - Select OK. Extract the EOO metric from the Area_km2 column in attribute table.
    - NOTE: If you only have two records or two distinct points, a bounding geometry will not generate. If this occurs, you can buffer the points by ~1m and run the Bounding geometry tool around the buffer layer. Because the "species_records.csv" is projected, buffering should be done in meters, not degrees. To buffer the records:
        - 'Vector' → 'Geoprocessing Tools' → 'Buffer'
        - Set 'input layer' to 'species_records.csv' and 'distance' to 0.00001. Select OK to create a temporary scratch layer called 'buffered'.
        - Repeat the EOO calculation using the new 'Buffered' input layer.

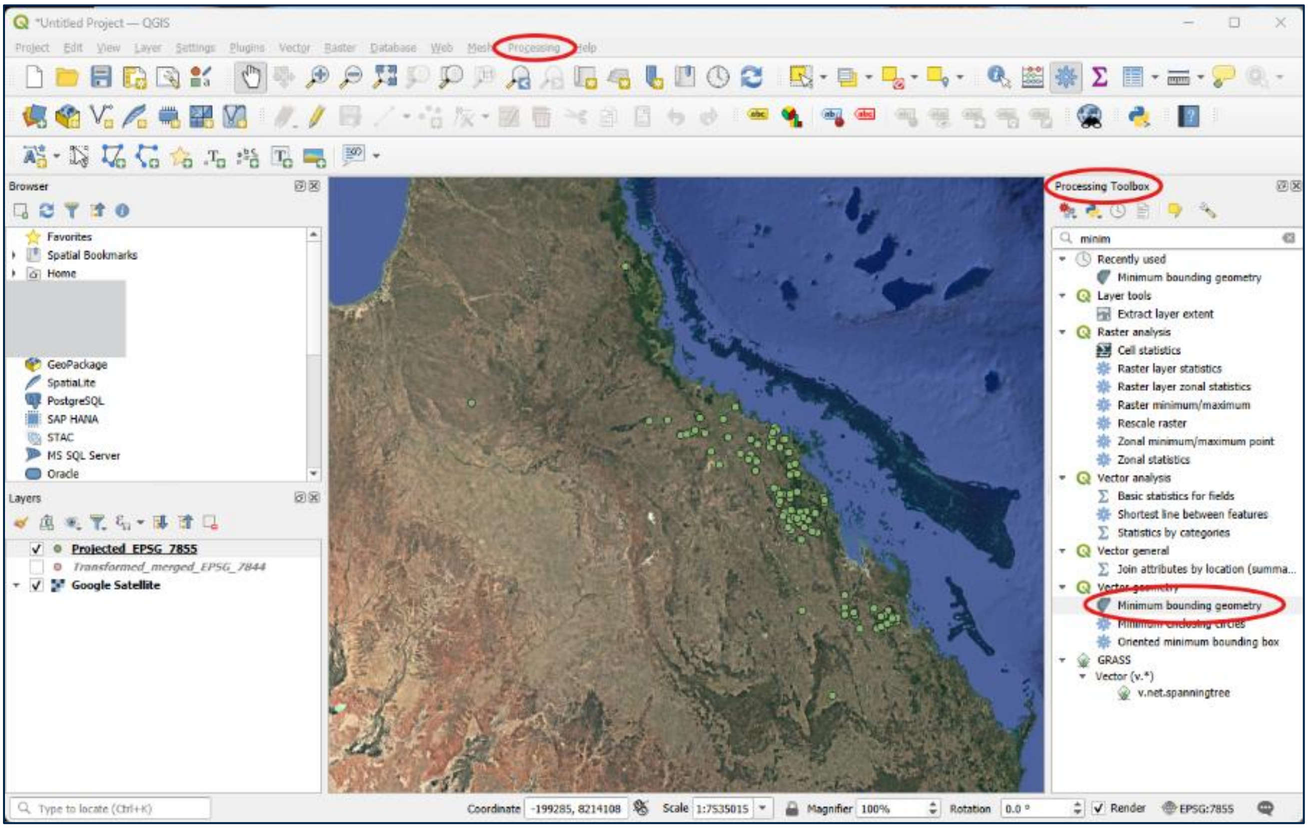


Figure 13. Screenshot demonstrating how to select the minimum bounding geometry tool to generate EOO in QGIS.

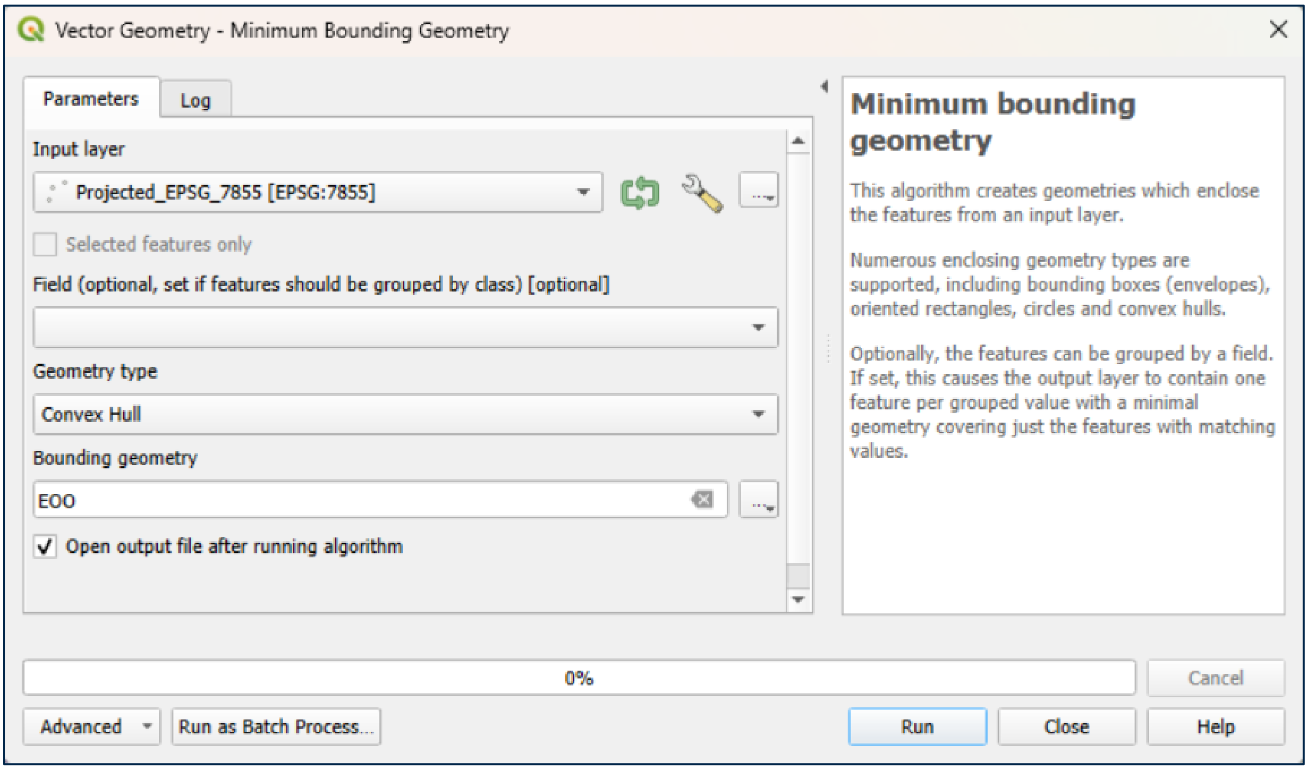


Figure 14. Screenshot demonstrating the example parameters used within the minimum bounding geometry tool to generate EOO in QGIS.

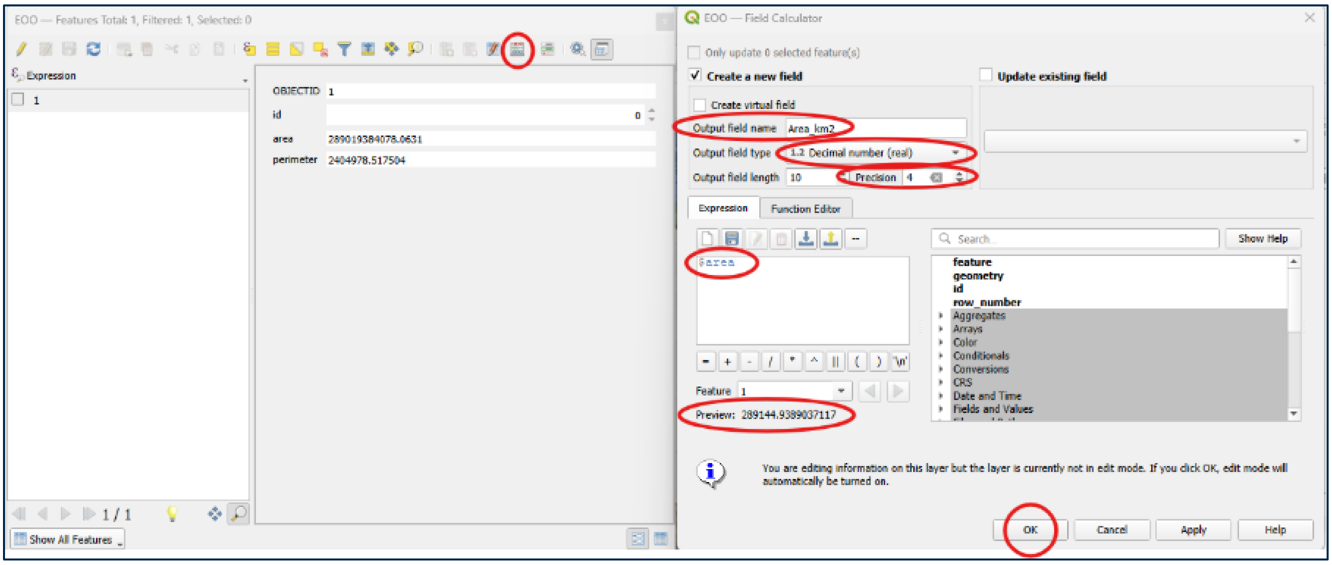


Figure 15. Screenshot demonstrating the where to source the *Field Calculator* in the *Attribute Table* to create a new output column with the calculated EOO in QGIS.

Calculate AOO

14. Create base grid using either map canvas extent, or occurrence extent (Figure 16).
    - Go to: 'Vector' → 'Research Tools' → 'Create Grid'
    - Set: 'Grid extent': 'Calculate from layer' (occurrence points or map extent); 'Spacing': 2000 m × 2000 m; 'CRS': project (projected) CRS → 'Run' grid creation
15. Translate grid by: 'Processing Toolbox' → 'Translate (Vector geometry → Translate)'
    - 'Offset X': shift east (meters) e.g. 100 m = slight adjustment
    - 'Offset Y': shift north (meters) e.g. 500–2000 m = major repositioning
        - Repeat shifting until grid alignment best captures occurrence distribution
16. Run AOO calculation (Figure 17).
    - 'Vector' → 'Analysis Tools' → 'Count Points in Polygon'
        - Select the AOO grid generated in previous step for 'Polygon' and select the species records for 'Points'. Select 'Run' to generate a 'Count' scratch layer
    - Evaluate occupied cells by opening Attribute Table
        - For few records: Sort by 'NUMPOINTS' column (click on the column title), then manually select all entries of 1 or more.
        - For many records: Click on select/filter icon (or press Crtl+F). Then, filter and select all grid cells with NUMPOINTS <0 (i.e. a species occurrence in that grid cell) by entering 0 in NUMPOINTS bar and selecting 'Greater than (>)' from the drop-down menu. Then click 'Select features'.
        - Export the selected features (highlighted in yellow) as an AOO layer:
            - Left-click the generated scratch layer 'Count' → 'Export' → 'Save Selected 'Features As'.

- Click three dots next to file name bar and save layer in the species mapping folder → create folder 'AOO' → file format 'ESRI shapefile', name 'AOO.shp'. Set CRS to project projected CRS.

- To calculate the AOO area, click the 'Show Statistical Summary' icon in top bar Σ (opens below layers on left) → 'Statistics' = AOO layer → select attribute 'id'. The statistic 'Count' is the number of occupied grid cells. Each cell is equal to 4 km^2 (i.e. 2 x 2 km grids), so <u>multiply the number of occupied cells by 4</u> to obtain the AOO area value.

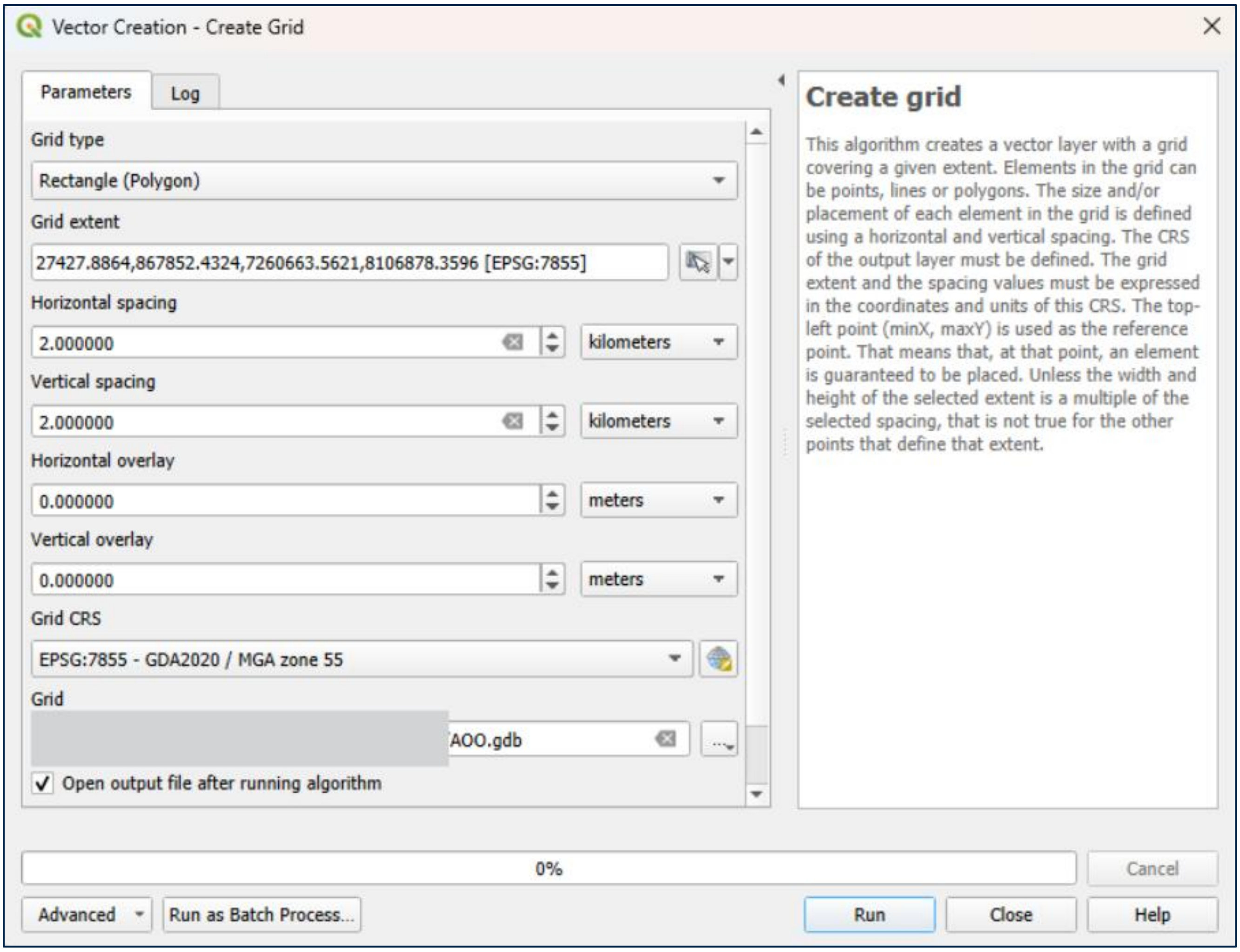


Figure 16. Screenshot demonstrating the parameters used within the *Create Grid* tool in the first step to calculating AOO in QGIS.

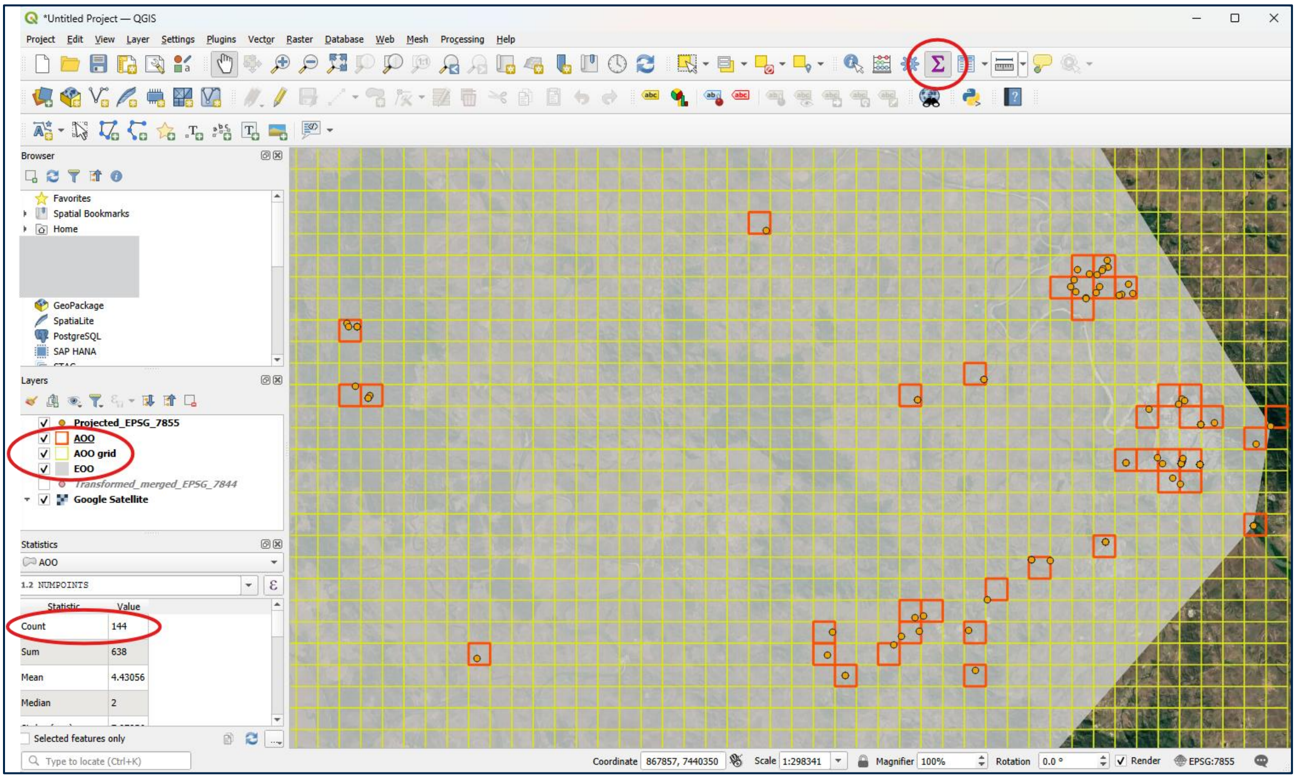


Figure 17. Screenshot demonstrating the output from *Create Grid* in QGIS: the yellow grid across the map extent and the 2x2km² squares occupied by occurrences in red. The number of occupied squares is displayed within the *Statistics* field (Σ). Multiply the count by 4 to get the AOO.

Appendix 5. Spatial characterisation of species distribution in Queensland Globe and QGIS

Queensland Globe

Follow these steps to create relevant maps that display the geographical context of the species in Queensland Globe:

- Rename the decimalLatitude and decimalLongitude columns as 'latitude' and 'longitude', respectively. Ensure there are no blank columns or rows in the datasheet.
- Import species records ('Layers' → 'Add my data → Each row as point → 'Import) (Figure 18).
- Change colour so they are visible – orange with black outline and 100% fill opacity is recommended (Figure 19).
- Explore relevant layers that can be used to describe the spatial context of the species' distribution.
- 'Layers' → 'Add layers' (Figure 18).
    - 'Boundaries' → 'Cultural Heritage party boundary'
    - 'Biota' → 'Regional Ecosystem Mapping' → 'Biodiversity Status – pre-clear'
    - 'Biota' → 'Regional Ecosystem Mapping' → 'Biodiversity Status – remnant'
    - 'Economy' → 'Production Permits' → 'select all'
    - 'Environment' → 'Nature Refuge + Parks'
    - 'Environment' → 'Parks' → 'Protected areas and forests'
    - 'Planning Cadastre' → 'Land Use'
    - 'Planning Cadastre' → 'Land parcels'
    - 'Society' → 'National native title tribunal' → 'Indigenous land use agreements'
- Change the base map as required to enhance the visibility of some layers (e.g., change the base map layer to 'base map grey' or 'base map topographic' to display mining lease tenure more clearly.
- Take screenshots of relevant maps. Before taking a screenshot, *reduce the size and shape of the web-browsing window to be similar to the size of the nomination form box.* This will ensure the map labels are displayed at a size that can be read.
- Be sure to capture scale bar + legend in screenshot.

Important considerations

- Most of Queensland is covered in exploration permits for resource extraction. It is appropriate to consider 'exploration permits' as a future potential threat, and 'mining leases' as a current/future-actual threat.
- Layer descriptions and metadata are available within the Queensland Spatial Catalogue.
- GeoRes Globe can provide a useful alternative to Queensland Globe for reviewing mining context.
- If the 'Cultural Heritage Boundary' layer does not provide adequate information to determine the Traditional Owners, please refer to the map provided by the Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS) or refer to any relevant National Park management plans that may contain information about Traditional Owners.

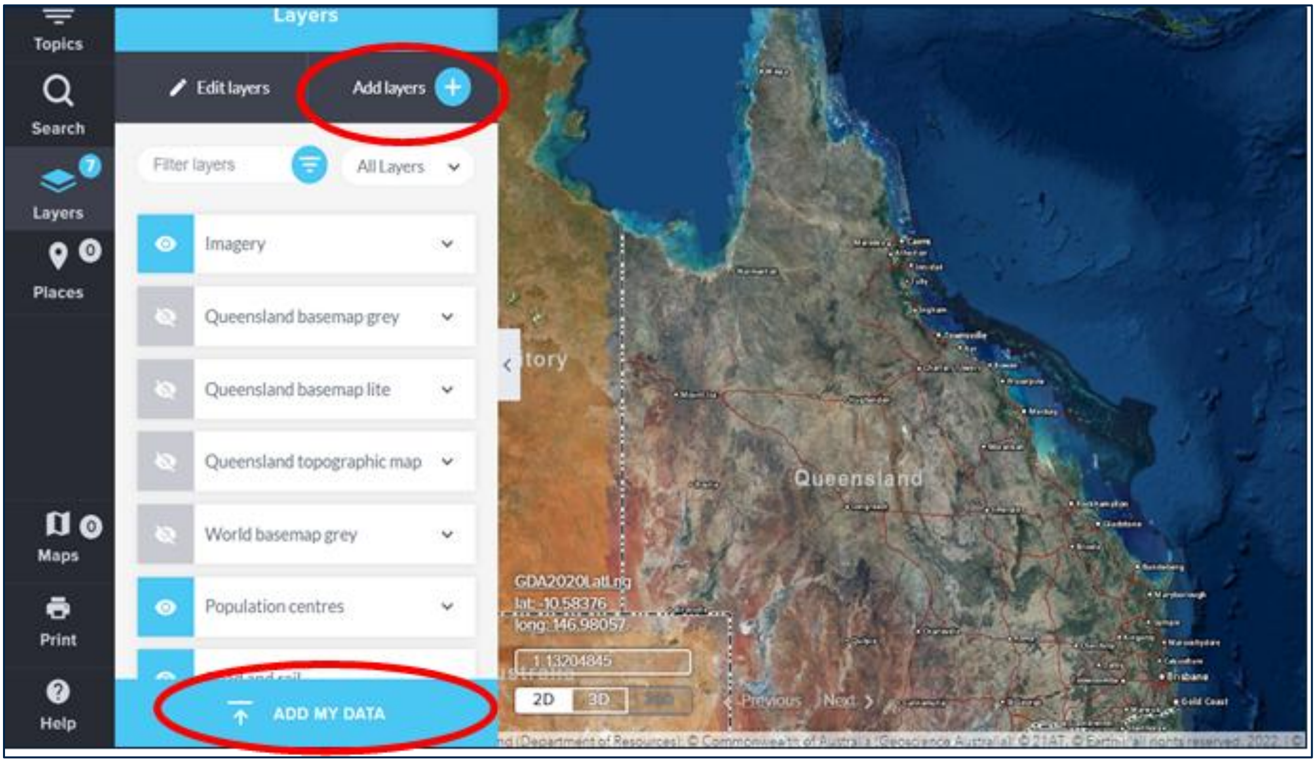


Figure 18. Screenshot demonstrating how to add data and layers in Queensland Globe (red ellipses).

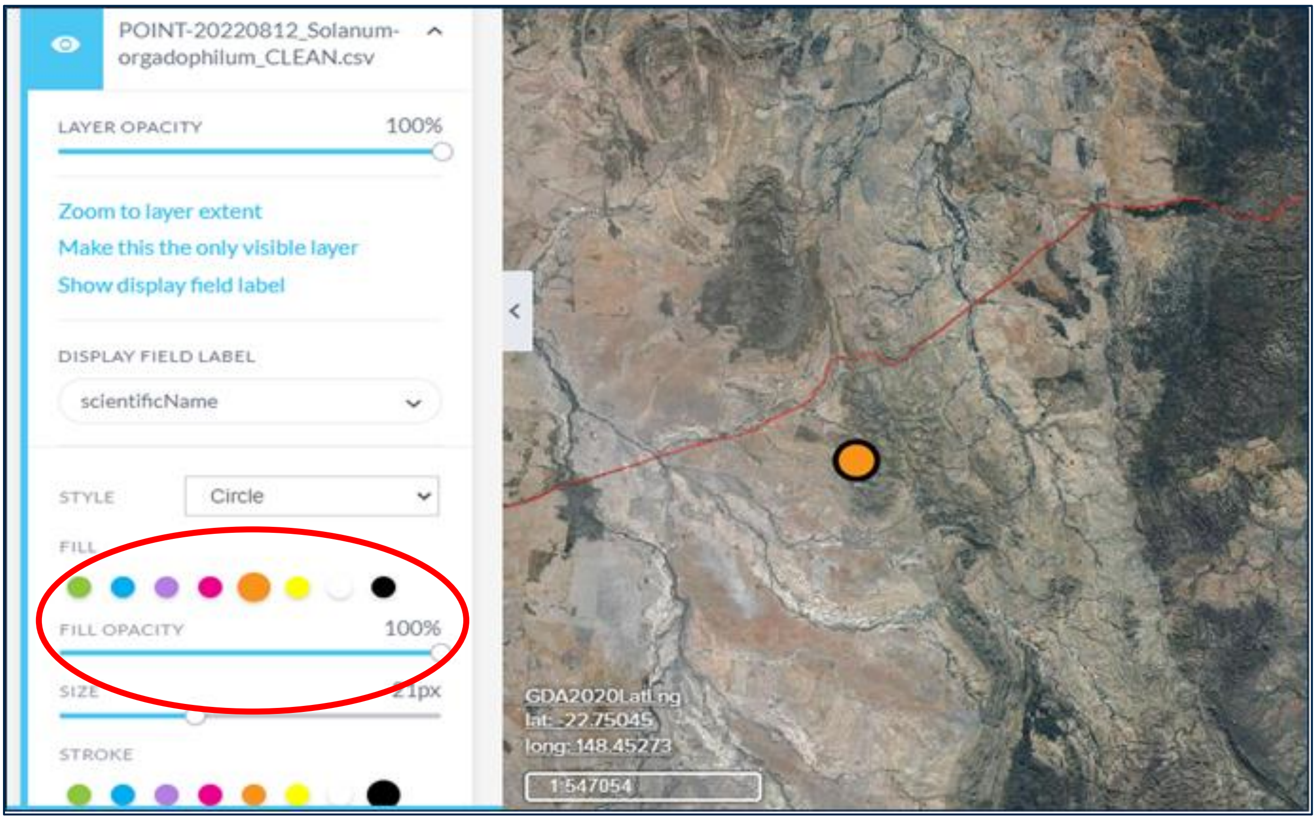


Figure 19. Screenshot demonstrating how to change the colour and size of occurrence records in Queensland Globe (red ellipse).

QGIS

In QGIS, to create relevant maps that display the geographical context of the species, nominators can use the projected data (meters) or the geographic data (degrees) in another project file. Relevant spatial layers can be obtained from the QSpatial catalogue and are the same as those suggested for view in QGlobe (above). A detailed list of relevant spatial layers are provided below.

Follow these instructions to download spatial layer data in QSpatial:

- In QSpatial, create a public login account.
- Then search the spatial data of interest (Figure 20).
- If the data exists in the search page list it can be downloaded by clicking the 'Download dataset' option below the dataset information, or if via the 'download dataset' option to the right of the screen on the data page.
- In the 'request download' pop-up (Figure 21), select the file type to download; either a geodatabase .gbd, or a shapefile .shp. Then, select the appropriate CRS want the data in, which should align with the CRS of the datapoints (i.e. whichever projected MGA zone or GDA2020 geographic 2D [EPSG:7844]).
- The request will be sent and the available download sent to the elected email address.

Suggested spatial layers:

- Relevant bio region and sub-region: Biogeographic sub regions - Queensland
- Habitat description and status: see here for guidance on description and here for the result of analyses using these spatial layers.
    - Biodiversity status of pre-clearing and 2021 remnant regional ecosystems - Queensland series
        - Categorise layer by 're' for regional ecosystem, 'bd_status' for biodiversity status, 'vm_poly' for vegetation management class, and 'dbvg1m' for dominant vegetation
        - For the full description of regional ecosystems, download the latest Regional Ecosystem Description Database.
    - Wetland data - version 7 - Queensland series
- Land use by urban services, energy and mining, agriculture, state forests and national parks are of particular interest
    - Land use mapping series
    - Grazing land management land types V7
- Impact of wild and planned fire:
    - Sentinel-2 Queensland Fire Scars Series
    - Landsat fire scars Queensland series
    - Fire regime - Queensland series
    - Bushfire prone area - Queensland series
    - Fire Extent and Severity 2019-2020 - South East Queensland
- Protected areas

- Collaborative Australian Protected Areas Database (CAPAD) 2024
- Matters of state environmental significance - Queensland series
- Protected areas of Queensland series
- High value regrowth 2021 - Queensland
- Fish habitat areas - Queensland
- World Heritage Areas of Queensland
- Map of Queensland wetland environmental values

- Energy, mining, and forestry impacts
  - Queensland mining and exploration tenure series
  - Queensland borehole series
  - Forest areas - Queensland series
  - Forest plantation licence areas - Queensland
- Pests and pathogens
  - Plant biosecurity zones - Queensland series
  - Queensland Weed Distribution Current
  - Queensland pest distribution survey series
- Other layers useful for context
  - Cultural Heritage Data - Queensland series
  - Geographic features - Queensland series
  - Hydrographic features - Queensland series
  - Contours - Queensland - series
  - Vegetation Management Act series
  - Water resource management features - Queensland series
  - Drainage basin sub areas - Queensland
  - Groundwater dependent ecosystems and potential aquifer mapping - Queensland

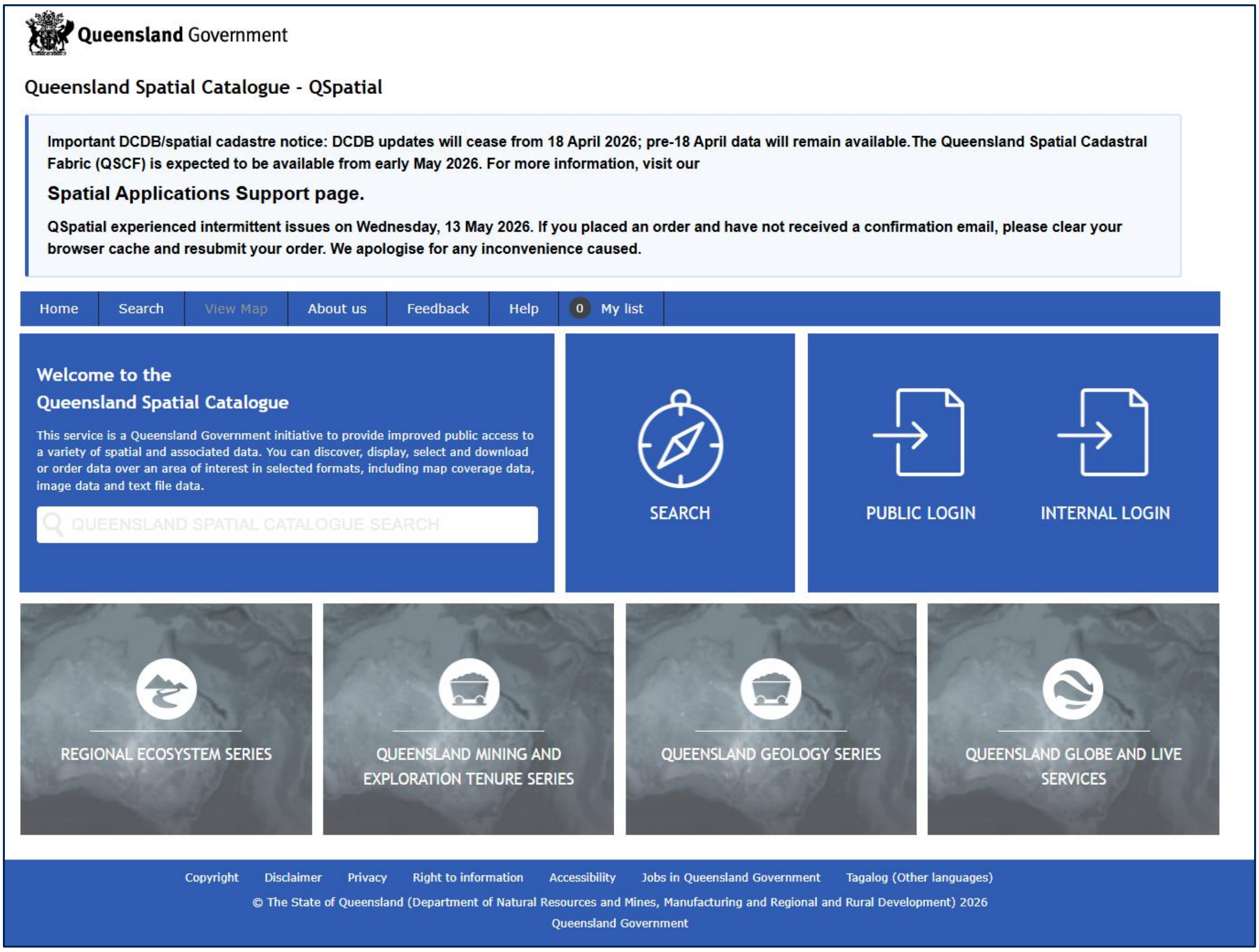


Figure 20. Queensland Spatial (QSpatial) Catalogue interface

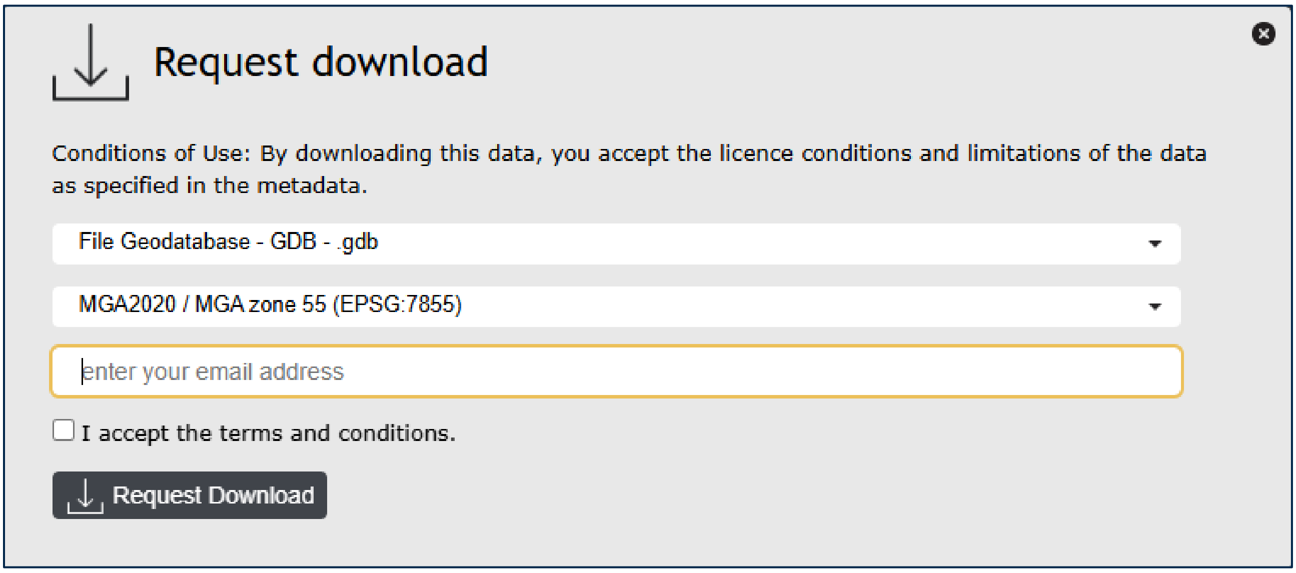


Figure 21. QSpatial download pop-up with example parameters. Select CRS suitable to data.

Appendix 6. Example questions for expert consultation

- **Distribution:** Has the species been well surveyed? Is it accurately represented by the distribution map provided? Is it likely to be overlooked in the field? If so, why? Is the species likely to still be present at all sites?
- **Population size:** Can you provide a population size estimate based on the number of mature individuals? These are the thresholds we use in the assessment: <50, 50-250, 250-1,000, 1,000-2,500, 2,500-10,000, 10,000-20,000.
- **Generation length:** Do you know when the species would become reproductively mature (under normal conditions), and how long it lives for? A range of values is useful if you are unsure.
- **Habitat:** My current understanding of the habitat is [insert habitat requirements here]. Would you agree with this?
- **Disturbance ecology:** Can you provide any information on how the species would respond to disturbances such as fire, cyclones and flooding? Would these events typically kill the species? Would it recover well thereafter?
- **Dispersal:** What are the likely pollinators and seed dispersal mechanisms? (flora only)
- **Reproduction:** What are the conditions needed for breeding? (fauna only)
- **Threats:** What are the key threats? Do they impact all subpopulations in the same manner? Do you think the population is declining due to these threats? Do you know of any data to support this?
- **Recovery actions:** Are there current recovery actions or monitoring for the species? Can you recommend any additional actions?

Appendix 7. Potential conservation/threat abatement actions

(Adapted in part from DAWE, 2021).

IUCN threat category	Example recovery actions
Residential and commercial development	• Ensure the species and its habitat are adequately represented in the protected area estate. Investigate options to protect additional habitat under appropriate conservation covenants. • Prior to any land clearing, ensure thorough targeted surveys are undertaken by a suitably qualified person to identify occurrences of the species so that adequate mitigation can be undertaken. • Raise awareness of the species with the local community to encourage stewardship activities, such as habitat improvement via weeding, erosion control etc. • If any individuals are likely to be directly impacted by residential/commercial development, ensure they are adequately represented in an *ex-situ* conservation collection.
Agriculture and aquaculture	• If livestock grazing occurs in the area, landowners/managers to use an appropriate management regime and stocking density that does not detrimentally affect this species and manage total grazing pressure at important sites through exclusion fencing or other barriers. • Develop and implement a stock management plan for <SPECIES> for roadside verges and travelling stock route. Distribute this information to drovers and graziers in the area to increase awareness of the species' requirements. • Does the species require a specific % of ground cover (i.e., some birds and reptiles)? If so, add a conservation action to retain or enhance cover. • Undertake extension/awareness activities to inform landholders of the presence (or potential presence) of the species, with the aim of collaborating to protect the species and its habitat.
Energy production and mining	• Ensure the species and its habitat are adequately represented in the protected area estate. Investigate options to protect additional habitat under appropriate conservation covenants. • Prior to any land clearing, ensure thorough targeted surveys are undertaken by a suitably qualified person to identify occurrences of the species so that adequate mitigation can be undertaken. • If any populations are likely to be directly impacted by energy production/mining, ensure they are adequately represented in an *ex-situ* conservation collection.
Transportation and service corridors	• Ensure the species and its habitat are adequately represented in the protected area estate. Investigate options to protect additional habitat under appropriate conservation covenants. • Prior to any land clearing, ensure thorough targeted surveys are undertaken by a suitably qualified person to identify occurrences of the species so that adequate mitigation can be undertaken. • If any populations are likely to be directly impacted by transportation corridors, ensure they are adequately represented in an *ex-situ* conservation collection.

Biological resource use	Timber harvesting • For target species – Investigate and establish sustainable take levels (if any) to ensure the species' population persists in the long term. • For non-target species – Ensure logging is excluded from areas where the species occurs in <STATE FOREST NAME>. Determine a suitable buffer around occurrences of the species from which to exclude logging activities and prevent direct and indirect damage to the species and its habitat. • Incorporate <SPECIES> into the management plan for <STATE FOREST NAME>. • Ensure all contractors are aware of the species' presence, and their obligations to protect it. • Precisely map the occurrences of the species throughout <STATE FOREST NAME> to guide management actions. Illegal take (overfishing, illegal seed/plant/animal collection) • Undertake education and awareness activities to communicate the detrimental impact that illegal take has for the species. • Investigate the suitability/feasibility of reinforcing the wild population with translocated individuals. Ensure disease and genetic implications are carefully managed. • Ensure genetic diversity from areas targeted by poachers is adequately represented in ex situ conservation collections.
Human intrusion and disturbance	• Prevent habitat disturbance. Control access routes by installing gates/fences to suitably constrain <STOCK/VEHICLE/PUBLIC> access to known sites on public land and manage access on private land or other land tenures. • Improve the management of stream flows, water quality and riparian environments throughout catchments of existing and potential sites by… • Protect and rehabilitate riparian vegetation <OR OTHER KEY HABITAT> by… • Ensure land managers are aware of the species' occurrence and implement protection measures against key and potential threats.
Natural system modifications – fire	• Fires must be managed to ensure that prevailing fire regimes do not disrupt the life cycle of <SPECIES>, degrade the habitat of the species, promote invasion of exotic species, or increase impacts of grazing/predation. • Physical damage to the habitat and individuals of the <SPECIES> must be avoided during and after fire operations. • Fire management authorities and land management agencies should use suitable maps and install field markers to avoid damage to <SPECIES>. • Undertake active weed control after fire management along urban roadsides. *For orchids and other geophytes* Ensure that prescribed fires occur only within the habitat during the dormant phase of the <SPECIES> life cycle. *For obligate seeding shrubs (serotinous obligate seeding shrubs are a small subset of genera that release seed in response to fire rather than spontaneously at seed maturation and include some Eucalypts, Hakea, Banksia, Melaleuca etc.)* • Ensure that fires do not occur within populations before an accumulation of a

	seedbank large enough to replace the number of fire-killed standing plants. Replacement estimates should incorporate expected post-fire rates of seedling survival. • Ensure that intervals between successive fires account for the longevity of the standing plant population, noting that serotinous seedbanks are unlikely to persist longer than the standing plant population. • Ensure that fires are sufficiently intense to trigger complete seed release from the serotinous fruits (i.e., by ensuring canopy combustion) and to trigger optimal germination. *Woody resprouting plants* • Avoid successive fire intervals that are shorter than the period required for burnt individuals to resprout and adequately recover. *Fire-killed long-lived plant species, or species that occur in communities dominated by them (e.g., alpine, rainforest and subalpine plant communities)* • Ensure fuel reduction and other planned fires are not implemented at the site. • Where appropriate, employ fuel reduction activities and other protective measures at strategic locations nearby to reduce the potential adverse impacts of wildfire on the species' population, but ensure these are well planned and implemented and do not constitute an increased risk (e.g., through escape of planned fires), and are of low intensity. *Groundcover-dependent vertebrates* • Ensure that a high proportion of the habitat is maintained with a post-fire age sufficient to provide adequate cover (or habitat) to the threatened species. • Ensure immediate and ongoing post-fire predator control within the habitat when fires do occur. • Ensure grazing by introduced herbivores is minimised or excluded post-fire until adequate vegetation recovery has occurred. • Ensure that areas of dense ground cover/leaf litter are retained within the habitat when prescribed fires are implemented. Reduce the frequency of high intensity fires to retain hollow logs and large woody debris on the ground. *Arboreal mammals and hollow-dependent birds* • Reduce the frequency of high intensity fires to limit the loss of hollow-bearing trees, and/or minimise bottlenecks in the recruitment of young trees to larger size classes. • Reduce the intensity of fires so that the canopy (and associated nesting sites) is retained during/after fire events. • Investigate the option to install carefully designed (species-specific) nest boxes if there is a shortage of hollows in some areas. *Seed-eating animals* • Manage fire to produce a fine-scale mix of vegetation of different ages (time-since fire), including some relatively long-unburnt vegetation. *Nectivorous animals and other canopy feeders* • Reduce the frequency of high intensity fires that affect the timing and volume of flower production, and the canopy foliage. *Habitats in which invasive grasses and forbs are a threat*

	• Minimise use of prescribed fire and follow up with appropriate weed control. • For tropical and arid-tropical areas, use prescribed fire after invasive grass seed has germinated and before seed set has occurred to control invasive annual grasses. *Habitats in which invasive (exotic or native) shrubs or trees are a threat* • Where appropriate, use prescribed fire to manage the density and/or abundance of invasive species that may reduce the suitability of habitat for the species. • Where appropriate, use manual or chemical control methods as an alternative to prescribed fire. This should consider the probability of invasive species germinating in response to physical disturbance of soils. *For species with few individuals or single populations* • Avoid any management or research activities that may negatively impact the persistence of the population.
Invasive and other problematic species, genes and diseases	*General* • Develop and implement strategies to control predation by the <INVASIVE SPECIES>, as detailed in the relevant Threat Abatement Plans or management strategies. • Implement measures to monitor for and identify <INVASIVE SPECIES>. • Implement suitable hygiene protocols to protect known subpopulations from outbreaks of <DISEASE/PARASITE – scientific/common name> • Ensure appropriate hygiene protocols are adhered to when entering or exiting sites for survey, monitoring or management such as those outlined in the Arrive Clean, Leave Clean Guidelines (Commonwealth of Australia, 2015). *Disease - phytophthora (Phytophthora cinnamomi)* • Implement a *P. cinnamomi* management plan to ensure that it is not introduced into uninfected areas where the species occurs, and that the spread in areas outside of, but adjacent to the population is mitigated. • Ensure that appropriate hygiene protocols are adhered to when entering or exiting the known location of <SPECIES>, such as those outlined in Podger et al., (2001). • Implement a hygiene management plan and risk assessment to protect known populations from further outbreaks of *P. cinnamomi*. This may include but is not limited to ensuring contaminated water is not used for firefighting purposes; contaminated soil is not introduced into the area as part of restoration, translocation, infrastructure development or revegetation activities; all areas where <SPECIES> is known to occur that are free of *P. cinnamomi* are sign posted and hygiene stations are implemented and maintained. • Implement mitigation measures in areas that are known to be infected by *P. cinnamomi,* this may include but is not limited to application of phosphite ($H3PO3$), noting the potential deleterious effects as a fertiliser with prolonged usage. *Disease - chytrid fungus (Batrachochytrium dendrobatidis)* Nominators should refer to actions in the Threat abatement plan for infection of amphibians with Chytrid fungus resulting in Chytridiomycosis (Commonwealth of Australia, 2016). *Disease - myrtle rust (Austropuccinia psidii)*

	Nominators should refer to the recovery actions outlined in Myrtle rust in Australia: a national action plan (Makinson et al., 2020) when considering recovery actions for myrtle rust-impacted species. Examples include: • *Follow the recommendations and actions outlined in Myrtle rust in Australia: a national action plan (Makinson et al., 2020). This should include…<INSERT RELEVANT ACTIONS HERE>* • *Engage with experts on the pathogen and species to ensure a coordinated response to the impact of myrtle rust on this species.* *Predators and feral herbivores* Nominators should refer to relevant threat abatement plans for key predators and feral herbivores. If relevant add an action about the need to consider the impact of fox and cat control post any burn or large rain event. • Ensure immediate and ongoing post-fire predator control within the species' habitat. • Protect vulnerable subpopulations from grazing/browsing pressure after fire events through targeting culling or enclosure fencing. *Invasive weeds* Nominators should refer to relevant threat abatement plans for invasive weeds. • Identify and remove new weeds or undertake weed control (identify which is relevant) in the local area that could become a threat to the species, using appropriate methods. Consider the possible disturbance/overspray threats associated with the control method.
Pollution	• Investigate options to limit or manage pollution to minimise impacts on the species. • Liaise with key stakeholders to develop a management strategy to address the negative impacts of pollution on the species. • Undertake extension and awareness activities to ensure key stakeholders are aware of the negative impacts of pollution on the species.
Geological events	• Develop a management strategy to guide recovery actions for the species after significant weather/geological events. • Establish an *ex-situ* subpopulation/seed bank/conservation collection that represents the maximum range of genetic diversity possible.
Climate change and severe weather	• Undertake research to better understand the conservation genetics of the species. Specifically, determine if the species demonstrates genetic sub structuring; the effective population size based on genetic variation; and whether some genetic variation is already infrequent or at threat of extinction. • Undertake research to better understand the biology and ecology of the species, and the implications that climate change may have for the species. • Establish an *ex-situ* population via seed banking or propagation for conservation and research, ensuring the maximum range of genetic diversity possible is represented

Recovery actions grouped by theme (i.e., these may apply to multiple threats and should be repeated against all relevant threats in the nomination form where applicable).	
Ex situ conservation (For plants)	Ex-situ conservation collections/populations should be considered when there is a high extinction risk to the species in the wild. Translocations should always follow best-practice guidelines, and these should be referenced in the listed recovery actions accordingly. • Establish plants in cultivation in appropriate institutions such as botanic gardens. • To manage the risk of losing genetic diversity, undertake appropriate seed and storage in long term custodial collections until no longer needed and determine viability of stored seed. Best practice seed storage guidelines and procedures should be adhered to and seek to maximise seed viability and germinability. Seeds from all natural populations to be collected and stored. • To manage the risk of losing genetic diversity, undertake seed collections and store at appropriate institutions. Seeds from as many wild plants as possible across the majority of wild subpopulations should be collected and stored. • If deemed appropriate, undertake conservation translocations in suitable habitat with secure land tenure, to increase the number of subpopulations of <SPECIES>, in accordance with the *Guidelines for the translocation of threatened plants in Australia* (Commander et al., 2018) OR equivalent guidelines for fauna.
Stakeholder engagement / community engagement (relevant to many threats)	Stakeholder engagement/extension activities should be included where a species is not wholly protected in conservation estate. Prior to listing actions regarding stakeholder engagement, nominators should identify the relevant stakeholders (e.g., Traditional Custodians, landholders, public land managers, drovers (travelling stock routes), industry (e.g., mining, fishing), the general public (for high profile species), NGOs, and/or developers. Nominators should then determine the objectives for any public engagement (e.g., to improve management on private land, to avoid negative publicity, to ensure recent scientific knowledge is incorporated into public land management). Separate engagement processes (and thus recovery actions listed in the nomination form) will likely be required where there are different objectives. • For small populations – prepare a <SPECIES/WEED/FERAL PEST/DISEASE> management strategy with input from local experts or <OTHER STAKEHOLDER(S)>. Work with <STAKEHOLDERS> to implement the management strategy. • Actions must be stated for each engagement process identified (e.g., Indigenous engagement/consultation, a specific community/ landholder consultation). • Engage and involve Traditional Custodians in conservation actions, including the implementation of Indigenous fire management and other survey, monitoring and management actions. • Ensure information on <SPECIES> and their habitat is shared between state forest managers and government scientists. New population data and research should be available to all stakeholders to continue to implement best-practice land management that minimises the impacts of potential threats on the species. • Where research identifies potential habitat for the species in areas that are privately-owned, liaise with landholders to provide information on the species and its habitat requirements, and encourage reporting of any sightings. • Increase the recognition and support for the species' recovery by disseminating information on the species and its conservation status to the public.

Survey and monitoring priorities	*Time-series monitoring* Time-series monitoring is critical for detecting changes in population over time and therefore discerning whether the population is responding positively or negatively to threats and threat abatement actions. Consider including a recovery action related to time-series monitoring under any relevant threats where data is required to understand the threat or the species' response to the threat more comprehensively. • Design and implement a time-series monitoring program (or if appropriate, support and enhance existing programs) to determine population size and trends in population demographics in relation to threats and management actions. Use data to assess population size and the viability of and status of the (sub)population(s). • Monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary. • Where the public is involved in citizen science type monitoring (e.g., many birds, frogs, flying foxes), determine whether these data can be used in monitoring populations, or whether the methods could be adapted to generate more useful data. • For fire impacted species – establish and maintain a monitoring program to document post-fire recovery, determine minimum tolerable fire intervals, determine trends in population size and distribution, determine threats and their impacts, and monitor the effectiveness of management actions and the need to adapt them if necessary. • For plants threatened by fire – monitor the size, structure, and reproductive status of populations at different stages in the fire cycle, taking opportunities to monitor after planned and unplanned fires (where they occur) and improve understanding of the fire response of the species. Precise fire history records must be kept for the habitat and extant populations (confirmed and suspected) of the species. • For animals threatened by fire – monitor the response of the population to fire using an appropriate measure (i.e. occupancy, population abundance, individual mortality, ranging behaviour, breeding success, etc.) based on knowledge of the ecology of the species, and with a monitoring design that aims to improve understanding of the species' response to fire. Precise fire history records must be kept for the habitat and extant populations (confirmed and suspected) of the species. • Predation – monitor the abundance of introduced predators across the species' range and responses of <SPECIES> to predator control programs. Evaluate the use and effectiveness of management interventions and modify if required. *Poorly known species – survey requirements* For taxa where population size or distribution are not comprehensively known, further targeted survey is typically required to better understand the distribution, population size, threats and required threat abatement actions for the species. Consider listing this recovery action against any threats that would rely on a better understanding of population size, distribution, and threats for appropriate management to occur. • Undertake targeted surveys in suitable habitat to locate any additional occurrences of the species to assess population size and distribution more precisely.
Information and research priorities	*General* For taxa with poorly known biology and ecology, further research is often required to adequately inform recovery planning (i.e., weed management strategies, fire

management strategies) and also the listing (i.e., generation length). Consider listing this recovery action against any threats where further research is required to inform effective threat management.

- For plants - investigate the ecological requirements of <SPECIES> that are relevant to persistence and recruitment, including seed storage conditions in ex situ seed banks; population genetic structure, levels of genetic diversity and minimum viable population size; reproductive status, longevity, fecundity, and frequency and size of recruitment events; soil seed bank dynamics, particularly the longevity of seed in the soil seed bank; pollinator identity, biology, and requirements; the effect of drought on mortality rates of the species.
- For fire impacted species – Identify an optimal fire regime for the species by assessing population-level responses to a range of fire regimes and modelling population viability across all fire scenarios. Assess the efficacy of management options in reducing the incidence, extent, and intensity of fire.

Species Distribution Modelling for estimating extent of occurrence (EOO)

Species distribution modelling (SDM) is appropriate when the geographical range of a species is poorly known and is often used when limited records are available and data is often of a broad spatial resolution. Note that this requires a reasonably sized dataset of species presence information plus the range of environmental variables that are known to influence the species' distribution (Phillips et al., 2006). If this data is not available, then a research priority should be to collect and assimilate this information.

- Develop predictive models for the species' geographical distributions based on the environmental conditions of sites of known occurrences.

Habitat Suitability Modelling to assess Area of Occupancy (AOO)

Habitat Suitability Modelling is used to identify the environmental variables a species prefers and requires finer scale data than the SDM but produces results of a much higher and more accurate resolution. Note that this requires a reasonably high number of presence records, plus the knowledge of environmental variables located at this site and other sites chosen at random.

- Develop habitat suitability models to determine the ecological/environmental indices responsible for a species' distribution, and how it may change due to the impending threats (Guisan & Zimmermann, 2000).

Connectivity analysis

Connectivity analysis is used to identify and prioritize important areas for connectivity conservation between disconnected populations across a heterogeneous landscape. Note that this requires information on individual-based movement, or genetic diversity in the population. IF not available then collection of these data should be a research priority.

- Undertake connectivity analysis to prioritise important areas for conservation, the location of critical habitat linkages and barriers to the movement of individuals and gene flow (McRae et al., 2008).

Appendix 8. Data qualifier examples for key parameters

Extent of occurrence		
Observed	*EOO*	Comprehensive surveys of all known and potential habitat have been undertaken for the species and used to create a distribution map. The area of a minimum convex hull around this distribution provides an observed EOO.
	Continuing decline in EOO	A census has been undertaken for a species at three-year intervals for the past 20 years. Data from the last three census events indicate the species has become progressively absent at several formerly known sites. At each census year, the EOO has become smaller as the local extinctions occur on the edge of the species' range. Therefore, there is an observed continuing decline in the EOO for this species.
	Reduction in EOO	If the EOO contracted, but has since stabilised, this would be considered an observed reduction in EOO (rather than continuing decline) and could be used to suspect a reduction under Criterion A1-4c.
Estimated	*EOO*	Surveys have been taken at representative sites across the species' distribution and specimen records from these sites have been lodged to relevant collection institutions. The area of a minimum convex hull around this distribution provides an estimated EOO. *Note: The minimum data quality requirement for assessing a species' EOO under Criterion B is 'estimated'. See Section 9.1.1 for further information.*
	Continuing decline EOO	Monitoring plots are established at 10 core habitat sites across the species' range. Monitoring at 3 time periods indicates the species' range is contracting. Because the data includes representative sites and 2+ time periods, a continuing decline in EOO can be estimated.
	Reduction in EOO	If the EOO contracted but has since stabilised, this would represent an estimated reduction in EOO and could be used to suspect a reduction under Criterion A.
Projected	*EOO*	Surveys have been taken at representative sites across the species' distribution and specimen records from these sites have been lodged with relevant collection institutions. These have been used to create a suitable habitat model for the species. The area of a minimum convex hull around this distribution provides a projected EOO as it has been extrapolated in space.
	Reduction in EOO	Monitoring plots are established at 10 core habitat sites across the species' range. A mine has been approved for development along the northern boundary of the species' range which equates to 50% of its estimated EOO. Although production has not commenced, future reductions are highly likely to occur and can be quantified. Therefore, a reduction in EOO can be

		projected for the species. Projected reductions in EOO can be used to suspect a reduction under Criterion A1-4c.
Inferred	*EOO*	The species is highly cryptic but is closely associated with another taxa. The EOO can be inferred using the EOO of the closely related taxa. *Note: The minimum data quality requirement for assessing a species' EOO under Criterion B is 'estimated'. Inferred EOOs do not meet the minimum data quality requirements for assessment under Criterion B. See Section 9.1.1 for further information.*
	Continuing decline in EOO	A species within the same genus has an estimated continuing decline in EOO due to feral pig impacts. The study species has very similar ecology and habitat, and feral pigs are known to occur in high densities at the northern extent of the species' EOO. Therefore, a continuing decline in the EOO can be inferred for this species.
Suspected	*EOO*	The EOO is derived from anecdotal information relating to suitable habitat for the species (e.g. verbal accounts of the species' occurrence in generalized localities). *Note: the minimum data quality requirement for assessing a species' EOO under Criterion B is 'estimated'. Inferred EOOs do not meet the minimum data quality requirements for assessment under Criterion B. See Section 9.1.1 for further information.*
	Continuing decline in EOO	The northern part of an *Acacia* sp. distribution is experiencing more frequent fire regimes. However, the species occurs in microhabitat with low biomass and the time between fires remains long enough to allow juvenile plants to become mature and produce seed. Therefore, a continuing decline in EOO can only be suspected in relation to this threat. A small, insectivorous mammal lives in rocky scarps and fire regimes are becoming more frequent in the landscape. However, the rocky scarps are thought to act as a pyric buffer and prevent direct impacts to the species. Although its prey may be impacted in the broader landscape, a continuing decline in EOO can only be suspected for the species. *Note: The minimum data quality requirement for assessing a continuing decline under Criterion B or C is 'inferred'. Suspected continuing declines do not meet the minimum data quality requirements for assessment under Criterion B or C. See Section 9.1.1 for further information.*
Area of occupancy		
Observed	*AOO*	Comprehensive surveys of all known and potential habitat have been undertaken for the species and all known sites are georeferenced. The georeferenced sites are intersected with a 2 x 2km grid. The sum of the area of grid cells that include a record of the species provided an observed AOO.

	Continuing decline in AOO	A census has been undertaken for a species at three-year intervals for the past 20 years. Data from the last three census events indicates the species has become progressively absent at several formerly known sites. Research has demonstrated that the species is fire-sensitive, and the localised extinctions correspond to recent, high intensity fire scar mapping. At each census year, the AOO has become smaller. Therefore, there is an observed continuing decline in the AOO for this species.
	Reduction in AOO	If the AOO contracted but has since stabilised, this could only be considered an observed reduction in AOO (rather than continuing decline) and could be used to suspect a population reduction in mature individuals under Criterion A1-4c.
Estimated	*AOO*	Surveys have been taken at representative sites across the species' distribution and specimen records from these sites have been lodged to relevant collection institutions. The georeferenced sites are intersected with a 2 x 2km grid. The sum of the area of grid cells that include a record of the species provided an observed AOO. This is the standard usually applied in Queensland nominations. *Note: The minimum data quality requirement for assessing a species' AOO under Criterion B is 'estimated'. See Section 9.1.1 for further information.*
	Continuing decline in AOO	Monitoring plots are established at 10 representative sites across the species' range. Monitoring at three time periods indicates the number of 2 x 2km grid cells occupied by the species is declining due to localised extinctions. Threats are continuing and these declines are also liable to continue. Because the data includes representative sites and 2+ time periods, there is an estimated continuing decline in AOO.
Projected	*AOO*	Surveys have been taken at representative sites across the species' distribution and specimen records from these sites have been lodged with relevant collection institutions. These have been used to create a distribution model for the species. The sum of the area of grid cells that intersect the modelled habitat provides a projected AOO.
	Continuing decline in AOO	Monitoring plots are established at 10 core habitat sites across the species' range. Invasive weeds are progressively outcompeting the species at several sites within the species' range. Impacts are likely to occur for the foreseeable future, resulting in a gradual decline in the number of 2 x 2km grid cells occupied by the species. Therefore, a continuing decline in AOO can be projected for the species as these impacts are extrapolated into the future.
Inferred	*AOO*	The species is highly cryptic but is closely associated with another taxa. The AOO can be inferred using the AOO of the closely associated taxa. *Note: The minimum data quality requirement for assessing a species' AOO under Criterion B or D is 'estimated'. Inferred AOOs do not meet the minimum*

		data quality requirements for assessment under Criterion B or D. See Section 9.1.1 for further information.
	Continuing decline in AOO	Continuing decline in AOO based on an estimated continuing decline in habitat quality. The decline in habitat quality must be of a sufficient scale to indicate the AOO will decline (i.e. all habitat within the 2 x 2km^2 grid cell must be impacted). Small scale or localized declines in habitat quality may not warrant an inferred decline in AOO. A continuing decline (causing localised extinction) has been estimated based on sample sites within one subpopulation due to domestic stock. This threat is present across all sites, and therefore there is quantitative information on one subpopulation that there will be decline due to domestic stock. This can be projected to impact all subpopulations for the species and thus cause continuing decline in EOO, AOO and quality of habitat.
Suspected	*AOO*	The AOO is derived from anecdotal information (e.g. poorly documented or unverified reports) of suitable habitat for the species. *Note: The minimum data quality requirement for assessing a species' AOO under Criterion B or D is 'estimated'. Suspected AOOs do not meet the minimum data quality requirements for assessment under Criterion B or D. See Section 9.1.1 for further information.*
	Continuing decline in AOO	The species is thought to be negatively impacted by climate change. However, because there is no comprehensive information on the species' biology or specific habitat requirements, the mechanism of decline cannot be identified. Therefore, the decline is only suspected and does not meet the data quality requirements under Criterion B or C. *Note: The minimum data quality requirement for assessing a continuing decline under Criterion B or C is 'inferred'. Suspected continuing declines do not meet the minimum data quality requirements for assessment under Criterion B or C. See Section 9.1.1 for further information.*
Area, extent and quality of habitat		
Observed	*Area and extent of habitat*	Comprehensive surveys of all known and potential habitat have been undertaken for the species and all known sites are mapped with georeferenced polygons. The areas of georeferenced sites supporting the species are used to calculate the area of habitat. Note that the specific habitat must be clearly defined at a scale relevant to the life history of the species.
	Continuing decline	A species of fish is known to only occur in arid zone springs. The area of habitat was defined as polygons around the springs in which the species has been found during comprehensive surveys over the past three generations. Due to aquifer drawdown, the area occupied by springs (and mapped as polygons during repeat surveys) has been declining in the past

		two generations. This decline can be considered an observed continuing decline in the area and extent of habitat if it is liable to continue. The same spring endemic species is known to rely on clear water to complete its life cycle, and therefore water turbidity can be considered a key component of habitat quality. Water turbidity has been sampled at every spring occupied by the species in the past three generations. The number of springs that have turbidity levels exceeding the species' tolerance is increasing due to feral pigs. Therefore, this can be considered an observed decline in quality of habitat.
Estimated	*Area of habitat*	Surveys have been taken at representative sites across the species' distribution and specimen records from these sites have been lodged to relevant collection institutions. Remote-sensing data is used to identify other areas of suitable potential habitat. The georeferenced areas of these sites are used to estimate the area of habitat for the species.
	Continuing decline	Woody debris cover is identified as an important habitat component for a frog. Monitoring at representative sample sites at two points in time indicate it is declining by an average of 15% each year. The decline is attributed to feral pigs, which smash the logs in search of food, which is liable to continue. This information can be used to estimate a continuing decline in habitat quality for the frog species. Invasive weeds are known to outcompete a plant species. Monitoring at representative sample sites at two points in time indicate invasive weed cover is increasing by 30% every 2 years. This information can be used to estimate a continuing decline in area of habitat for the plant species.
	Reduction	A bird species that occurs in the Brigalow Belt depends on Allocasuarina vegetation for feeding habitat. Using Regional Ecosystem mapping, a reduction of >80% in the past 3 generations (80 years) can be quantified and attributed to expansion of cropping lands. This information can be used to estimate a reduction in the area, extent and quality of habitat for the species, and to suspect a population reduction under Criterion A1-4c.
Projected	*Area of habitat*	Surveys have been taken at representative sites across the species' distribution and specimen records from these sites have been lodged to relevant collection institutions. The georeferenced sites are used to generate a potential habitat model (extrapolated in space). This area can be considered a projected area of habitat for the species.
	Continuing decline	Moisture availability is crucial to the survival of the species. Climate change modelling indicates a projected decline in moisture availability for the area where a montane species occurs. Studies of moisture requirements and tolerance thresholds for the species have been established. By combining moisture tolerance thresholds for the species, with the projected rate of decline in moisture availability for the area where the species occurs, a future decline in habitat quality can be projected. *Note: Although this decline has not yet commenced, it has a high likelihood of occurring. 'Suspected' future continuing declines (e.g. declines in areas of*

		habitat due to a proposed mine that has not yet been approved) do not meet the minimum data quality requirements under Criterion B or C. Continuing decline in area/extent of habitat predicted by a statistical model of land cover change, based on landcover changes from remote-sensing data.
Inferred	*Habitat quality*	There is no data available on habitat requirements for the study species of plant, but research on a closely related taxa has estimated that moisture availability is crucial for survival. Therefore, moisture availability can be inferred to be an important component of habitat quality for the study species.
	Continuing decline	Climate change modelling indicates a projected change in moisture availability for the general area where a montane species occurs. Moisture availability is crucial to the survival of the species and is projected to decline with high certainty. Although the change to moisture availability has been projected, the moisture requirement thresholds for the species have not been specifically studied. Therefore, this can only be used to infer a decline in habitat quality for the species, as there are assumptions that changes in moisture availability will be outside the tolerance of the species. *Note: Although this decline has not yet commenced, it has a high likelihood of occurring. 'Suspected' future continuing declines (e.g. declines in areas of habitat due to a proposed mine that has not yet been approved) do not meet the minimum data quality requirements under Criterion B or C.* A species of frog depends on seasonal wetlands to complete its life cycle. Feral pig damage to these sites occurs throughout the distribution of the frog species, compacting soils and damaging the microhabitat provided by the plant. Although the mechanism of decline is well established, there is no quantitative data, so this information can be used to infer a continuing decline in habitat quality. *Note: The minimum data quality requirement for assessing a continuing decline under Criterion B or C is 'inferred'. Suspected continuing declines do not meet the minimum data quality requirements for assessment under Criterion B or C. See Section 9.1.1 for further information.*
Suspected	*Habitat quality*	Field surveys in a very limited area of the species' distribution have found it commonly associated with riparian areas with high levels of canopy cover. Canopy cover appears to be an important component of habitat quality; however, surveys have been limited and rely on substantial assumptions of the habitat occupied by the species in other areas. Therefore, it is suspected that canopy cover is an important component of habitat quality.
	Continuing decline	Flowering melaleuca trees are a substantial component of a bat's diet throughout the year and are inferred to be an important component of habitat quality. Feral pigs cause substantial damage to the ground layer vegetation, including declines in recruitment of the bat's favoured food tree species. The bat is known to switch between food sources, and there is no clear indication that recruitment will cause a long-term loss of food trees.

		As this relies on circumstantial evidence, this continuing decline is suspected. *Note: The minimum data quality requirement for assessing a continuing decline under Criterion B or C is 'inferred'. Suspected continuing declines do not meet the minimum data quality requirements for assessment under Criterion B or C. See Section 9.1.1 for further information.*
Number of locations/subpopulations		
Observed	*Number of subpopulations*	Comprehensive surveys of all known and potential habitat have been undertaken for the species and used to determine the number of subpopulations. Delineation of subpopulations includes quantitative data (i.e. genetic data) on dispersal rates between and within sites to ensure there is typically <1 successful gamete per year.
	Continuing decline	A recent population census including all subpopulations/locations documented a local extinction of two subpopulations/locations, and substantial decline in another subpopulation/location. The threat causing the decline is ongoing, and therefore this can be considered an observed continuing decline in the number of subpopulations/locations for the species. *Note: the species' life history traits must be considered when assessing whether a local extinction has occurred. The absence of a species from a particular site may be due to differences in life stages between survey periods (e.g. conditions for germination have not yet been met for the season(s)). When documenting an 'observed' decline in the number of subpopulations/locations, an assessor must have reasonable certainty that the species' absence from a site is genuine.*
Estimated	*Number of subpopulations*	Surveys have been taken at representative sites across the species' potential habitat area and specimen records from these sites have been lodged with relevant collection institutions. These have been analysed to estimate the number of subpopulations with reference to the known dispersal mechanism of the species.
	Continuing decline	Sampling across the range of the species indicates one subpopulation has become locally extinct and two subpopulations are no longer large enough to be viable. As the surveys were based on systematic sampling rather than a full census, a continuing decline in the number of subpopulations is estimated.
Projected	*Number of subpopulations*	The number of subpopulations expected to persist based on estimated data (as above), plus future threat impacts can be used to project the number of subpopulations that may persist in the future. Surveys have been taken at representative sites across the species' habitat and have been used to determine additional areas of potential habitat where the species is likely to occur. The number of additional subpopulations that could be present in the unsurveyed areas is calculated within using the dispersal capacity of the taxon.

	Continuing decline	Sampling across the range of the species indicates one subpopulation has become locally extinct and two subpopulations are no longer large enough to be viable. As the threat causing the decline is pervasive, and liable to continue, the rate and magnitude of decline can be extrapolated into the future to project a continuing decline in the number of subpopulations.
Inferred	*Number of subpopulations*	Surveys have been taken at some sites throughout the species' range, and areas of other suitable habitat where the species is highly likely to occur have been identified via expert elicitation. The dispersal mechanisms for the species are not known but are known for a closely-related taxa. This information is used to infer a maximum dispersal distance (i.e. via pollination or propagules) for the species and assess whether regular gamete exchange is like to occur between sites. Alternatively, the presence of additional subpopulations may be inferred due to the presence of highly suitable habitat elsewhere (although this should be used to inform maximum values only, and not the 'value assessed').
	Continuing decline	Feral cats occur throughout the range of a small mammal that has three subpopulations. There is no species-specific data exploring predation by feral cats for the species, but feral cats are known to have severe impacts on another, closely related species that is a similar size. Predation of the similar species has been significant enough to cause local extinctions (and loss of subpopulations). Therefore, it can be inferred that the study species is also experiencing a continuing decline in the number of subpopulations. *Note: The minimum data quality requirement for assessing a continuing decline under Criterion B or C is 'inferred'. Suspected continuing declines do not meet the minimum data quality requirements for assessment under Criterion B or C. See Section 9.1.1 for further information.*
Suspected	*Number of subpopulations*	The species is generally poorly known with only two collection records at one site. Anecdotal information suggests the species may be more widespread in an adjacent mountain range, and this is used to suspect the presence of an additional subpopulation. *Note: such suspicions should only be used to generate a maximum plausible bound for subpopulations.* *Note: To assess a number of individuals within a subpopulation, the minimum data quality requirement is 'estimated'. Thus, a 'suspected' number of subpopulations does not meet the minimum data quality requirements for assessment under Criterion C. See Section 9.1.1 for further information.*
	Continuing decline	Part of a species' distribution (i.e. one site or subpopulation) occurs in a mineral exploration permit. Because the permit does not equate to guaranteed mining activity, this threat can only be suspected. Part of a species' population (i.e. one site or subpopulation) occurs in an area subject to development; however, the subpopulation has been poorly surveyed and its full extent is unknown. Thus, it is uncertain if the

		development will result in the loss of the entire subpopulation and a continuing decline in the number of subpopulations is 'suspected'. *Note: The minimum data quality requirement for assessing a continuing decline under Criterion B or C is 'inferred'. Suspected continuing declines do not meet the minimum data quality requirements for assessment under Criterion B or C. See Section 9.1.1 for further information.*
Number of mature individuals		
Observed	*Number of mature individuals*	A complete census of all mature individuals within a population.
	Reduction	A census involving a direct count of all known individuals within a population is made at three time periods relevant to the life history of the species. The data indicates 50% of the mature individuals have died over the past 10 years. This data can be used to observe a reduction under Criterion A1 or A2.
	Continuing decline	If the abovementioned census involved multiple survey periods and there is no indication the decline will cease, this data can be used to observe a continuing decline under Criterion B and C.
Estimated	*Number of mature individuals*	Population counts at a representative suite of sites across the species' distribution. May involve statistical assumptions regarding the proportion of mature individuals at a site (of the total number of individuals), and/or be extrapolated (i.e., estimate of densities across the species' known range to derive an overall population size). A botanist regularly visits three monitoring sites for a threatened plant. At these sites, the number of mature individuals within 6 x 1ha plots are recorded to obtain an average density of plants per ha. The average density per ha is then extrapolated over the known habitat of the species to provide an estimated number of mature individuals. For a vocal bird, transect counts of singing males may be used with assumptions about the overall proportions of mature males these represent, and about sex ratios to estimate the number of mature individuals. An estimate of the proportion of mature individuals in the population derived from demographic information of the population. *Note: The minimum data quality requirement for assessing a number of mature individuals under Criterion C or D is 'estimated'. See Section 9.1.1 for further information.*
	Continuing decline	A continuing decline in the number of mature individuals could be estimated for a species from population size estimates from two or more time points. *Note: the species' life history traits must be considered when assessing whether a genuine decline in the number of mature individuals has occurred. The*

		possibility that a decline may be due to differences in life stages between survey periods (e.g. conditions for germination have not yet been met for the season) must be documented, if/where appropriate. Mark-recapture studies have found the relative abundance of a small mammal has declined over the past three generations. The species is known prey of feral cats and has been frequently found in stomach contents analysis from cats in the region. As the threat of feral cats is liable to continue, a continuing decline can be estimated for the species.
	Reduction	A population reduction could be estimated for a species using metrics such as an index of abundance (catch per unit effort, density, number of nesting females, abundance based on mark-recapture).
Projected	*Number of mature individuals*	Data from current population estimates can be used to project a future population size for the species, particularly where a rate of decline or increase is known.
	Continuing decline	An ecologist obtains estimates for the number of mature individuals from representative permanent monitoring plots that are monitored annually. Based on data from the past three monitoring periods, the species is declining at a rate of 10% each year. The threats are ongoing, and the decline is liable to continue into the future. By extrapolating this rate of decline into the future, a continuing decline in the number of mature individuals can be projected for the species under Criterion B and C.
	Reduction	If the generation length is known, a reduction can be projected under Criterion A. If the decline was going to occur in a discrete area (i.e., infrastructure impact site that is spatially constrained), this may constitute a projected reduction rather than continuing decline. Projected reductions can be assessed under Criterion A4.
Inferred	*Number of mature individuals*	Catch statistics were used to infer a population size for a marine fish at a particular point in time. Inference may also involve extrapolating an observed or estimated quantity from known subpopulations to calculate the same quantity for other subpopulations. Number of mature individuals calculated by combining information from density estimates at sample sites that are not representative of the population as a whole (i.e. one subpopulation not included). Number of mature individuals calculated from closely related species with similar ecology and subject to similar threats, where they can be plausibly assumed to have similar densities. An estimate of the proportion of mature individuals based on demographic data from a similar species. For example, Species Y has a population size of 500 and 25% are mature. Species X has a population size of 100 and %

		mature are unknown, however it can be inferred the number of mature individuals is 25 (i.e., 25% of 100). Field observations of mature plants (but not from systematic monitoring plots) are used to determine a rough estimate of mature individuals at a particular site. This can be extrapolated over an area of habitat by an expert to give an inferred number of mature individuals. *Note: The minimum data quality requirement for assessing a number of mature individuals under Criterion C or D is 'estimated'. 'Inferred' population estimates do not meet the minimum data quality requirements under Criterion C or D. See Section 9.1.1 for further information.*
	Continuing decline	A survey on one subpopulation estimated a continuing decline in the number of mature individuals. A continuing decline could be inferred for the subpopulations where similar threats are occurring. A montane mammal has highly specific habitat requirements to suit its narrow thermal range, and only occurs above 1,000m. A combination of climate change projections and habitat suitability modelling indicates its known microhabitat will experience temperatures in excess of its thermal tolerance in the next two generations. Therefore, a continuing decline in the number of mature individuals is inferred for the species. *Note: Although this decline has not yet commenced, it has a high likelihood of occurring. 'Suspected' future continuing declines (e.g. declines in areas of habitat due to a proposed mine that has not yet been approved) do not meet the minimum data quality requirements under Criterion B or C.*
	Reduction	Catch statistics from multiple time points were used to infer a reduction in population size for a marine fish. The cause of the reduction is well understood and has not ceased, therefore a continuing decline can also be inferred.
Suspected	*Number of mature individuals*	The number of mature individuals based on a best guess using minimal or no field knowledge for the species (i.e., knowledge from a very limited number of sites or knowledge that may be outdated). *Note: The minimum data quality requirement for assessing a number of mature individuals under Criterion C or D is 'estimated'. 'Suspected' population estimates do not meet the minimum data quality requirements under Criterion C or D. See Section 9.1.1 for further information.*
	Continuing decline	While feral cats are known to cause declines in critical weight range mammals, their impact on smaller, cryptic species is less understood. While they are known to successfully predate similar species, the impact on the population is poorly understood, but there is some evidence a decline may be occurring. Climate change is projected to cause a decline in moisture availability for high elevation plants. A short-lived grass that occurs at a variety of elevations (500-1,200m) is likely to experience habitat change, particularly at the higher elevations in coming years. However, as grasses can be

		resilient to moisture deficits, the mechanism for decline is not clear. It may even outcompete other, more sensitive taxa. A decline in habitat quality is suspected, however cannot be inferred for this species. *Note: The minimum data quality requirement for assessing a continuing decline under Criterion B or C is 'inferred'. Suspected continuing do not meet the minimum data quality requirements for assessment under Criterion B or C. See Section 9.1.1 for further information.*
	Reduction	Anecdotal information indicating a species used to be seen regularly but is now rarely encountered can be used to suspect a population reduction and/or continuing decline. Population reduction in the number of mature individuals based on information on trends in harvest, habitat quality, and sightings (e.g., from a structured elicitation of information from multiple experts familiar with the taxon).

Appendix 9. Data qualifier examples for common threats

Land clearing	
Observed (quantitative)	Comprehensive surveys have been undertaken for a plant species, and it is known to only occur at three sites. These sites were cleared for agriculture (cropping) and comprehensive follow up surveys have failed to relocate the species. This can be considered an observed reduction in population size due to land clearing.
Estimated (quantitative)	A bird species that occurs in the Brigalow Belt depends on *Allocasuarina* vegetation for feeding habitat. Using Regional Ecosystem mapping, a reduction of >80% in the past 3 generations (80 years) can be quantified and attributed to the expansion of cropping lands. This information can be used to estimate a reduction in the area, extent and quality of habitat for the species, and to **suspect a population reduction** under Criterion A1-4c.
Projected (quantitative)	A skink occurs in remnant patches of Brigalow Forest within the Brigalow Belt. The habitat for the species is well-defined and has been mapped on GIS. Some of the habitat patches are too small to be protected and occur on freehold land where plans for a development have been approved, with likely impacts to the species' habitat assessed. This information can be used to project a population reduction in the future under Criterion A4.
Inferred (qualitative)	A daisy is closely associated with Brigalow, which is the dominant tree species in a number of Regional Ecosystems in the Brigalow Belt. An 80% reduction in Brigalow-dominated REs has been documented. Because the two species are closely associated, a continuing decline in the area of habitat can be inferred for the daisy.
Suspected (qualitative)	Collection records indicate a species has a strong affinity for fertile soils at low elevations. Current collection records occur in close proximity to cleared areas. However, the species was only identified 50 years ago, and no collection records occur in these cleared areas. Given the close proximity to these cleared areas, botanists suspect it has undergone historic declines due to land clearing. This information is based on suspicion and therefore can be used to suspect a continuing decline or reduction due to land clearing for the species.
Inappropriate fire regimes	
Observed (quantitative)	A census has been undertaken for a species at three-year intervals for the past 20 years. Data from the last three census events indicate that the species has become progressively absent at several formerly known sites. Research has demonstrated that the species is fire-sensitive, and the localised extinctions correspond to recent, high intensity fire scar mapping. At each census year, the AOO has become smaller. Therefore, there is an observed continuing decline in the AOO for this species. If the AOO contracted but later stabilised, this could only be considered an observed reduction in AOO (rather than continuing decline) and could be used to **suspect** a population reduction in mature individuals under Criterion A1-4c.
Estimated (quantitative)	Based on monitoring data from a representative suite of sample sites, the number of mature individuals is declining in concert with an increase in fire frequencies. Fire regimes in the area are projected to become more frequent with heating and drying

	associated with climate change. This data can be used to estimate a continuing decline for a species. *Note: Projected future increases in fire frequency alone cannot be used to estimate a continuing decline for a species, they must be coupled with data from a suite of representative monitoring sites that demonstrate species' decline.*
Projected (quantitative)	Based on monitoring data from a representative suite of sample sites, the number of mature individuals is declining at a rate of 6% annually due to an increase in fire frequency. This rate of decline can be used with the known generation length of a species to project a percentage decline in the future under Criterion A3 and A4.
***Inferred* (qualitative)**	An obligate seeder, which is killed by fires, requires a minimum fire-free interval of 15 years to maintain a stable population size. Thus, appropriately timed fire is an important component of habitat quality for the species. Fire frequency determined from remote-sensing data indicates an average return interval of 7 years over the past 30-year period. It can also be inferred that the specific microhabitat of the species was burnt during these fires as the vegetation accumulates substantial, flammable biomass. This information can be used to infer a continuing decline in habitat quality and number of mature individuals for the species.
Suspected (qualitative)	The northern part of an *Acacia* sp. distribution is experiencing more frequent fire regimes. However, the species occurs in microhabitat with low biomass and the time between fires remains long enough to allow juvenile plants to become mature and produce seed. Therefore, a continuing decline in habitat quality can only be suspected in relation to this threat. A small, insectivorous mammal lives in rocky scarps and fire regimes are becoming more frequent in the landscape. However, the rocky scarps are thought to act as a pyric buffer and prevent direct impacts to the species. Although its prey may be impacted in the broader landscape, a continuing decline in habitat quality can only be suspected for the species.
Invasive weeds	
Observed (quantitative)	A census has been undertaken for the population and the distribution of invasive weeds within each subpopulation has been mapped. Follow up surveys have been undertaken at two additional time points and found localised extinctions for three subpopulations have occurred. Because this data is based on a comprehensive survey (i.e., census) this can be used to observe a continuing decline in subpopulations for the species.
Estimated (quantitative)	Invasive weeds are known to outcompete a plant species. Monitoring at representative sample sites at two points in time indicate invasive weed cover is increasing by 30% every 2 years. This information can be used to estimate a continuing decline in habitat quality for the plant species.
Projected (quantitative)	Monitoring plots are established at 10 core habitat sites in part of the species' range. The other part of the species' range is very difficult to access and there are no monitoring sites there. Monitoring at 3 time periods indicates the species' range is contracting due to invasive weeds. By extrapolating the trend estimated within the monitored part of the species' range, a **continuing decline** can be projected across the species' range.

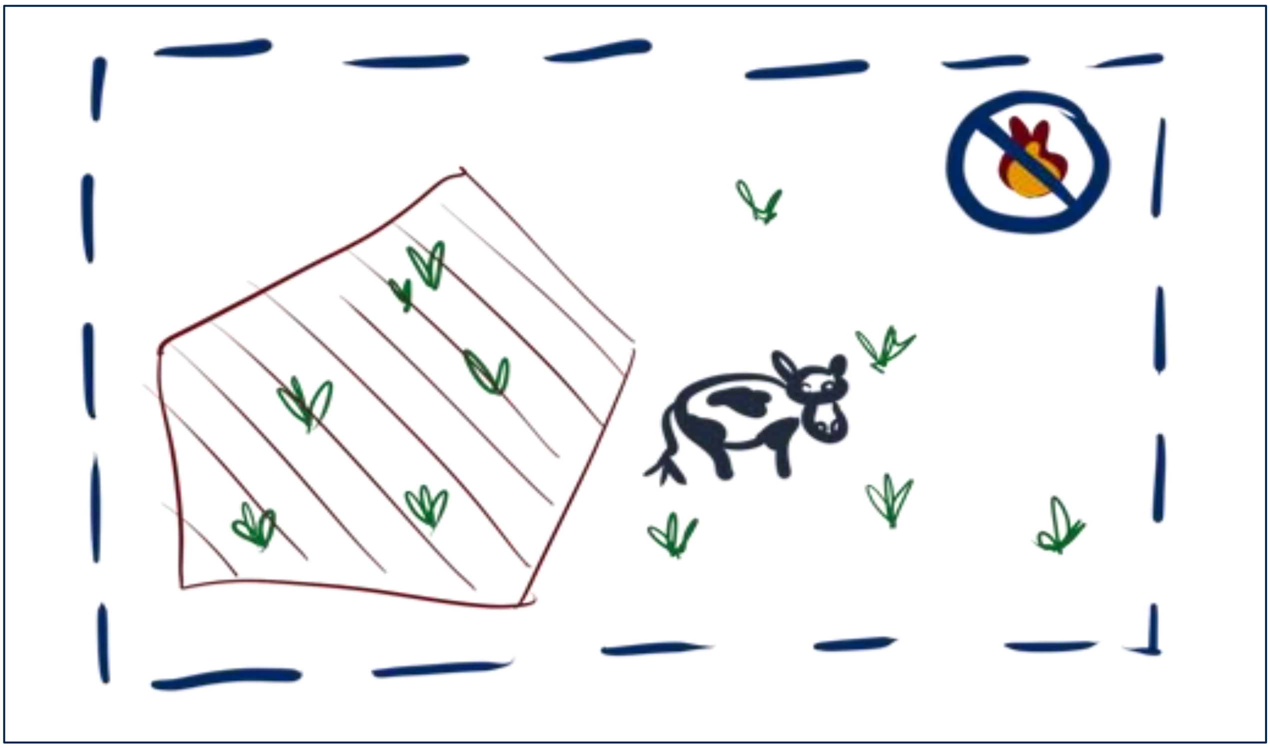
Inferred (qualitative)	Lantana is known to be present within the specific microhabitat occupied by the species (i.e. creekside areas). The species is a fire sensitive ground-cover plant vulnerable to competition and microhabitat changes. Remote sensing indicates there have been recent fires in the area. Although there is no quantitative data available, a continuing decline in habitat quality can be inferred for the species, as fire-free habitat is an important component of habitat quality for the species that lantana is altering.
Suspected (qualitative)	Invasive weeds are known to be present within the general area where the species occurs, however the specific impacts to the species are not known. Therefore, it is suspected that a continuing decline in habitat quality may be occurring for the species.
Vertebrate pests (cattle, pigs, cats)	
Observed (quantitative)	A species of fish is known to only occur in arid zone springs and is known to rely on clear water to complete its life cycle, therefore water turbidity can be considered a key component of habitat quality. Water turbidity has been annually sampled at every spring occupied by the species in the past three generations. The number of springs that have turbidity levels exceeding the species' tolerance is increasing due to feral pig impacts. Therefore, this can be considered an observed decline in quality of habitat.
Estimated (quantitative)	Woody debris cover is identified as an important habitat component for a frog. Monitoring at representative sample sites at two points in time indicate woody debris cover is declining by an average of 15% each year. The decline is attributed to feral pigs, which smash the logs in search of food and is liable to continue. This information can be used to estimate a continuing decline in habitat quality for the frog species. Mark-recapture studies have found the relative abundance of a small mammal has declined over the past three generations. The species is known prey of feral cats and has been frequently found in stomach contents analysis from cats in the region. As the threat of feral cats is liable to continue, a continuing decline in mature individuals (and possibly AOO, EOO and number of subpopulations/locations – depending on the data) can be estimated for the species.
Projected (quantitative)	An ecologist obtains estimates for the number of mature individuals from representative permanent monitoring plots that are monitored annually. Based on data from the past three monitoring periods, the species is declining at a rate of 10% each year due to feral cat predation. This data can be used to project a percentage reduction within three generations for assessment under Criterion A4b. It can also be used to assess a continuing decline under Criteria B and C.
Inferred (qualitative)	A species of frog depends on seasonal wetlands to complete its life cycle. Feral pig damage to these sites occurs throughout the distribution of the frog species, compacting soils and damaging the microhabitat of the plant. Although the mechanism of decline is well established, there is no quantitative data, so this information can be used to infer a continuing decline in habitat quality. A species within the same genus has an estimated continuing decline in EOO due to feral pig impacts. The study species has very similar ecology and habitat, and feral pigs are known to occur in high densities at the northern extent of the species' EOO. Therefore, a continuing decline in the EOO can be estimated for this species.

	Feral cats occur throughout the range of a small mammal that has three subpopulations. There is no species-specific data exploring predation by feral cats for the species, but feral cats are known to have severe impacts on another, closely related species that is a similar size. Predation of the similar species has been significant enough to cause local extinctions (and loss of subpopulations). Therefore, it can be inferred that the study species is also experiencing a continuing decline in the number of subpopulations (noting that several subpopulations have not been recorded in recent years).
Suspected (qualitative)	Flowering melaleuca trees comprise up a substantial component of a bat's diet throughout the year and are inferred to be an important component of habitat quality. Feral pigs cause substantial damage to the ground layer vegetation, including declines in recruitment of the bat's favoured food tree species. The bat is known to switch between food sources, and there is no clear indication that declines in recruitment will cause a long-term loss of food trees. As this relies on circumstantial evidence, this continuing decline is suspected and therefore does not meet the minimum data quality requirements under Criteria B and C. While feral cats are known to cause declines in critical weight range mammals, their impact on smaller, cryptic species is less understood. The impact on the population is poorly understood and therefore a continuing decline is only suspected.
Climate change / severe weather / cyclones etc.	
Observed (quantitative)	A census is undertaken every three years for a threatened plant species. A severe cyclone impacted the distribution of the species and a follow up census revealed tree death of 30% for the same species. This information can be used as an observed reduction under Criterion A1-2a.
Estimated (quantitative)	Mark-recapture studies indicate a montane mammal has decreased in abundance over a 5-year period. This has been correlated with an increase in temperature in the area, which exceeds the thermal tolerance of the species (as established in previous studies). This data can be used to estimate a continuing decline in the number of mature individuals under Criterion B.
Projected (quantitative)	Moisture availability is crucial to the survival of a plant species. Climate change modelling indicates a projected decline in moisture availability for the area where a montane species occurs. Studies of moisture requirements and tolerance thresholds for the species have been established. By combining moisture tolerance thresholds for the species, with the projected rate of decline in moisture availability for the area where the species occurs, a future decline in habitat quality can be projected. Although this decline has not yet commenced, it has a high likelihood of occurring. *Note: Although this decline has not yet commenced, it has a high likelihood of occurring. 'Suspected' future continuing declines (e.g. declines in areas of habitat due to uncertain factors) do not meet the minimum data quality requirements under Criterion B or C.*
Inferred (qualitative)	Climate change modelling indicates a projected change in moisture availability for the general area where a montane species occurs. The moisture requirement thresholds for the species have not been specifically studied, but have been established for closely-related species within the genus. Moisture availability is thought to be crucial to the survival of the species. Therefore, this can only be used to infer a decline in habitat quality

	for the species, as there are assumptions that the changes in moisture availability will be outside the tolerance of the species (as for closely related species). Research has demonstrated that a montane mammal has highly specific habitat requirements to suit its narrow thermal range, which only occurs above 1,000m. A combination of climate change projections and habitat suitability modelling indicates its known microhabitat will experience temperatures in excess of its thermal tolerance in the next two generations. Therefore, a continuing decline is inferred for the species. Although this decline has not yet commenced, it has a high likelihood of occurring (merely plausible future continuing declines do not meet the minimum data quality requirements under Criteria B or C).
Suspected (qualitative)	The species occurs in an area where climate change impacts, specifically an increase in severe cyclones, will occur. However, the species can recover well from disturbance as it has strong resprouting capacity. Cyclones may create opportunities for invasive weeds to establish. As this information is largely circumstantial, and no clear mechanism of decline is identified, this should be considered a suspected continuing decline and therefore does not meet the minimum data quality requirements under Criteria B and C. Climate change is projected to cause a decline in moisture availability for high elevation plants. A short-lived grass that occurs at a variety of elevations (500-1,200m) is likely to experience habitat change, particularly at the higher elevations in coming years. However, as grasses can be resilient to moisture deficits, the mechanism for decline is not clear. It may even outcompete other, more sensitive taxa. A decline in habitat quality is suspected, however cannot be inferred for this species.
Mining activities + road / transport infrastructure	
Observed (quantitative)	A census was undertaken for a plant known from a single site that occurs in a road expansion area. After the road construction, a follow-up census was undertaken. During this follow up survey it was recorded that the species' range and number of mature individuals had been reduced due to construction. This can be used to observe a reduction in the number of mature individuals for the species. If the impacts were liable to continue, this could be used to observe a continuing decline in the number of mature individuals.
Estimated (quantitative)	Monitoring sites were established at a mine impact site to determine the number of plants likely to be impacted by a mining pit. Population estimates were made by calculating the average density of mature individuals at six survey sites and extrapolated over the area of suitable habitat in the impact area to calculate the population size for the species. This information can be used to estimate a reduction in mature individuals for the species.
Projected (quantitative)	Monitoring plots are established at 10 core habitat sites across a species' range. A mine has been approved for development along the northern boundary of the species' range which equates to 50% of its estimated EOO. Although production has not commenced, future reductions are highly likely to occur and can be quantified. Therefore, a reduction in EOO can be projected for the species. Projected reductions in EOO can be used to suspect a reduction under Criterion A1-4c. If the mining was liable to continue at other sites (and it could be quantified in terms of EOO/AOO, area etc.), this could also be used to project a continuing decline argument under Criteria B and C.

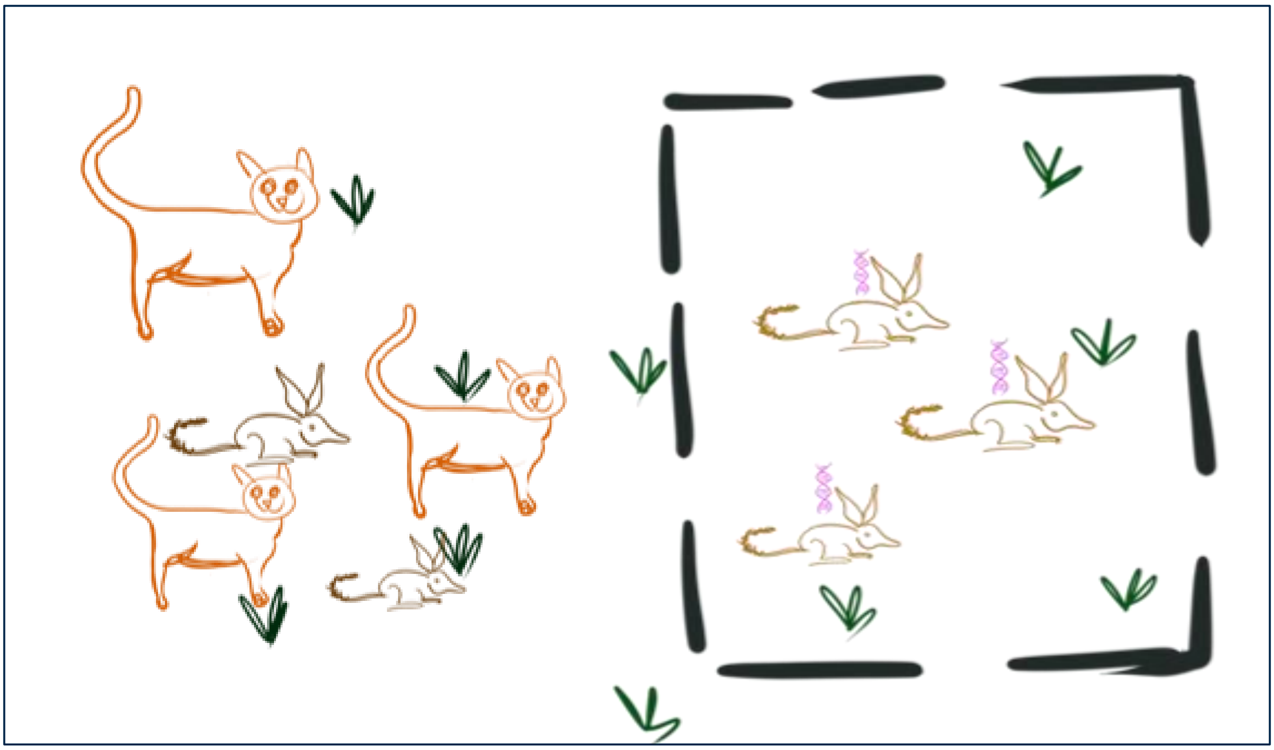
Inferred (qualitative)	A long-lived, perennial plant is known to occur within a coal seam gas mining lease. Areas of vegetation in which it is known to grow have been cleared, invasive weeds have been introduced and fire has now been excluded from the area. A continuing decline in habitat quality can be inferred for the species.
Suspected (qualitative)	Part of a species' distribution occurs in a mineral exploration permit. Because the permit does not equate to guaranteed mining activity, this threat can only be suspected.
Disease – myrtle rust, phytophthora, chytrid fungus	
Observed (quantitative)	A census was undertaken for a restricted Myrtaceae species in 2010. Myrtle rust was introduced to the population in 2015, and a follow up census was undertaken and found that 90% of mature plants are now dead. This can be used as an observed reduction under Criterion A. The decline is liable to continue, so this can also be applied as a continuing decline in the number of mature individuals.
Estimated (quantitative)	Monitoring plots have been established at representative sites across a species' range. The species is in the Myrtaceae family and is susceptible to myrtle rust. After two surveys three years apart the number of mature individuals has declined by 40% and can be used as an estimated reduction under Criterion A. The decline is liable to continue, so this can also be applied as a continuing decline in the number of mature individuals.
Projected (quantitative)	Mark-recapture data indicates the relative abundance of a once common frog is decreasing at a rate of 30% each breeding season due to chytrid fungus and it is now locally extinct from some sites at the south of its range. This data can be used to project a continuing decline in mature individuals in other areas of its range as the disease spreads. Because the local extinctions caused a decline in EOO and AOO, this can also be included as a continuing decline under Criterion B and used to suspect a reduction under Criterion A3-4c.
Inferred (qualitative)	A plant within the Myrtaceae family grows within the naturalised distribution of myrtle rust. Minimal field surveys have been undertaken for this species. However, it is severely impacted by myrtle rust in an *ex-situ* garden. This information can be used to infer a continuing decline for the species based on the presence of myrtle rust in the area that the species occupies.
Suspected (qualitative)	A plant within the Myrtaceae family grows within the naturalised distribution of myrtle rust. There is no information on whether it is susceptible to infection, and other species in the genus can be highly susceptible or display no symptoms at all. This information can be used to suspect a continuing decline in habitat quality for the species.

Appendix 10. Locations with multiple threats across a species’ range



When there are two or more serious plausible threats, nominators should apply the threat that results in the smallest number of locations. In the above example, the nominate species (an obligate seeding plant represented by the green drawings) is threatened by a mine site in one area (brown cross hatching), over-grazing by cattle (outside of the mine impact area), and fire exclusion to protect grazing pasture and the mine site (fire symbol). The whole population is represented inside the blue dashed line. When assessing the locations, the threat resulting in the smallest number of locations would be lack of fire, which equates to one location, as it impacts the entire distribution of the species, rather than just parts of it.

Appendix 11. Locations with different threats in parts of a species' range



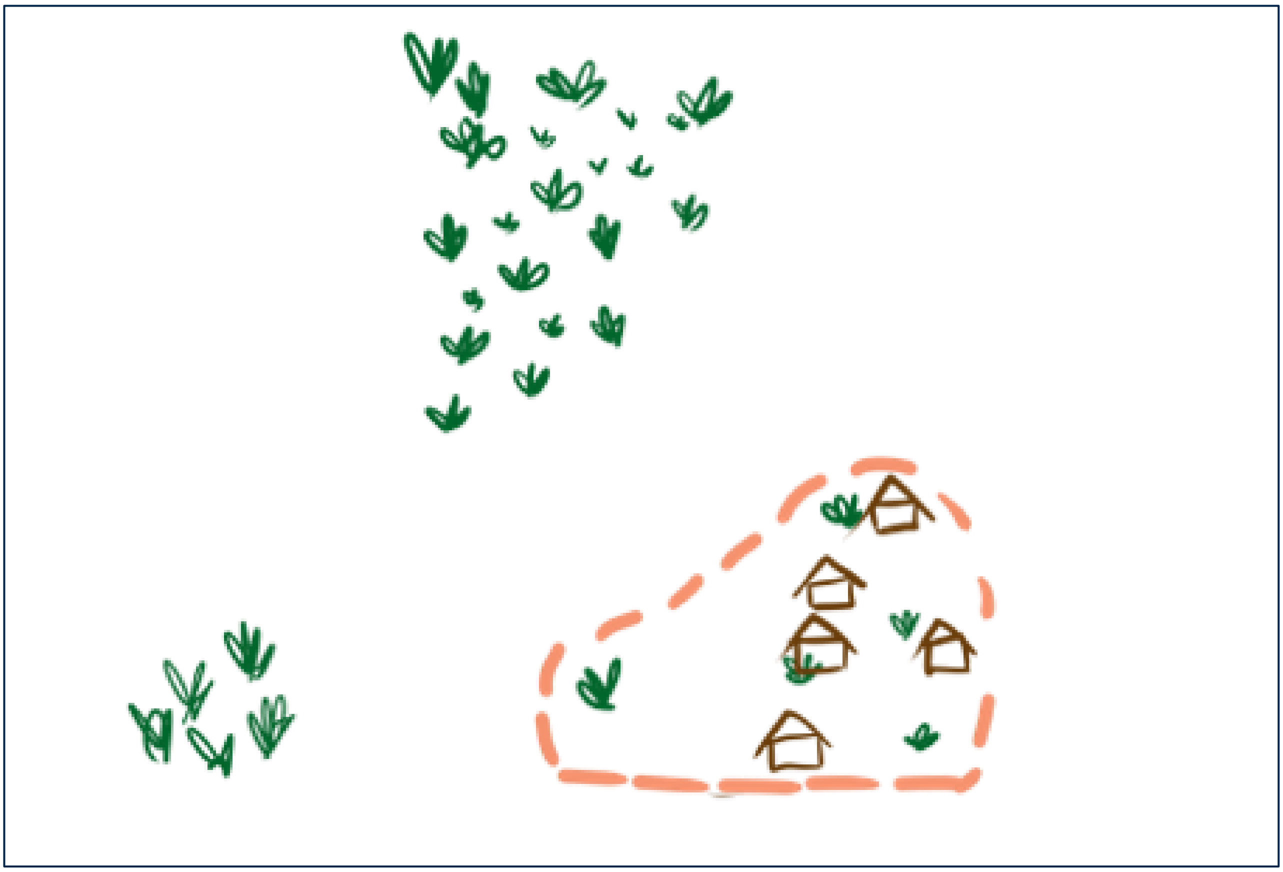
Where the most serious plausible threat differs across the species' range, nominators should assess each of these areas independently according to the corresponding threat. In the above example, the nominate species, a small mammal occurs in an area with abundant feral cats. The nominate species is also protected in an enclosure where feral cats cannot enter. In the enclosure, the most serious plausible threat is genetic depression via inbreeding. When assessing locations, nominators would assign one location to the area outside the enclosure fence, where feral cats can simultaneously impact all individuals. A second location would be assigned to the area within the enclosure fence where genetic inbreeding could rapidly impact all individuals. Therefore, there would be two locations for the nominate species.

Appendix 12. Locations where the most serious plausible threat is caused by cumulative impacts

Where the most serious plausible threat is habitat loss that occurs gradually and cumulatively via many small-scale events, locations should be defined by, *"the area over which the population will be eliminated or severely reduced within a single generation or three years, whichever is longer"* (IUCN SPC, 2024). In the scenario above, the nominate species (green drawings) is a perennial shrub that has a generation length of 10 years, which occurs in an area being developed for housing (orange). Only parts of the population are currently impacted, but the housing footprint extends across the whole population (orange). The housing footprint is expected to be fully developed within the next 6 years (which is within a single generation for the species). Rather than defining locations at the scale of a single house or property, locations should be defined as the cumulative impact area. Therefore, the nominate species occurs at one location.

Note: If the species has a relatively short generation length (i.e. 2-3 years) and the full development would not occur within the span of one generation (i.e. a staged development over a 10-year period), use of multiple locations may be more appropriate.

Appendix 13. Locations with a combination of impacted and unimpacted sites



Where part of the population is not impacted by a threat, nominators should consider:

- not using locations if area impacted is <50% of the species' distribution/EOO/AOO; or
- using subpopulations as a proxy for locations in the unimpacted areas; or
- transposing the size of smallest location from impacted areas to non-impacted areas. If selecting this option, ensure that it is sufficiently justified.

In the above example, the nominate species is a shrub (green drawing) with a generation length of five years, which occurs in three subpopulations. One subpopulation occurs within a housing development (orange dashed line). The other subpopulations are not impacted by any threat.

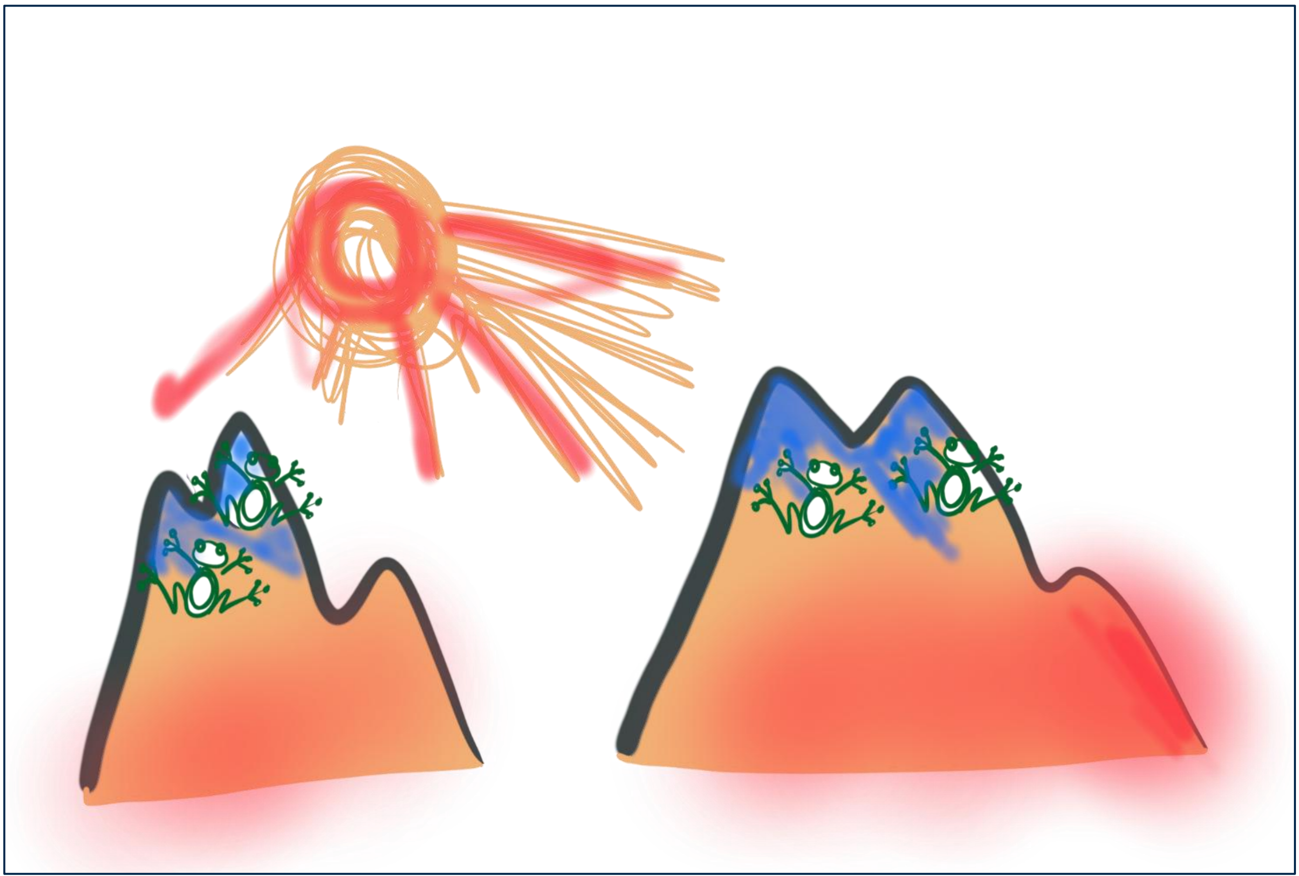
When delineating locations, the following thought process could be followed:

- The most serious plausible threat is housing development, which only impacts part of the population. The part of the population impacted by this threat will be one location, as the development is likely to be fully completed within 4 years (shorter than one generation for the species).
- For the part of the population not impacted by this threat, there could be two additional locations based on the subpopulations if the subpopulations were used as a proxy for the size of locations.

- Alternatively, the size of the location impacted by houses could be transposed onto the remaining distribution of the species. This would also result in two additional locations.
- The nominator could decide that it is not appropriate to assess the locations for the species as >50% of the population is not impacted by any threat. In this situation, the species would not have the required location data to be assessed under Criterion B or D. This may be the most appropriate option if the species has not been well surveyed and is also likely to occur in many other locations. However, the general preference is that locations are assessed where there is any plausible threat, and that minimum and maximum plausible bounds are used to deal with any uncertainty, even if these bounds are large.

Therefore, the nominate species could be argued to have three locations.

Appendix 14. Locations for climate change



Climate change should only be used as the most serious plausible threat to define locations when the direct mechanism can be clearly defined. The (IUCN SPC, 2024) use the term 'proximate causes', but direct mechanism is used here for clarity. If the threat identified is an increase in temperature or decrease in precipitation due to climate change, this should not be used to define locations. This is because the direct mechanism (i.e. the specific relevance to the species) has not been clearly defined. Rather, if the threat was a decrease in precipitation due to climate change, resulting in reduced soil-air moisture that is relied upon by high elevation montane specialist plants, this could be used to define locations. Similarly, if the threat was an increase in temperature, such that it would exceed the thermal tolerance of a species, this could be used to define locations. However, the implications of this threat may vary based on several factors, such as generation length, the quality of modelling, or variation in the species' distribution (see below).

For long-lived species

A long-lived tree species occurs on two mountain tops in north Queensland. If the direct threat mechanism for the long-lived tree species (one generation = 200 years) is identified to be habitat shifting and alteration (montane drying) resulting in habitat loss for the species, this could be used to count locations. For example, if losses to habitat are projected within the species' distribution within the next 20-50 years by well-founded research, the following approaches might be used to delineate locations:

- If both mountains occur in a similar climatic region (i.e., elevation, latitude/longitude and/or bioregion), nominators could argue that both mountain tops will experience the impacts of increased temperatures similarly within the next 20 – 50 years. Therefore, the species may occur at one location as these changes are highly likely to cause serious impacts to the species within a single generation. The situation would differ for a short-lived species (see below).

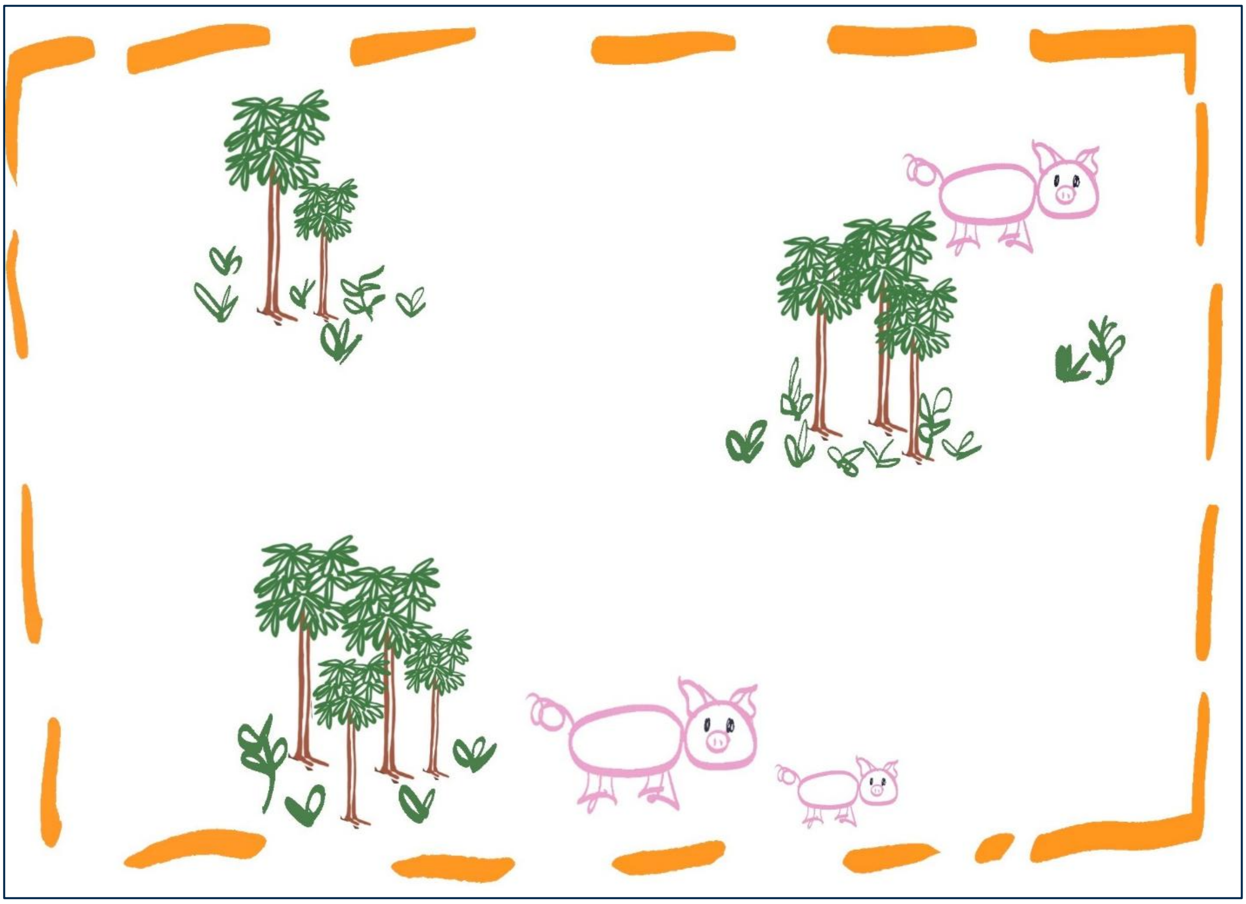
- If the mountains were sufficiently geographically separated, occurred at different latitudes or longitudes, elevations or even in a different bioregion, nominators may consider that the increase in temperatures will occur at different rates, or to different severities, and may not impact the species severely at both sites within the same timeframe. Therefore, each mountain peak may be considered a separate location.

For short-lived species

A frog species occurs on two different mountain-top habitats. If the direct threat mechanism is identified to be increased temperatures that exceed the thermal tolerance of the frog species (which has a generation length of 5 years), this could be used to count locations. Particularly where the frog species relies on cooler temperatures in high-altitude environments, which are projected to disappear in the next 20-50 years. In this scenario, the following approaches might be used to delineate locations:

- If both mountains occur in a similar climatic region (i.e., similar elevation, latitude/longitude and/or bioregion), then nominators could argue that both mountain tops will experience the impacts of increased temperatures simultaneously. However, these impacts are unlikely to occur within the next 5 years, or over the course of one generation (noting that projections are for 20 – 50 years in the future). Therefore, it may be most appropriate to use a range of locations for the species (i.e. 1- 5) to account for the fact that parts of its habitat may not be impacted within a single generation.
- If the mountains were sufficiently geographically separated, occurred at different latitudes or longitudes, or even in a different bioregion, nominators consider that the increase in temperatures will occur at different rates, or at different severities, and may not impact the species simultaneously. Therefore, each mountain peak may be considered to support several locations. It may be most appropriate to use a broader range of locations for the species (i.e. 1-10) to account for the fact that impacts to its different habitat niches are poorly understood.

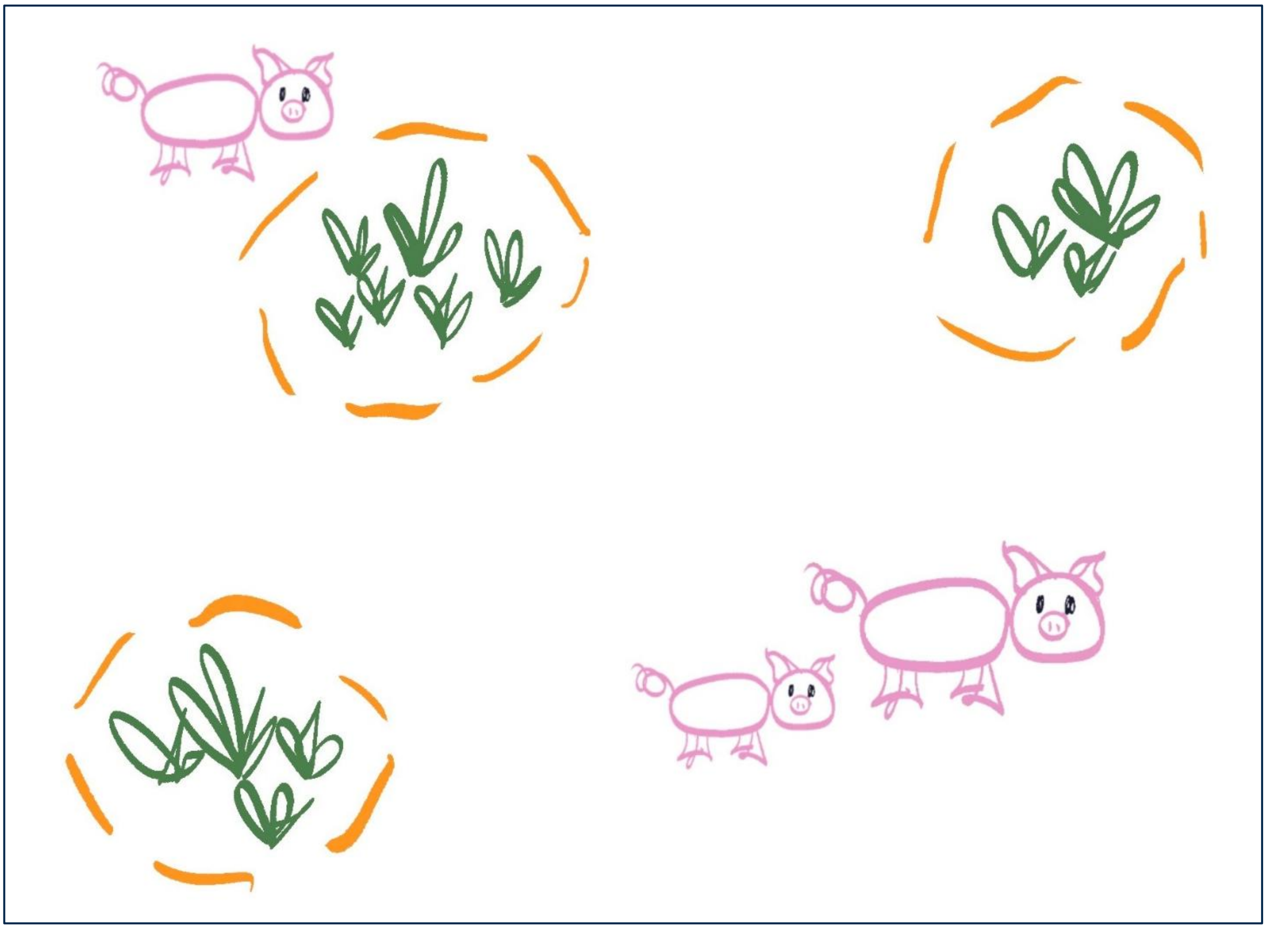
Appendix 15. Differences in assessing locations for short-lived and long-lived species



For long-lived species

A long-lived lowland rainforest tree (generation length = 80 years) occurs within three subpopulations on alluvial soils in a bioregion where impacts from feral pigs in this habitat type is extensive. Research has clearly documented that feral pigs (pink) adversely impact the species' habitat quality by damaging seedlings (although impacts on this rare species have not been specifically documented). Feral pigs are known to be common within the species' distribution. Because it is highly plausible that all three subpopulations will be adversely impacted by feral pigs within the next 80 years (i.e. one generation), it is most appropriate to group all subpopulations as one location (orange dashed line).

Note: The situation may differ if the species' distribution is expansive or if parts of the species' distribution may not be impacted by feral pigs (refer Appendix 13. Locations with a combination of impacted and unimpacted sites *for further information).*



For short-lived species

A short-lived lowland rainforest herb (generation length = 1 year) occurs within three subpopulations on alluvial soils in a bioregion where impacts from feral pigs in lowland environments are extensive. Research has clearly documented that feral pigs adversely impact the species' habitat quality by directly killing young herbs (although impacts on this rare species have not been specifically documented). Feral pigs are known to be common within the species' distribution. While it is plausible that all three subpopulations could be impacted by feral pigs within one year, it is not 'highly plausible' that severe impacts would occur at all sites given that the species has been recorded at the same sites for several successive years. Thus, it possibly more appropriate to group each separate site as a different location (i.e. 6 locations).

Note: The situation may differ if the species' distribution is expansive or if parts of the species' distribution may not be impacted by feral pigs (refer Appendix 13. Locations with a combination of impacted and unimpacted sites *for further information).*

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