Internal use only	
Reference Number	/

Nomination to change the conservation class of a species under the Queensland *Nature Conservation Act 1992*

Complete this form to nominate a species for assessment of its conservation class under the *Nature Conservation Act 1992* (NC Act). Any subspecies, variety, race, hybrid, mutation or geographically separate population (hereafter 'species') can be nominated. The appropriate conservation class will be selected during an expert assessment process and, following approval processes, reflected in the next suitable update of the NC Act.

A species may be nominated to an appropriate conservation class from any other conservation class. The nomination assessment process may result in a species being recommended to the conservation class as nominated, or to a class better supported by scientific data and expert opinion. Assessments and nominations will be shared with the Commonwealth and other Australian jurisdictions within the species' distribution.

All plant and vertebrate species native to Queensland are protected under the NC Act and classified as Least Concern unless found eligible for a different conservation class. Invertebrate species are only protected under the NC Act if specifically named under a conservation class. A species can be nominated for listing or reassignment from any conservation class to:

A national threat category:

- Extinct (EX), Extinct in the Wild (EW), Critically Endangered (CR), Endangered (E) or Vulnerable (V) if it meets at least one of the International Union for Conservation of Nature (IUCN) criteria for species at risk of extinction

A state threat class:

- Near Threatened (NT) if the species meets at least one of the criteria for species at risk of becoming threatened in the future based on concerns relating to population dynamics or threats
- Least Concern (LC) if evidence is provided that no criteria for a higher class have been met, and the species won't become eligible for a higher class in the foreseeable future should conservation actions cease due to reclassification.

The assessment of species against the national threat categories reflected in this form complies with the Memorandum of Understanding for the Common Assessment Method (CAM) between the Commonwealth and Australian states and territories. The objective of the CAM is for partner jurisdictions to adopt each other's national assessments as appropriate. Information about the CAM can be found at https://www.qld.gov.au/environment/plants-animals/wildlife-permits/common-assessment.

To nominate a species with an Australian distribution that is not restricted to Queensland, use the nomination form and guidelines at http://www.environment.gov.au/biodiversity/threatened/nominations/forms-and-guidelines and email the completed form to the Australian Government at EPBC.nominations@environment.gov.au.

Important notes for completing this form

- **To enable a species eligibility for listing to be assessed against the criteria, please complete the form as comprehensively as possible by providing a response in each box with an orange border.**
- Completing a nomination is a demanding task. Nominators are encouraged to seek advice from experts where appropriate to assist in completing the nomination form.
- The opinion of scientific experts may be cited as personal communication with their approval. Please provide the experts' names, qualifications and contact details (including employment in a government agency if relevant) in the reference list at the end of the form.
- Include any available information and analysis or state when the required information is not available.
- Figures, tables and maps can be included at the end of the form or provided as separate electronic files or hardcopy documents (referenced as appendices or attachments in your nomination).
- Cross-reference relevant areas of the nomination form where needed.
- **Reference all information sources**, both in the text and in a reference list at the end of the form. Identify confidential material and the reason it is sensitive. With the exception of information you have identified as confidential, nominations under the CAM process may be made available by a state, territory or the Commonwealth Government to experts or the public for comment, and their contents may be published.
- If the species becomes listed nationally, the Australian Government will publish nomination information on its SPRAT website as a Conservation Advice. Your details as nominator will not be released and will be treated as confidential information.
- Guidance on interpreting this nomination form can be found in the "*Guidelines for Assessing the Conservation Status of Native Species*" developed by the Australian Government under the EPBC Act here http://www.environment.gov.au/biodiversity/threatened/nominations/forms-and-guidelines. Although not fully relevant under the NC Act, the guidelines provide assistance on several aspects of this form. Please email SpeciesTechnical.Committee@des.qld.gov for further advice on completing the nomination.

Further information on selected questions

INTRODUCTION

In accordance with the CAM, the Commonwealth Government is the default assessment 'lead' for species occurring across multiple Australian jurisdictions. Upon receipt, the nomination will be subject to a prioritisation and assessment process under the EPBC Act. Download the nomination form here http://www.environment.gov.au/system/files/pages/d72dfd1a-f0d8-4699-8d43-5d95bbb02428/files/nomination-form-species.pdf, and email it to epbc.nominations@environment.gov.au. For further information on the EPBC Act nomination, prioritisation and assessment process go to http://www.environment.gov.au/biodiversity/threatened/nominations.

Note: where the relevant jurisdictions agree, a State or Territory (rather than the Commonwealth) may lead the assessment of a cross-jurisdictional species in consultation with the Commonwealth and other relevant jurisdictions.

A nomination for a species endemic to Queensland or with its only Australian distribution in Queensland, for example a species that occurs in Queensland and Papua New Guinea, can be assessed under the NC Act. Completed nomination forms should be submitted to SpeciesTechnical.Committee@des.qld.gov.au.

Species native to Queensland may be nominated for addition to any conservation class under the NC Act, or to be transferred between classes. If the taxon at risk is a population or hybrid, or if you wish to know if a species has

been unsuccessfully nominated under the NC Act in the past, please contact the Queensland Department of Environment and Science for advice at SpeciesTechnical.Committee@des.qld.gov.au.

To search for a species' conservation class under the NC Act refer to the *Nature Conservation (Wildlife) Regulation 2006*: https://www.legislation.qld.gov.au/view/html/inforce/current/sl-2006-0206.

You may also search the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) list of threatened species in the Species Profile and Threats Database (SPRAT) at www.environment.gov.au/cgi-bin/sprat/public/sprat.pl.

The full lists of threatened fauna and flora under the EPBC Act are available here:
www.environment.gov.au/cgi-bin/sprat/public/publicthreatenedlist.pl?wanted=fauna
www.environment.gov.au/cgi-bin/sprat/public/publicthreatenedlist.pl?wanted=flora.

A list of nominated species that did not meet the assessment criteria for listing under the EPBC Act are available at www.environment.gov.au/biodiversity/threatened/unsuccessful-species.html.

A nomination to transfer a species from a threatened conservation class to Least Concern or Near Threatened under the NC Act need not address sections marked with an asterisk (*).

SCIENTIFIC AND COMMON NAMES OF NOMINATED SPECIES

- Provide the currently accepted scientific and common name(s) for the species (including Indigenous names, where known). Note any other scientific names that have been used recently such as superseded names.

TAXONOMY

- Record the species' authority and the taxonomic group to which it belongs (Family name is sufficient for plants; both Order and Family name are required for fauna).
- Is the species known to hybridise with other species? Describe any cross-breeding with other species in the wild, indicating where and how frequently this occurs.

DISTRIBUTION

- Describe the species' current geographic distribution within Queensland, and where applicable, outside Australia.
- Summarise current presence and absence information for the species including knowledge of regular or sporadic structured survey, intentional searches in nearby locations or likely habitat, or were the sightings incidental? Is there a high level of confidence that all possible locations are known, or is moderate or substantial additional survey required? If so, are high priority locations for further survey known? What is expert opinion on the likelihood of additional locations?
- Provide a map, if available, indicating latitude, longitude, map datum and location names
  - Indicate the percentage of the global population that occurs in Queensland, and what is its significance?
  - Is the Queensland population distinct, geographically isolated, or does part or all of the population migrate into/out of the Queensland jurisdiction?
  - Explain the relationship between the Queensland population and the global population.
  - Do global threats affect the Queensland population?
- Give locations of other existing or proposed populations such as populations that are captive, propagated, naturalised outside their range, recently re-introduced to the wild, and planned to be re-introduced. Note if these sites have been identified in recovery plans. Provide latitude, longitude, map datum and location name, where available, in an attached table.
- Give details of fauna species' home ranges/territories including any relevant daily and seasonal or irregular movement patterns, such as arrival/departure dates if migratory.
- Does the species occur within an EPBC Act listed ecological community? You will find a list of EPBC Act listed ecological communities here: www.environment.gov.au/cgi-bin/sprat/public/publiclookupcommunities.pl.

BIOLOGY/ECOLOGY

- **Life cycle**: Provide detail on the age at sexual maturity, average life expectancy, natural mortality rates, and generation length
  - "*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 species that breed only once. Where generation length varies under threat, use the more natural pre-disturbance generation length. It is often calculated as = (longevity + age at maturity)/2. Provide details of the method(s) used to calculate the generation length.
- **Reproduction**: Provide detail on the reproductive requirements of this species.
  - **Flora**: When does the species flower and set fruit? What conditions are needed for this? What are the pollinating and seed dispersal mechanisms? If the species reproduces vegetatively, describe when, how and what conditions are needed. Does the species require a disturbance regime (e.g. fire, cleared ground) to reproduce?
  - **Fauna**: provide an overview of the species' breeding system and breeding success, including: when it breeds; what conditions are needed for breeding; whether there are any breeding behaviours that may make it vulnerable to a threatening process.
- **Habitat**
  - Provide information on aspect, topography, substrate, climate, forest type, associated species, sympatric species and anything else that is relevant to the species' habitat.
  - Explain how habitats are used (e.g. breeding, feeding, roosting, dispersing, basking, etc.).
  - Does the species use refuge habitat (e.g. in times of fire, drought or flood)? Describe this habitat.
- **Feeding (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.
- **Movement (fauna)**: provide information on daily and seasonal movement patterns.

IDENTIFICATION OF KNOWN THREATS AND IMPACTS OF THE THREATS

- For each threat, describe:

a. whether it is actual or potential
b. how and where it impacts on this species
c. what its effect has been so far (is the threat known or suspected, does it only affect certain populations?) Present supporting information/research).
d. its expected effect in the future (is the threat known or suspected, does it only affect certain populations, is there supporting research/information?) Present supporting information/research).
e. its relative importance or the magnitude of the impact on the species.

- Identify and explain any additional biological characteristics particular to the species that are threatening to its survival (e.g. low genetic diversity).
- If subject to natural catastrophic events, i.e. events with a low predictability that are likely to severely affect the species, identify the type of event, its likely impact, and its likelihood of occurrence (e.g. a drought/cyclone in the area every 100 years). If **climate change** is an important threat to the species, provide referenced information on how climate change might significantly increase the species' vulnerability to extinction. Please refer to the *Guidelines for Assessing the Conservation Status of Native Species*: http://www.environment.gov.au/system/files/pages/d72dfd1a-f0d8-4699-8d43-5d95bbb02428/files/tssc-guidelines-assessing-species-2018.pdf.

*CONSERVATION ADVICE: THREAT ABATEMENT AND RECOVERY ACTIONS

- Describe how threats are or could be abated and/or species recovered.
- 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 species nominated as Extinct in the Wild, provide location details for any naturalised or captive populations and the level of human intervention required to sustain the species.

IMPACT OF TRANSFERRING A THREATENED SPECIES TO NEAR THREATENED OR LEAST CONCERN

- Only complete this section if you are nominating a species for transfer 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 ceased following its transfer out of a threatened wildlife class.

CURRENT LISTING CLASS AND CATEGORY

- Note: The term 'class' under the NC Act is equivalent to the term 'category' under the EPBC Act.
- Select the species' current class under the NC Act where applicable. Search the species' NC Act class here: https://www.legislation.qld.gov.au/view/html/inforce/current/sl-2006-0206.
- Select the species' current category under the EPBC Act where applicable. Search the Australian Government SPRAT Database here: www.environment.gov.au/cgi-bin/sprat/public/sprat.pl.

NOMINATED LISTING CLASS

- **After completing the section 'Eligibility against the criteria'** sufficient evidence should be available to determine your response to this section. Please select the NC Act class to which the species is being nominated.

REASONS FOR A NOMINATION TO TRANSFER TO ANOTHER CLASS

Please describe why the species is being nominated to transfer to another conservation class in Queensland:

- *Genuine.* The change in class is the result of a genuine status change that has taken place since the previous assessment. For example, the change is due to an increase in the rate of decline, a decrease in population or range size or habitat, or declines in these for the first time (owing to increasing/new threats).
- *Knowledge.* The change in class is the result of new knowledge, e.g. owing to new or newly synthesised information about the status of the taxon (e.g. better estimates for population size, range size or rate of decline).
- *Taxonomy.* The change in class is due to a taxonomic change adopted during the period since the previous assessment. Such changes include:
  - *newly split* (the taxon is newly elevated to species level)
  - *newly described* (the taxon is newly described as a species)
  - *newly lumped* (the taxon is recognised following lumping of two previously recognised taxa)
  - *no longer valid/recognised* (either the taxon is no longer valid, e.g. because it is now considered to be a hybrid, variant form or subspecies of another species, or the previously recognised taxon differs from a currently recognised one as a result of a split or lump).
- *Mistake*. The previous class was applied in error.

- *Other.* The change in class is the result of other reasons not easily covered by the above, and/or requires further explanation. Examples include change in assessor's attitude to risk and uncertainty.

INITIAL LISTING

- The reasons for the initial NC Act listing may be available in the original nomination for the species. This can be obtained by emailing the Department of Environment and Science's Species Technical Committee at SpeciesTechnical.Committee@des.qld.gov.au.
- The reasons for EPBC Act listing may also be available. Search for the species' EPBC Act listing and conservation advice for threatened species in the SPRAT Database www.environment.gov.au/cgi-bin/sprat/public/sprat.pl.
- If there is insufficient information to provide details of the reasons for the original listing, please state this.

CHANGES IN SITUATION LEADING TO THE NOMINATION TO TRANSFER TO ANOTHER CLASS

- Describe the changes that have occurred or are likely to occur to the species' population, range or habitat that influence the nomination to change the species' conservation class.

STANDARD OF SCIENTIFIC EVIDENCE AND ADEQUACY OR SURVEY

- Provide statements or expert opinion on the standard of evidence supplied in the nomination form, and the adequacy of the sighting's information provided.

ELIGIBILITY AGAINST CRITERIA

- For a species to be eligible as Near Threatened or a class of threatened wildlife, it must be assessed as meeting **at least one** of the five 'criteria' on this nomination form. For example, for a species listed as Vulnerable to be transferred to the Endangered class, it must meet the threshold/s for at least one of the five criteria for Endangered.
- A species does not have to be found eligible for the same class under all criteria; however, all questions must be answered. If information is not available for a particular criterion, a statement to this effect is required.
- If you hold unpublished data that support assessment of a criterion, you must provide them with the nomination.
- Standards for assessing a species' conservation status in Australia align with the IUCN Red List Criteria and Categories. Please refer to the IUCN guidelines for explanations of how to address the criteria https://www.iucnredlist.org/resources/redlistguidelines.
- Using the GeoCat assessment tool is highly recommended to ensure maps and calculations for Area of Occupancy (AOO) and Extent of Occurrence (EOO) meet IUCN standards (http://geocat.kew.org/, Bachman, S., Moat, J., Hill, A. W, De La Torre, J., & Scott, B. (2011), Supporting Red List threat assessments with GeoCAT: geospatial conservation assessment tool. ZooKeys, (150), 117).

  GeoCat provides the IUCN compatible estimates required by the CAM, for example: AOO must be greater than or equal to 4km2; all AOOs will be multiples of 4km2; and EOO must be greater than or equal to AOO.

  Re-centring the grid to ensure AOO doesn't look inaccurately large and detrimentally effect the true recognition of the threat level to the species is acceptable.

PUBLICATION APPROVAL

- Place a tick in the box and complete the suggested citation to have your name retained on the nomination form if it is published in full or provided outside the nomination process, for example, for ecological or other research purposes. You will not be contacted in relation to publication opportunities.

DECLARATION

In signing this nomination form, you agree to grant the Queensland Government (as represented by the Department of Environment and Science) a perpetual, non-exclusive, worldwide, royalty-free licence to use, reproduce, publish, communicate and distribute information that you have provided in the nomination form that is not referenced to other sources with the exception of information specifically identified by you as confidential, in websites and publications and to promote those websites and publications in any medium.

As nominator, your details are automatically subject to the provisions of the *Privacy Act 1988* and will not be divulged to third parties. The Commonwealth, State and Territory governments have agreed to collaborate on national threatened species assessments using the CAM. As part of this collaboration, your nomination, including your details as nominator, may be provided to other government jurisdictions, who will also observe these privacy and confidentiality arrangements.

If you subsequently agree to be cited as the author of specific, cited information, you will be acknowledged in all publications and websites in which that information appears, in a manner consistent with the *Style Manual for Authors, Editors and Printers* (latest edition).

Nomination form to change the conservation class of a species in Queensland

Details of the nominated species

SCIENTIFIC NAME OF SPECIES (SUBSPECIES, VARIETY, ETC. TO BE SPECIFIED WHERE RELEVANT)

Euastacus eungella Morgan, 1988

COMMON NAME(S)

Eungella spiny crayfish

TAXONOMY

Provide any relevant detail on the species' taxonomy (e.g. authors of taxon or naming authority, year and reference; synonyms; Family and Order).

Crayfish in the Order Decapoda, Family Parastacidae. Formally described in Morgan (1988).

*CONVENTIONAL ACCEPTANCE OF TAXONOMY

Is the species' taxonomy conventionally accepted?

☒Yes
☐No

If the species is not conventionally accepted, please provide the following information:

- 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 considered to be a new species.

Click or tap here to enter text.

*DESCRIPTION

Provide a description of the species. Include where relevant its distinguishing features, size and social structure. How distinct is this species in its appearance from other species? How likely is it to be misidentified?

Euastacus eungella is a small crayfish from the upland rainforests of Eungella National Park, inland from Mackay, Queensland. *Euastacus eungella* is part of the poorly spinose group of *Euastacus* species, which is characterised by a small body size and relatively few spines (Coughran 2008). This species has been recorded as having an occipital carapace length (OCL) of up to 33 mm (Morgan 1988; Coughran 2008) and weighing up to approximately 20 g (McCormack 2012). The colour in this species varies, and it can have a purple, blue, green or brown back (Morgan 1988; McCormack 2012), with smaller, immature individuals often being pale brown or green (Morgan 1988). Thus, colour is not a reliable diagnostic characteristic in this species, as is also true for freshwater crayfish in general, since colour can vary greatly within species, even within a section of stream (J. Furse pers. comm. 2020).

Euastacus eungella is most similar morphologically to *E. monteithorum* (Monteith's spiny crayfish) and then to *E. bindal* (Mt. Elliot crayfish) (Morgan 1989), which are found about 450 km to southeast and 250 km to the northwest respectively. *Euastacus eungella* can be differentiated from both species as *E. eungella* has dorsal carpal spines and the others do not (Morgan 1997). There are no other species of *Euastacus* reported from within 250 km of *E. eungella*'s distribution (Morgan 1988), however there are crayfish species from the Genus *Cherax* reported from the Eungella area (Morgan 1988). *Cherax cairnsensis* (part of the taxonomically problematic *C. depressus* [orange-fingered yabby] complex; Short 2000) are sympatric with *E. eungella* in larger, lower altitude streams. The two species overlap at a zone which represents the lower altitude end of *E. eungella*'s distribution and the upper end of *C. cairnsensis*'s (McCormack 2012). The two genera can usually be differentiated as species of *Euastacus* typically have more spines than *Cherax*, but *E. eungella* is relatively smooth and so could be confused with *Cherax* (Furse & Coughran 2010). However, the taxa can be differentiated as the propodus (the fixed part of the chelae/claw) is smooth for *Cherax* and rough for *E. eungella,* with small ridges and spines.

DISTRIBUTION

Provide a succinct overview of the species' known or estimated current and past distribution, including international/national distribution. Provide a map if available.

Is the species' habitat protected within the reserve system (e.g. national parks, Indigenous Protected Areas, or other conservation estates, private land covenants, etc.)? If so, which populations? Which reserves are actively managed for this species? To your knowledge, which reserves are being actively managed in way that provides incidental benefits for this species? Give details.

What is the current evidence for the presence and absence of the species in its known or nearby locations, and in potential habitat? Is there a high level of confidence that all locations are known, or is moderate or substantial additional survey effort required? If so, where should further survey be undertaken?

Euastacus eungella was described from a site at about 900 m ASL in the Clarke Range in Eungella National Park, at the head of the Pioneer Valley about 70 km west of Mackay, Queensland (Morgan 1988). The Clarke Range is a plateau on the eastern edge of the Great Dividing Range, with peaks up to 1259 m ASL (Mt. Dalrymple). It is a zone of overlap between many tropical and subtropical species, while also hosting many of its own endemics (Ashton et al. 2020). The uplands of the Clarke Range is an island of cool, wet rainforest in a warm sea of eucalypt woodlands and human-altered lowlands (Ashton et al. 2020). Eungella National Park is relatively large (area 59885 hectares), and is home to the largest patch of rainforest in the 1200 km between the World Heritage rainforests of the Wet Tropics to the north and Gondwana rainforests to the south on the NSW border (Ashton et al. 2020). The Clarke Range area is part of the Clarke - Connors Ranges Biogeographic Subregion within the Central Mackay Coast Region (Interim Biogeographic Regionalisation for Australia, IBRA7; Commonwealth of Australia 2012). The Clarke - Connors Ranges Subregion runs north-south, sandwiched between the Proserpine - Sarina Lowlands to the east and Brigalow Belt North to the west.

Euastacus eungella is found in the montane rainforests of the southern section of Eungella National Park. It straddles the upland drainage divides of three basins, the Burdekin, Pioneer and O'Connell (Fig. 1). Most known records are within a kilometre of the drainage divide. *Euastacus eungella* has been reported from a number of sites in the Burdekin Basin (Broken River, Massey Creek, Urannah Creek; 620 – 930 m ASL), Pioneer Basin (Cattle Creek [type location], Finch Hatton Creek, Tree Fern Creek; 220 – 1030 m ASL), and O'Connell Drainage (Boulder Creek; 225 m ASL). Most *E. eungella* sites (84%) are at an altitude of over 500 m ASL, with 66% over 700 m ASL.

Distributional data of *E. eungella* were assembled from published sources: Morgan (1988), Ponniah & Hughes (2004), Shull et al. (2005); databases: Atlas of Living Australia (www.ala.org.au), OZCAM (ozcam.org.au), Queensland Museum (VERNON Database via P. Davie and D. Potter); and personal communications: H. Hines (QPWS unpub. data), R. McCormack (Australian Aquatic Biological unpub. data).

Euastacus eungella's Area of Occupancy (AOO) is 76 km^2, and Extent of Occurrence (EOO) is 179 km^2 (calculated with GeoCat, available at: geocat.kew.org; Bachman et al. 2011). *Euastacus eungella* is considered to inhabit a single location (upland rainforest community of Eungella National Park) as defined by the IUCN (IUCN Standards and Petitions Subcommittee 2019), based on common threats (see Criterion B below for more information).

All of the recorded sites of *E. eungella* are within Eungella National Park (Fig. 1), except a single low site on Tree Fern Creek that is about 150 m outside the Park. Thus, *E. eungella* receives the umbrella protection afforded to a native species within a national park. The species is not actively managed, but its presence as an endemic species is noted in the management statement for the Mackay Highlands (QDNPRSR 2013). There are discussions about putting Eungella National Park forward as a possible World Heritage Area (QDNPRSR 2013; Ashton et al. 2020), which would probably have various species management implications, but this has not gone forward as yet.

Eungella National Park is flanked to the north and south by a number of state forests and reserves (Fig. 2), which have also been surveyed, but to a lesser extent. The *E. eungella* sites used to determine its distribution have been verified to delineate as accurate a picture of the species' whereabouts as possible. However, there is at least one site where *E. eungella* has been reported as having been seen well to the north of verified sites that has not been included here (from 2001, 37 km northwest of the next most northern verified site). This is at Amelia Creek (Burdekin Basin), about 2.5 km west of Cathu State Forest (Fig. 2). There are no specimens or photographs from this record and so it has been treated as unverified here, however the relevant researchers are experienced field naturalists, and the habitat at the site matches other *E. eungella* sites to the south reasonably well (altitude 620 m ASL; Regional Ecosystem 8.12.2/8.12.1a; Queensland Herbarium 2019). If this site were included in occurrence calculations, the species' EOO would be 658 km^2.

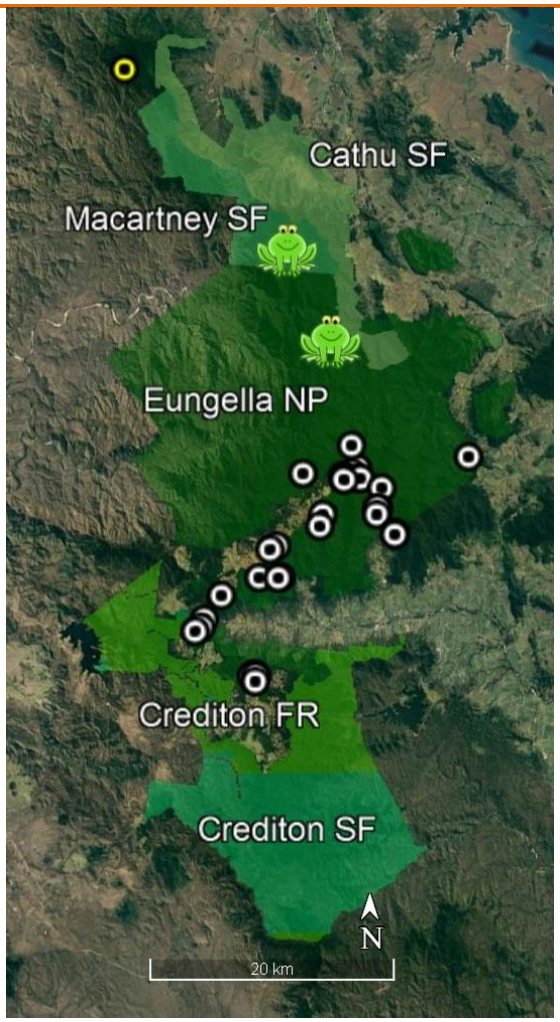


Fig. 2: National Parks (NP), State Forests (SF) and Forest Reserves (FR) in the Eungella area. (white circles = verified *Euastacus eungella* sites, yellow circle = unverified *E. eungella* site, frogs = selected *Taudactylus* sites). Displayed in Google Earth Pro (version 7.3.2.5776).

The unverified Amelia Creek record was noted during a frog survey, and this highlights an issue with this crayfish dataset. *Euastacus eungella* has most often been encountered and recorded during the surveying and monitoring of sympatric threatened frog species (H. Hines pers. comm. 2020). These incidental records make up a majority of the sightings, with very little surveying have been done specifically for *Euastacus eungella*. Morgan (1989) noted that the distribution of various *Euastacus* species closely matches that of various frog species from the Genus *Taudactylus* on multiple mountain tops from the very south of Queensland to the north, including at Eungella.

Euastacus eungella is sympatric at Eungella with two endemic frog species from this genus, *Taudactylus eungellensis* and *T. liemi.* The known distributions of these frog species, both historic and contemporary, closely match that of *E. eungella*, with nearly all of the frog sites also occurring in the southern part of Eungella National Park (Meyer et al. 2020). The altitudinal range of both species is also very similar to *E. eungella* (220 – 1030 m; most > 700 m), with *T. liemi* 230 – 1050 m (most > 600 m) and *T. eungellensis* 190 – 1050 m (most < 700 m) (Meyer et al. 2020).

Taudactylus species apparently have very similar environmental preferences to *E. eungella,* namely higher altitude notophyll rainforest near creeks and seepage areas. Therefore, it is potentially significant that *Taudactylus eungellensis* has been recorded at Macartney State Forest (in 1990) to the north of Eungella NP (Fig. 2), and both *T. eungellensis* and *T. liemi* recorded at Urannah Creek (2009-2015) in the northern part of Eungella NP at an altitude and in a Regional Ecosystem (RE) conducive to *E. eungella* (~650 m; RE 8.12.1a/8.12.2) (Meyer et al. 2020). This is the same creek which hosts a verified *E. eungella* site 8.5 km to the southeast (or ~12.5 km upstream creek distance). There is potential *E. eungella* habitat in terms of appropriate elevation and vegetation in a number of places in the northern portion of Eungella NP and in the surrounding state forests (D. Ferguson pers. comm. 2020). This includes in the general area (near Cathu State Forest) of the unverified *Euastacus* record mentioned above (D. Ferguson pers. comm. 2020). However, some of the habitat in these areas is not suitable and can be fairly dry (K. McDonald, C. Hoskin pers. comms. 2020). A number of surveys (for frogs) in the Massey Creek area of northern Eungella NP (C. Hoskin pers. comm. 2020) and Cathu

and Macartney State Forests (K. McDonald pers. comm. 2020) did not report *Euastacus*, although these were not always in prime *Euastacus* habitat and did not target *Euastacus* (C. Hoskin pers. comm. 2020).

The northern section of Eungella NP is highly isolated, with dense vegetation, steep escarpments and deep gorges, making it very challenging to survey. Therefore, it and other state forests have experienced very limited survey effort (D. Ferguson pers. comm. 2020). There has been some frog sampling in the northern part of Eungella NP (Meyer et al. 2020), sometimes by helicopter, but relatively little (D. Ferguson pers. comm. 2020), and no crayfish-specific surveys.

There is also potential for *Euastacus eungella* to be found in Crediton Forest Reserve and Crediton State Forest to the south of Eungella NP (Fig. 2), especially as *E. eungella* has been sampled only a few hundred metres from the Crediton Forest Reserve in the Broken River, which also flows through the Forest Reserve. This suggests that the limited survey effort for frogs, and negligible survey effort for *Euastacus*, over this whole, largely inaccessible area, is probably inadequate to have complete confidence in defining the full extent of the species' distribution. Despite this, there is little chance that *E. eungella* could be present more than a few kilometres beyond the limits of the various reserves in the area, given the lack of suitable habitat (vegetation, precipitation, elevation, temperature) and the human modified landscape. Therefore, the very largest theoretically possible Extent of Occurrence for *E. eungella* would be if it were ubiquitous throughout all of the local reserves (Fig. 2; total of 1108 km^2), which equates to a maximum possible EOO for the species of 1900 km^2.

The presence of "highland" species at some lower altitudes sites (Table 1) suggests that they can tolerate lower elevations, at least in some places at some times, even if overwhelmingly their distribution is at more upland sites. Whether these particular lowland sites have certain "upland" characteristics (groundwater fed, cold air drainage, shelter, vegetation; H. Hines pers. comm. 2020), and/or some sub-populations can tolerate harsher conditions, and/or these lower sites are population sinks at the very edges of distributions is unclear. However, it highlights the complexity behind determining the reason for a species' distribution.

It is certainly clear that elevation is a key factor in determining distribution, however elevation is usually tightly correlated with temperature and precipitation. Vegetation communities are also closely linked to altitude. Woody plants at Eungella National Park are stratified by elevation, with distinctly different assemblages from 200 – 600 m and above 800 m, and different palm species are dominant above and below 800 m (*Archontophoenix alexandrae* below, *A. cunninghamiana* above) (Ashton et al. 2020).

Table 1. Breakdown of elevational range of *Euastacus eungella*, *Taudactylus eungellensis* and *T. liemi* sites (*Euastacus* data – this nomination; *Taudactylus* data – derived from Meyer et al. 2020).

			% of sites for that species			
Species	No. sites	Altitudinal range	<350 m	350-600 m	601-850 m	>850 m
Euastacus eungella	32	220-1030 m	9%	19%	28%	44%
Taudactylus eungellensis	32	190-1050 m	28%	31%	22%	19%
Taudactylus liemi	63	230-1050 m	11%	14%	38%	37%

Morgan (1989) warned that simplistic explanations of a species' range will not always prove true, as all of the various factors interact, and change over time. For example, *Euastacus* (and *Taudactylus*) closely track the presence of rainforest, which is only found currently in isolated pockets at altitude in eastern Queensland (Morgan 1989). However, during previous interglacial periods, rainforests would have been found more widely at lower altitudes, given a warmer and wetter climate (Marshall & Martin 2019). While the vegetation and increased precipitation might have been conducive to *Euastacus* expanding its range, the warmer climate (and therefore warmer water) almost certainly would not, and so *Euastacus* may have remained isolated on the cooler mountaintops despite the expanding rainforests, and perhaps their range may have even contracted as the rainforests expanded (Morgan 1989). Conversely during cooler glacial periods, *Euastacus* may have also been largely restricted to mountaintops despite the cooler climate, this time by the barrier of aridity (Ponniah & Hughes 2006).

There is still the possibility that the *E. eungella*'s distribution presented here really just reflects the distribution of its sympatric frogs, which were the real focus of most of the survey work. It may be that this *E. eungella* distribution only highlights the portion of the *E. eungella*'s distribution that happens to overlap with these frog species. However, this does not seem terribly likely given the presumed common physiological and physical

constraints acting on these species (temperature, water, connectivity), both now and in the past. Although the area is not generally well sampled, *E. eungella* specimens are not commonly reported in incidental observations, and so are almost certainly not very widely distributed. The extent of the *E. eungella* distributions presented here are probably reasonably accurate, but there should be targeted future *Euastacus*-specific surveys to delineate the precise distribution.

BIOLOGY/ECOLOGY

Provide a summary of biological and ecological information.

Include information on:

- life cycle including age at sexual maturity, life expectancy and natural mortality rates
- specific biological characteristics
- the species' habitat requirements
- for fauna: feeding behaviour and food preference and daily/seasonal movement patterns
- for flora: pollination and seed dispersal patterns

Little is known about the life cycle of *Euastacus eungella**,*** however it is recognised that *Euastacus* species have a suite of common biological characteristics, and many of these characteristics apply to *E. eungella* (Furse & Coughran 2011). The life-cycle of *E. eungella* is likely similar to other small, upland *Euastacus* species, meaning slow growth, late-maturing females, and a slow reproductive cycle (K-selection) (Furse & Coughran 2011). In particular the species is likely to be biologically similar to *E. monteithorum*, to which it is likely closely related (Morgan 1989). *Euastacus monteithorum* is the closest genetic match to *E. eungella* on GenBank (blast.ncbi.nlm.nih.gov) (93.28% for the mitochondrial COI gene, 19 May, 2020).

The largest recorded specimen had an OCL of 33.0 mm (Morgan 1988), although Morgan (1988) suspected that some large individuals might potentially be in the 40 – 50 mm OCL range because of some large chelae found in the Queensland Museum and reports of large individuals seen by rangers in the field (Morgan 1988; H. Hines QPWS unpub. data). Morgan (1988) considered specimens < 20 mm OCL to be "smaller" (likely immature), and suggested female sexual maturity might be reached at an OCL above about 30 mm. The timing of breeding is unknown as berried females have not been observed (McCormack 2012). The actual growth rates, population sizes and generation lengths of *E. eungella* are not known.

Like many spiny crayfish species, *E. eungella* is restricted to cooler upland habitats (Furse & Coughran 2011), but its precise thermal tolerance is not known. However, another montane rainforest species, *E. sulcatus*, becomes distressed at about 22ºC, and was effectively incapacitated at 27ºC, and all died (Bone et al. 2014). *Euastacus sulcatus* is much larger than *E. eungella* and so it is possible that *E. sulcatus* could handle temperature variation better.

Euastacus eungella, like many parastacid crayfish, hosts a species of ectocommensal temnocephalan flatworm (*Temnohaswellia pearsoni*) (Hoyal Cuthill et al. 2016). The diet of *E. eungella* is not well understood. *Euastacus eungella* makes extensive burrows, with multiple chambers and entrances, which are usually flooded (McCormack 2012). *Euastacus eungella* appears to spend most of its time in burrows, as it is rarely seen in daytime (McCormack 2012), so may be nocturnal, as is typical in many freshwater crayfish (Furse et al. 2006).

Euastacus eungella is found largely in upland tropical notophyll vine and mossy rainforest in a high rainfall area (average 2240 mm annually; Ashton et al. 2020). Its habitat is in small, cool, clear-flowing streams flowing through a rock and soil substrate, shaded by palms and other dense rainforest, and in wet permanent seepage areas (Morgan 1988; McCormack 2012). Nearly all *E. eungella* sites are at over 500 m altitude, with most sites in the 700 – 900 m range. However, a small number of sites in the Pioneer and O'Connell drainages are as low as about 220 m. At the lower sites, they are sympatric with another crayfish, *Cherax cairnsensis* (McCormack 2012).

Euastacus eungella is associated almost exclusively with Broad Vegetation Group (BVG) 5b (notophyll to microphyll vine forests, frequently with *Araucaria cunninghamii* [hoop pine], on ranges of central coastal bioregions; Neldner et al. 2019). Within this vegetation group, Regional Ecosystem (RE) type 8.12.2 (Evergreen notophyll to complex notophyll vine forest of uplands, highlands and foothills, on Mesozoic to Proterozoic igneous rocks; Queensland Herbarium 2019) is mapped at 88% of all recorded *E. eungella* sites (often in a mixed RE with 8.12.1a, 8.12.3a and/or 8.12.19; Queensland Herbarium 2019). RE 8.12.2 is particularly often found as a mosaic with RE 8.12.1a in the Clarke Range (Queensland Herbarium 2019). A small number of sites (12%) in upper Cattle Creek (Pioneer) are associated with BVG 6b (Simple evergreen notophyll vine forests to simple microphyll vine fern thickets on high peaks and plateaus of northern Queensland; Neldner et al. 2019), in particular RE 8.12.17a (Evergreen microphyll to notophyll mossy forest to thicket of ridges and plateaus on highlands to foothills, on Mesozoic to Proterozoic igneous rocks; Queensland Herbarium 2019). This *E. eungella* RE association is preliminary, as the method for defining frog sites (which are typically hundreds of metres long) may cause the site centroid to fall outside of the mapped rainforest RE polygon (H. Hines pers. comm 2020).

However, these preliminary results do accord well with our direct observational knowledge of *E. eungella*'s habitat.

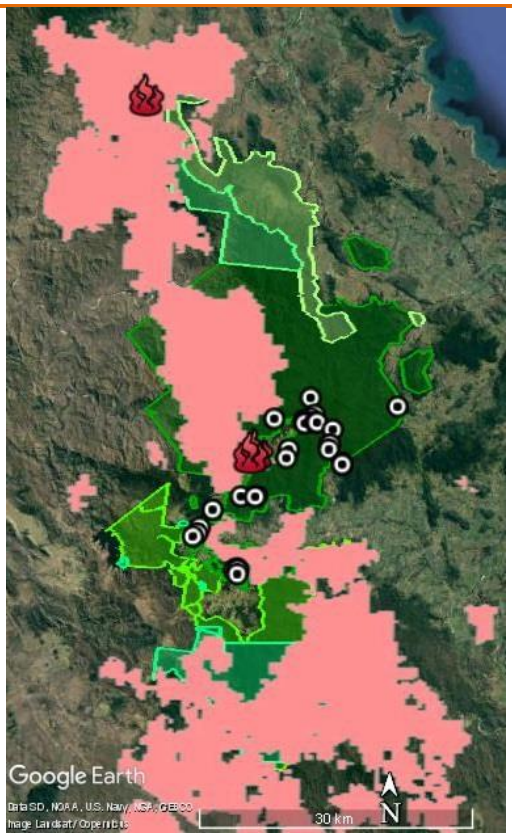
Threats

IDENTIFICATION OF KNOWN THREATS AND IMPACT OF THE THREATS

Identify any known threats to the species in the table below. Describe **past, current or future** threats, whether the threats are **actual or potential**, and the **type and level of impact** you believe each threat is having on the species.

Past threats	Impact of threat
Bushfire	Bushfire is a common feature of the general Australian environment, however this is typically more prevalent in sclerophyll forests than rainforests (Murphy et al. 2012). *Euastacus eungella* has been buffered to some extent as dense rainforest burns much less often than open woodland. As the upland rainforest is usually too wet to burn, it has not evolved the traits to cope with fire that much of the rest of the Australian environment has (Hines et al. 2020). This means that the notophyll forest that is *E. eungella*'s home is fire sensitive (Queensland Herbarium 2019; Hines et al. 2020). The small, restricted distribution of *E. eungella* places it at risk in the event that fire does impact its very limited area. The main fire season at Eungella is usually May to November (Hines et al. 2020). Even though rainforest patches that are home to *E. eungella* are surrounded by much more flammable eucalypt forest, the rainforest has usually avoided large-scale damage. However, when even just the rainforest edges burn, it can have negative effects as it allows the influx of lantana (*Lantana camara*) and other weeds, which are themselves fire prone (Bushfire Consortium 2012). During drought, when there is low soil moisture and high temperatures, fire can enter the rainforest, including in the narrow rainforest gullies (H. Hines pers. comm. 2020). Large-scale bushfires occurred in the Clarke-Connors Ranges in 1999, 2001, 2004, 2006, 2012 and 2018 (Reef Catchments 2013; Hines et al. 2020; NAFI 2020). When conditions are particularly extreme and bushfire enters the rainforest, the effects can be long-lasting (Reef Catchments 2015). Even fires with very low flame heights can have major consequences in the rainforest, as they lead to loss of leaf litter, seedling bank, and ground vegetation, and can result in tree and shrub death after a few months through bark and root damage (Hines et al. 2020). When gaps open up in the canopy following fires, invasive species like lantana and grasses often invade the rainforest itself, changing the moist microclimate, competing with the reestablishment of native plants, and making future fires more intense and frequent (Hines et al. 2020). Areas that have been logged in the past (National Park) or are still being logged (state forests, forest reserves) are more at risk from bushfires because existing gaps in the canopy promote drying of fuels (Hines et al. 2020). When bushfires do reach the rainforest, it can transform ecosystem structure and function and change the boundary between it and the sclerophyll forest (Hunter 2003), which is not suitable *E. eungella* habitat. For example, a previously logged patch of rainforest near Crediton burned in 1992, with more than half of the rainforest trees dying with lantana subsequently becoming dominant (Hines et al. 2020). The effects of these fire regimes may be amplified by interactions with drought (see below). It is not clear what the direct impact of fire on crayfish populations may be, however another rainforest crayfish (Ellen Clark's Crayfish; *Euastacus clarkae*) suffered a mass kill directly after a fire (McCormack 2015). Similarly, *E. bispinosus* (Glenelg spiny crayfish) abundances declined after fire events, perhaps due to associated reduction of habitat quality (Johnston et al. 2014). Indirect impacts of fire are potentially long-lasting, and include serious habitat degradation and/or destruction, and ensuing water quality issues that highly impact freshwater species (Bryant et al. 2012). Sediment and ash run-off from fires can degrade water quality, leading to a change in the pH of the water and low dissolved oxygen (Silva et al. 2020). Level of past impact = low.
Drought	Drought is a common feature of the general Australian environment, including in northern Queensland over a long timescale (QDES 2019). Severe drought is obviously a challenge for a freshwater species. Level of past impact = low.

Feral pigs	"Predation, habitat degradation, competition and disease transmission by feral pigs (*Sus scrofa*)" was listed by the Federal Government in 2001 as a key threatening process under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (Commonwealth of Australia 2017). Negative impacts can be direct (predation, digging, rooting, wallowing) and indirect (changing plant species composition, water quality) (Commonwealth of Australia 2017; Negus et al. 2019). Feral pigs are thought to consume crayfish and damage its habitat (Commonwealth of Australia 2017). They are considered a major threat for genera of burrowing crayfish, e.g. *Engaeus* (TAS, VIC)*, Engaewa* (WA) (Commonwealth of Australia 2017). Feral pigs cause significant damage in rainforests, in both the highlands and lowlands (Mitchell & Mayer 1997), in particular in moist rainforest gullies (Reef Catchments 2013), which are prime habitat for *E. eungella*. At least two REs associated with *E. eungella* (8.12.1, 8.12.19) are subject to feral pig damage (Queensland Herbarium 2019). Habitat destruction caused by feral pigs to stream beds and banks is evident and obvious in many places in Australia (Steward et al. 2018; J. Coughran & J. Furse pers. comm. 2020). Feral pigs damage the soil which encourages the growth of weeds, including fire prone species (Bushfire Consortium 2012). They also often move into areas that have recently experienced bushfires to look for food. Feral pigs are widespread throughout the Mackay Highlands (Reef Catchments 2013). They are reported from the same upland rainforest area as *E. eungella* (QDES 2020). Level of past impact = low/moderate.
Unauthorised collection	All *Euastacus* species are "no take" species under the Queensland *Fisheries Act 1994* (Furse & Coughran 2011). Although there are no known cases of *E. eungella* having been the object of illegal collecting (G. Lennox pers. comm. 2020), *E. eungella* is rare and has a blue morph, which is likely to be very attractive to collectors (R. McCormack pers. comm. 2020) and valuable on the black market, placing it at risk. One possible threat is that *E. eungella* could be inadvertently captured instead of *Cherax*, which are commonly caught as bait, even though this is illegal within a National Park. *Euastacus eungella* are relatively smooth and thus could be mistaken for *Cherax (*Furse & Coughran 2010). Level of past impact = unknown/low.
Current threats	**Impact of threat**
Bushfire	While a small part of Crediton Forest Reserve was burned in October 2019 (Queensland Government 2020), the Eungella Region was largely unaffected by the 2019-2020 bushfires. However, the fire season of the previous year, 2018, was the most extreme Eungella National Park had seen for a long time, and it even burned significant areas of rainforest. The fire weather conditions in 2018 were extreme, with preceding dry conditions, high temperatures, low humidity, strong winds, and a lack of moisture from clouds (Hines et al. 2020). Twelve areas in the Mackay Highlands burned (71,000 hectares burnt), including 11,217 hectares of rainforest and scrub communities in the national park and state forests and reserve (Hines et al. 2020). This included large portions of the western part of Eungella National Park (Fig. 3). Even high altitude communities were not spared, with 4,161 hectares of rainforest over 800 m burning (a third of it at high to extreme severity) (Hines et al. 2020). These fires were eventually put out by the arrival of rains in early December (Hines et al. 2020). Subsequently, the burned portions of rainforest have been invaded by weeds (Hines et al. 2020). Because the bushfire penetrated the rainforest, it will certainly have impacted *E. eungella*, but precisely how is not clear. This fire encompassed an area larger than the size of the National Park, and burned unsampled areas that contain suitable rainforest habitat for *E. eungella.* A number of known *E. eungella* sites are within the fire zone in the southern part of Eungella National Park, as is the unverified site in the north near Cathu State Forest (see flames in Fig. 3). Many known sites were very close to the fire front, and most sites were not more than a few kilometres distant from it. Level of current impact = moderate/high.

	 **Fig. 3:** Extent of 2018 bushfires (in pink) in the Eungella area (fire scars, 250 m pixel; NAFI 2020) (white circles = verified *Euastacus eungella* sites; flames = *E. eungella* verified and unverified sites within fire zone; green outlines = national parks, state forests, forest reserves). Displayed in Google Earth Pro (version 7.3.2.5776).
Climate change	Average temperatures across Queensland have already increased by about 1°C over a hundred years ago (QDES 2019). Heatwaves are predicted to intensify (see Future Threats). Extreme heatwave conditions in November 2018 allowed the huge expansion of existing bushfires to burn large swathes of Eungella National Park (see Bushfires above). Tropical cyclones are also predicted to intensify in the area, while the number of major tropical cyclones worldwide has been increasing at about 8% per decade between 1979 and 2017 (Kossin et al. 2020). Severe Tropical Cyclone Ului caused extensive damage at Eungella in March 2010, and aided an invasion of exotic weeds (Reef Catchments 2013, 2015). Level of current impact = low/moderate.
Drought	Severe drought is a potential driver of habitat and population loss for *Euastacus eungella*, even within a national park. Recently, cool season rain has been the lowest on record in most of subtropical Queensland (BOM 2019). Annual average rainfall has fallen almost 14% in 30 years (Reef Catchments 2015). The upland rainforest has also received less moisture from clouds (Hines et al. 2020). Reduced rainfall means less water in the creeks from run-off and lower water tables, potentially adversely affecting both the crayfish directly and their rainforest environment. Level of current impact = low/moderate.
Unauthorised collecting	Australian crayfish are for sale in Australia and overseas (legally and illegally, including online), although it is not known if *E. eungella* are among these. Level of past impact = unknown/low.
Future threats – actual	**Impact of threat**
Bushfire	Projections for the Mackay area suggest bushfires will not become more frequent, however they will become more intense (QDES 2019), which is precisely the sort of fire that threatens the rainforest home of *E. eungella*. This means that fires of the intensity and breadth of 2018 at Eungella and 2019-2020 in much of the rest of the State may not be unusual events in the near future. The fires of 2018 have shown that rainforest is not safe from extreme fire events. Some resprouting has been seen from trees at Eungella, but there has also been weed invasions. Extreme bushfire leads to a great deal of tree and shrub mortality,

	a change in the nature of the rainforest, and a warming of the creeks with less shade from trees. This degrades the habitat for *E. eungella*. This level of damage may take hundreds of years to recover (Hines et al. 2020), and it may instead revert to a more lowland, fire prone, ecosystem permanently. The upland rainforest habitat of *E. eungella* is likely to burn more often than in the past given the more intense bushfires, and with the encroachment of more fire-prone sclerophyll forest species and lantana and other weeds moving up the slope in response to a warming climate. The entire distribution of *E. eungella* is in an area of proven fire risk, and because it has such a small, restricted distribution (which will shrink further with climate change), there is a real possibility of future extinction in the wild given the predicted more intense and more frequent bushfires of the future. Level of future impact = high.
Drought	The frequency and intensity of drought in in the Eungella area is difficult to predict, as some projections show less rainfall and some more (QDES 2019). However, water availability to *E. eungella* and the surrounding rainforest is likely to decrease, as increased evaporation will result from the predicted higher temperatures (QDES 2019). Further, ironically for an area whose name means "land of cloud" (Ashton et al. 2020), the Eungella uplands are also likely to receive less moisture from cloud stripping in future (Wallace & McJanet 2013). Level of future impact = moderate/high.
Climate change	The Earth is warming rapidly and the climate changing. Global climate projections predict a greater than 99% probability that most of the years between 2019 and 2028 will be in the top 10 warmest years on record for the planet (Arguez et al. 2020). Climate modelling for Queensland in general (QFES 2019) and the Mackay area in particular (QDES 2019), predicts significant, rapid future changes to climate. This includes higher temperatures, more hot days and more intense extreme weather events. Changes in overall rainfall, drought and fire weather are less certain, and could increase, decrease, or remain similar in the Mackay area. However, the worst case scenarios for climate change in Australia may actually be even worse than previously predicted given new analyses of more up-to-date climate models (CMIP6; Grose et al. 2020). Climate change is a real threat to freshwater crayfish since *Euastacus* species are sensitive to changes in temperature, tend to be highly specialised, and often have distributions that are highly fragmented and very limited ("short-range endemics" *sensu* Harvey 2002) (Richman et al. 2015; Hossain et al. 2018). These factors combine to make them particularly vulnerable to the effects of intensifying climate change (Richman et al. 2015). Many *Euastacus* species in eastern Australia are already "climate refugees" (Bone et al. 2014), having been restricted to cool montane areas by the increase in Australia's temperature and aridity over the last few million years (Ponniah & Hughes 2004). This is certainly the case for *E. eungella*, which is largely restricted to isolated montane rainforest. Hossain et al. (2018) considered that *E. eungella* was vulnerable to the modelled climate of 2050, which is only 30 years away. Climate change works in concert with, and is an intensifier of, many of the previously mentioned threats (e.g. bushfires, droughts, invasive species). Similarly, more extreme and more frequent weather events, such as cyclones and floods, can also severely impact freshwater crayfish. These events have already increased (Kossin et al. 2020). Predictions for the Mackay area suggest tropical cyclones may be less frequent, but more intense (QDES 2019). Intense storm events can scour high altitude streams and this can be deadly to juvenile *Euastacus* that seek refuge under leaves/fallen palm fronds, small loose rocks and logs (R. McCormack pers. comm. 2020). Mass mortality has been recorded in *Euastacus valentulus* (strong crayfish) in southern Queensland after a very intense rain storm and flash flood which killed hundreds, and probably thousands, of crayfish locally (Furse et al. 2012). Most of the crayfish killed in this event were about the same size as adult *E. eungella* (30-40 mm OCL). There are also reports of *E. sulcatus* in Lamington National Park having been killed in large numbers in large log jams following flooding associated with Ex-Tropical Cyclone Debbie in March 2017 (W. Buch pers. comm. 2020). Temperatures are predicted to increase in the Mackay area by 0.5 – 1.4°C by 2030 and 1.8 – 3.6°C by 2070 (over 1986 - 2005 levels; High Emissions; QDES 2019). Periodic, dangerous heatwaves are predicted to be more intense and more

common (QFES 2019). *Euastacus eungella*, and the isolated cool montane rainforests of the Eungella area, are at risk from climate change, since they are refugia for many cool-adapted flora and fauna species, *E. eungella* among them. Available habitat will shrink as narrow, suitable "climatic envelopes" migrate up the mountains in the face of rising temperatures, and may eventually disappear completely (Krockenberger et al. 2003). For example, a rise of only 1.0°C by 2030 could result in a 50% decrease in the area of upland tropical rainforests (Hilbert et al. 2001). Many of these habitats may already be near a threshold of survival (Murphy et al. 2012), having progressively shrunk in the face of the naturally warming and drying of the last few million years, and are now facing an accelerated warming due to human activities.

Elevation and temperature are tightly linked, and so whole biological communities will likely need to shift with the warming climate, with "lowland" communities working their way up the slope over time (Ashton et al. 2020). This is much the same as the fact that cities will experience the climate of warmer places in the future (for example, Mackay's climate in 2030 is predicted to be similar to that of Prosperine today [about 100 km northwest]; QDES 2019). Every 100 m increase in elevation at Eungella National Park leads to an average temperature drop in the understorey of 0.6°C (Ashton et al. 2020), which equates to about 0.4-0.5°C stream temperature (Morrill et al. 2005). The maximum temperature measured beneath the canopy at 1000 m in the study of Ashton et al. (2020) at Eungella was 23.5°C (measured 22/3/2013 – 14/6/2013). The highest confirmed *E. eungella* site is at 1030 m, about 1.2 km distant and 230 m below the summit of Mt. Dalrymple. Even if suitable habitat were to found at the summit (unlikely), the altitudinal difference only represents a relief of about 0.9 – 1.1°C of stream temperature. This means that *E. eungella* has a very limited temperature buffer.

The precise thermal tolerance of *E. eungella* is not known, but another montane rainforest species, *E. sulcatus,* became distressed at about 22ºC, and was effectively incapacitated at 27ºC, and all died (Bone et al. 2014). *E. sulcatus* is much larger than *E. eungella* and so perhaps *E. sulcatus* can handle temperature variation better, but as there are no thermal studies on *E. eungella,* this is unclear. However, *E. eungella* has been reported in a few lower altitude areas, so presumably has some ability to handle higher temperatures, although the lowlands are likely to become an increasingly hostile and nonviable habitat with climate change. This will contract and compact *E. eungella's* altitudinal distribution. The measured maximum temperatures (air, under canopy) in 2013 (400 m – 25.5ºC, 600 m – 25.0ºC, 800 m – 24.5ºC, 1000 m – 23.5ºC; Ashton et al. 2020) suggest that the lower portion of *E. eungella's* current distribution could rapidly become too warm, especially given these were only the autumn-winter temperatures.

Increased temperatures will almost certainly severely impact *E. eungella*. Higher temperatures, increased drought, and an intensified bushfire regime will also likely cause a change in the species of riparian vegetation and condition of the rainforest through changes in soil moisture levels, evapotranspiration and foliage damage during extreme heat events (A. Borsboom pers. comm. 2020), which would restrict the distribution of *E. eungella* further.

As the rainforest habitat degrades with climate change, the pressure from invasive species is predicted to increase, including from feral pigs and lantana.

Bland (2017) undertook a large-scale meta-analysis that considered the multiple interacting factors that influence extinction risk in freshwater crayfish. The single most important factor in extinction risk was range size, with high altitude habitat also leading to a higher risk of extinction. Both of these factors are relevant to *E. eungella*. Another study (Owen et al. 2015) considered freshwater crayfish species from around the world, and ranked them according to a combination of evolutionary distinctiveness and conservation status (EDGE); in effect, which species are the most unique evolutionarily and are most at risk. *Euastacus eungella* scored 6th highest of 719 species in one analysis and 8th of 719 in the other (tied with *E. monteithorum*) (Owen et al. 2015). Because of its highly restricted, small distribution, any impact on one part of the population is likely to influence the species' entire distribution and greatly increase extinction risk. Even a small adverse change could have a long-term impact, since a single stochastic

	event (fire, cyclone, heatwave, etc.) could potentially wipe out an already reduced/weakened population as a result of climate change. The options for persistence of *E. eungella* in the face of climate change are limited. *E. sulcatus* has shown some ability to adapt to higher temperatures, although this was a very small effect, much smaller than the predicted increases in temperature (Bone et al. 2014). Adaptation does not seem likely as *E. eungella* is almost certainly cool-adapted, and has been so for a long time. The rate of current climate change makes this unlikely. Another possibility is that *E. eungella* could move to cooler, higher altitudes to retain its preferred climate envelope. This is not likely as *E. eungella* has already been found at a site at 1030 m, only just over a kilometre distant from the highest local peak (Mt. Dalrymple, 1259 m). A third possibility is that *E. eungella* could migrate to other, cooler areas. This is very unlikely due to the hundreds of kilometres of unsuitable hot, dry lowlands that surround *E. eungella*'s current distribution. Eungella National Park is flanked by two established biogeographic barriers to rainforest species, the Burdekin Gap to the north and St. Lawrence Gap to the south (Chapple et al. 2011). Level of future impact = high.
Feral pigs	Feral pigs continue to provide a threat to *E. eungella*, both to individuals, local subpopulations, and to their general rainforest habitat quality. This threat is very likely to increase as the rainforest habitat degrades and contracts through bushfire, climate change and further invasive species impacts. Pig impacts foster the growth of fire-prone species, and after bushfires, feral pig impacts can increase as hungry pigs move out of adjacent burned areas into unburned ones (Hines et al. 2020). Level of future impact = moderate
Future threats – potential	**Impact of threat**
Unauthorised collecting	The level of future unauthorised collecting is difficult to estimate. However, *E. eungella's* rarity and very small distribution places it at a risk of depletion of numbers from any level of exploitation or collection (legal or otherwise) or an accidental introduction of a pathogen during this collection (see Crayfish plague below). Level of future impact = unknown/low.
Crayfish plague	*Aphanomyces astaci* (crayfish plague) is a highly contagious fungal disease that is uniformly fatal (100% mortality) to susceptible species (e.g., Panteleit et al. 2017), and it is considered one of the world's worst invasive species (Lowe et al. 2000). Many strains of the disease prefer cooler temperatures, which is also the preference of *E. eungella*. Crayfish plague is not currently known in Australia, but is documented as fatal to Australian freshwater crayfish (Unestam 1975), and it poses an extremely high risk to native freshwater crayfish species (DAWE 2019). Illegally imported specimens of the North American crayfish species known to carry the disease have been seized in multiple Australian states (Department of Primary Industries & Regional Development 2021; Business Queensland 2021), but not known to be infected. A single, illegally-imported crayfish infected with crayfish plague has the capacity to devastate the entire Australian crayfish fauna. Increasing illegal wildlife/aquarium trade appreciably increases the risk and probability of the disease's introduction to Australia. This is relevant to the Eungella region as another fungus (amphibian chytrid fungus *Batrachochytrium dendrobatidis*) has heavily impacted sympatric frogs from the 1980s, causing steep declines in one species (*Taudactylus eungellensis*) and the potential extinction of another (*Rheobatrachus vitellinus*) (Meyer et al. 2020). This disease may have been spread by humans visiting these areas (QDNPRSR 2013). Level of future impact = unknown.

*CONSERVATION ADVICE: THREAT ABATEMENT AND RECOVERY ACTIONS

Give an overview of recovery and threat abatement/mitigation actions that are underway, have been formally proposed or that you would like to recommend. Address all threats listed or state threats that lack conservation advice.

Current threats	**Abatement or recovery action underway**
Bushfire	Planned burns are carried out at Eungella National Park, which are done at times of higher soil moisture (G. Lennox pers. comm. 2020). Fuel build-up on the edges of rainforest needs to be controlled. This can be done through a mosaic burning regime adjacent to the rainforest to lessen the severity of bushfires (Bushfire Consortium 2012).
Feral pigs	It is challenging to manage and gauge the impacts of feral pigs (Reef Catchments 2013) given the difficult and isolated nature of much of the terrain. There is no

	specific feral pig program at Eungella National Park (G. Lennox pers. comm. 2020). Pig records at the parks are entered onto WildNet (QDES 2020).
	Abatement or recovery action proposed
Bushfire	Areas of rainforest that burned should be monitored over the long term to track their recovery (Hines et al. 2020). Increased weed management is a potentially import step to limit the spread of bushfires into the rainforest. The reduction of fire prone lantana and other grasses would slow the spread of fire into the rainforest and allow the rainforest to regenerate more quickly. Preliminary data from experimental studies suggest that transferring rainforest seedlings collected after planned burns to newly burned bushfire areas may be a way to increase the speed of recovery in some cases (Queensland Herbarium 2019). Cessation of logging in the state forests and forest reserve, which would be required for World Heritage status (QDNPRSR 2013), would likely lessen the frequency and severity of future bushfires.
Feral pigs	A program to monitor pigs and their impacts would allow the scale of the problem to be assessed. Pig management activities may need to increase in bushfire areas as invasive species (including pigs) move into freshly burned areas.
Unauthorised collecting	Regular checks should be made of the internet to see if *E. eungella* are offered for sale, and if so, the relevant parties prosecuted for illegal collecting, possession or sale. Further, information on correct hygiene protocols should be made available to those collecting legally to avoid introducing pathogens (for example: www.aabio.com.au/new/wp-content/uploads/2012/02/Hygiene-Protocol-2010.pdf). The Queensland Government is working on such protocols at the moment (J. Furse pers. comm. 2020).
Future threats – actual	**Abatement or recovery action underway**
	Abatement or recovery action proposed
Climate change	Detailed monitoring of the health of both *E. eungella* populations (numbers, distribution, population dynamics, etc.) and its habitat (vegetation, water availability, water quality parameters) should be undertaken to see if these are being adversely affected by the various factors associated with climate change. Given that *E. eungella* is potentially threatened by rising temperatures due to climate change, obtaining some data on its thermal tolerance is particularly vital. This is a common issue, as only 6% of crayfish worldwide have any data available on their thermal tolerance (Bland 2017). Species-specific thermal tolerance thresholds and environmental parameters (Richman et al. 2015) are important information for understanding *E. eungella's* long-term extinction risk. Baseline water temperatures at a number of sites in streams known to be home to *E. eungella* should be collected to monitor any temperature change over time. In conjunction with this, there should be yearly standardised population monitoring of crayfish in the same streams to track any population change. As there is very little background information on *E. eungella*, research should focus on population assessment and monitoring, biology, life history, habitat requirements, and resilience to invasive species and disease. Because the actual population status and health of most crayfish species is so poorly known, 88% of all crayfish listings use range-based criteria rather than data on population decline (Richman et al. 2015).
Future threats – potential	**Abatement or recovery action underway**
	Abatement or recovery action proposed

IMPACT OF TRANSFERRING A THREATENED SPECIES TO NEAR THREATENED OR LEAST CONCERN

Omit this section and proceed to 'Listing class/category' if the nomination does not involve transferring a species from a threatened class to Least Concern or Near Threatened.

If the threatened species (Extinct, Extinct in the Wild, Critically Endangered, Endangered or Vulnerable) were moved to Least Concern or Near Threatened, what would be the impact if conservation actions for the species were reduced or ceased? Would the species decline at such a rate that it would be eligible for listing under a threatened class again in the foreseeable future? Provide evidence, expert advice and appropriate references to support your response.

Conservation action	Impact on the species if abatement/recovery action is reduced or ceases

Listing class/category

CURRENT LISTING CLASS/CATEGORY

[Please mark the boxes that apply by double clicking them with your mouse.]

In what class is the species currently listed under the **NC Act**?

☐Extinct	☐Extinct in the Wild	☐Critically Endangered	☐Endangered
☐Vulnerable	☐Near Threatened	☐Least Concern	☒Not listed

In what category is the species currently listed under the **EPBC Act**?

☐Extinct	☐Extinct in the Wild	☐Critically Endangered	☐Endangered
☐Vulnerable	☐Conservation Dependent		☒Not listed

NOMINATED LISTING CLASS

To what class under the **NC Act** is the species being nominated?

☐Extinct	☐Extinct in the Wild	☐Critically Endangered	☒Endangered
☐Vulnerable	☐Near Threatened	☐Least Concern	☐Not listed

Nominating a species to transfer to another class

REASON FOR A NOMINATION TO TRANSFER TO ANOTHER CLASS

What is the reason for the nomination?

☐Genuine change of status	☒New knowledge	☐Mistake	☐Other
Taxonomic change - ☐'split'	☐newly described	☐'lumped'	☐no longer valid

INITIAL LISTING

Describe the reasons for the species' initial listing under the NC Act and/or the EPBC Act and, if available, the criteria under which it was formerly considered eligible.

Click or tap here to enter text.

CHANGES IN SITUATION LEADING TO THE NOMINATION TO TRANSFER TO ANOTHER CLASS

Please complete (a), (b) OR (c) as appropriate to the nomination.

(a) Critically Endangered, Endangered, Vulnerable or Near Threatened

Describe the change in circumstances that make the species eligible for listing in a class other than Extinct and Extinct in the Wild.

Euastacus eungella is being nominated as Endangered (EN) because of its very restricted distribution (EOO = 179 km^2; AOO = 76 km^2) in a single location (upland rainforest community of Eungella National Park). The entire population is threatened by bushfire, drought, climate change, feral pigs, and other factors (floods, invasive species, rainforest habitat loss) predicted to increase and intensify with climate change.

(b) Extinct in the Wild

A native species is eligible to be included in the Extinct in the Wild class if: (a) thorough searches have been conducted for the species; and (b) the species has not been seen in the wild over a period appropriate for its life cycle or form. The species may still survive in cultivation, captivity or as a naturalised population (or populations) well outside the historic range.

Describe how circumstances have changed that now make the species eligible for listing as Extinct in the Wild. Provide details of the last valid record or observation of the species in the wild.

Click or tap here to enter text.

(c) Extinct

A native species is eligible to be included in the Extinct class if there is no reasonable doubt that the last member of the species has died. A taxon is presumed Extinct when exhaustive surveys in the known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual.

Describe how circumstances have changed that now make the species eligible for listing as Extinct. Provide details of the last valid record or observation for the species in the wild and captivity.

Click or tap here to enter text.

Standard of scientific evidence and adequacy of survey

Please complete as appropriate to the nomination

For this assessment is it considered that the survey of the species has been adequate and there is sufficient scientific evidence to support the listing outcome. While the survey effort has not covered all potential areas, the largest likely possible distribution predicted from modelling for EOO and AOO values still qualifies the species as Endangered (see Criterion B below).

Eligibility against the criteria

CRITERION A

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 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

Please identify whether the species meets A1, A2, A3 or A4. Include an explanation, supported by data and information, on how the species meets the criterion (A1 – A4). If available include information on:

- whether the population trend is increasing, decreasing or static
- estimated generation length and method used to estimate the generation length

You must provide a response. If there is no evidence to demonstrate a population size reduction, this must be stated.

Insufficient data to determine eligibility.

There are not adequate population data to assess this as little is known about the population size of *E. eungella*. Nothing is known about any past or current changes. It is very likely that the population size will decline in the face of climate change (especially with hotter weather and less moisture) since this species is a cool mountain specialist restricted to upland rainforests. As temperatures increase, the available amount of suitable habitat is likely to decrease as the areas of rainforest habitat contract higher up the mountain. There will also be likely population reduction due to more frequent and intense bushfires and droughts. Given the current small size of this species' distribution, any further reductions will lay it open to a single stochastic event which could drive it to extinction.

CRITERION B:

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**

Please refer to the 'Guidelines for Using the IUCN Red List Categories and Criteria' for assistance with interpreting the criterion particularly in relation to calculating 'extent of occurrence', 'area of occupancy' and understanding of the definition and use of 'severely fragmented', 'locations', 'continuing decline' and 'extreme fluctuations'.

Please identify whether the species meets B1 or B2. Except for Near Threatened species, include an explanation, supported by data and information, on how the species meets at least 2 of (a), (b) or (c). For Near Threatened species, include an explanation, supported by data and information, on how the species meets (b).

Please note that locations must be defined by a threat. A location is a geographically or ecologically distinct area in which a single threatening event can rapidly affect all individuals of the species present.

Please use GeoCat to provide AOO and EOO estimates and maps whenever possible. If available, include information on:

- Whether there are smaller populations of the species within the total population and, if so, the degree of geographic separation between the smaller populations within the total population
- Any biological, geographic, human induced or other barriers enforcing separation

You must provide a response. If there is no evidence to demonstrate that the geographic distribution is precarious for either extent of occurrence AND/OR area of occupancy, this must be stated.

Euastacus eungella meets the thresholds for listing as **Endangered (EN)** under criteria **B1ab(i,ii,iii,v)** and **B2ab(i,ii,iii,v)** based on a single location threatened by bushfire, drought, climate change and feral pigs.

Euastacus eungella meets Criteria B1 and B2 for based on:

1) B1: EOO of 179 km^2. About 20% of the calculated EOO area for *E. eungella* is made up of highly unsuitable cleared lowlands and farm land.

2) B2: AOO of 76 km^2. As this species is restricted to the linear-like stream network and near-stream habitats, the actual area of habitation will be much smaller. *Euastacus eungella* was previously assessed under IUCN criteria (Furse & Coughran 2010) as Critically Endangered B1ab(iii). This assessment did not include all of the currently known sites at Eungella National Park, and so the calculated EOO and AOO are now both above the limits for Critically Endangered (100 km^2 and 10 km^2 respectively) even if the worst case scenario (a; Table 2) is assumed.

Some uncertainty exists over the full extent of the distribution of this species, due to a lack of targeted surveys. Further, a small nocturnal crayfish living in a burrow is easily missed and most of the relevant terrain is difficult and isolated. Therefore the estimates of EOO and AOO are likely to be underestimates of the species' entire distribution. However, the amount of potential upland habitat is limited, and the wider Eungella area is surrounded by areas which are inhospitable to a small upland crayfish. Therefore EOO was recalculated with a number assumptions (Table 2) to consider alternative scenarios. Even the highly optimistic, unrealistic, best case scenario (c; Table 2) still equates to *E. eungella* remaining firmly in the Endangered Category (EOO < 5000 km^2).

a: Known from single location, namely the upland tropical rainforest community of Eungella National Park. One stochastic event could drive the species to extinction. The bushfires of 2018 heavily impacted the Park, and future bushfires are predicted to become more frequent and fierce due to climate change, even in rainforests. Climate change, and in particular a warming climate, will impact the entire species' population simultaneously. Rising temperatures will impact *E. eungella*'s physiology directly, as well as making the current habitat less suitable, and will reduce the potential area of occupancy. *Euastacus eungella* is restricted to the cool, higher altitude areas, with little chance of natural migration, as the nearest suitable habitat is hundreds of kilometres away in every direction. Drought and heatwaves are also predicted to intensify and worsen, and would impact the whole population simultaneously.

b(i,ii,iii,v): The various threats identified above are inferred to cause continuing declines in (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; and (v) number of mature individuals. This decline could be very rapid, via future intense bushfires, heat wave, drought, flooding, or slow, mediated through the various effects of climate change.

Table 2. *E. eungella* EOO calculations (in km^2) for Eungella area: a) current estimate using verified sites only ("worst case"); b) also including unverified Amelia Creek and two Urannah Creek frog sites (from Fig. 2) ("medium case"); c) assuming ubiquity in all local reserves (Cathu SF, Macartney SF, Eungella NP, Crediton Forest Reserve, Crediton State Forest) ("best case")

	EOO (km^2)
a) verified sites only	180
b) incl. unverified and frog sites	658
c) ubiquity	1896

CRITERION C

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**

Please identify the estimated total number of mature individuals and either an answer to C1 or C2. Include an explanation, supported by data and information, on how the species meets the criteria. Note: If the estimated

total number of mature individuals is unknown but presumed to be likely to be >10 000, you are not required to provide evidence in support of C1 or C2, just state that the number is likely to be >10 000.

You must provide a response. If there is no evidence to demonstrate small population size and decline this must be stated.

There are **insufficient data** to assess *Euastacus eungella* against the thresholds for listing under Criterion C as there is little information available to determine a robust estimate of the number of mature individuals.

CRITERION D:

Very small population				
	Critically Endangered (CR)	**Endangered (EN)**	**Vulnerable (VU)**	**Near Threatened (NT)**
D1. 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.	**Not applicable**	**Not applicable**	**D2. Typically: AOO < 20 km² or number of locations ≤ 5**	**D2. Typically: AOO < 40 km² or number of locations ≤ 10**

Please identify the estimated total number of mature individuals and evidence of how the figure was derived.

For Criterion D2, please provide information on the species' area of occupancy, number of locations and plausible threats.

You must provide a response. If there is no evidence to demonstrate eligibility, this must be stated.

There are **insufficient data** to assess *Euastacus eungella* against the thresholds for listing under Criterion D1 as there is little information available to determine a robust estimate of the number of mature individuals. However, *E. eungella* does qualify under Criterion D2 as **Vulnerable (VU)**. This is because of a single location, and the combined threats of enhanced bushfires, drought, and heatwaves associated with climate change could drive the species towards extinction in a short timeframe.

CRITERION E:

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**

Please identify the probability of extinction and evidence of how the analysis was undertaken.

You must provide a response. If there has been no quantitative analysis undertaken this must be stated.

Euastacus eungella is **not eligible** for listing under this criterion because no quantitative analysis of populations is available.

SUMMARY OF CRITERIA UNDER WHICH THE SPECIES IS ELIGIBLE FOR LISTING AS: CR, EN, V, NT, EW or EX

Please mark the criteria and sub-criteria that apply.

☐Criterion A	☐A1 (specify at least one of the following) ☐a) ☐b) ☐c) ☐ d) ☐e); **AND/OR** ☐A2 (specify at least one of the following) ☐a) ☐b) ☐c) ☐d) ☐e); **AND/OR** ☐A3 (specify at least one of the following) ☐a) ☐b) ☐c) ☐d) ☐e); **AND/OR** ☐A4 (specify at least one of the following) ☐a) ☐b) ☐c) ☐d) ☐e)
☒Criterion B	☒B1 (specify at least two of the following) ☒a) ☒bi,ii,iii,iv) ☐c); **AND/OR**

Endangered	☒B2 (specify at least two of the following, other than NT) ☒a) ☒bi,ii,iii,iv) ☐c)
☐Criterion C	☐estimated number of mature individuals **AND** ☐C1 **OR** ☐C2 ☐a (i) **OR** ☐a (ii) **OR** ☐C2 ☐b)
☒Criterion D	☐D1 **OR** ☒ D2
Vulnerable	
☐Criterion E	
☐EX	
☐EW	
☐LC	Species nominated to change from a higher conservation class to Least Concern: No above boxes apply.

Other Considerations

*INDIGENOUS CULTURAL SIGNIFICANCE

Is the species known to have cultural significance for Indigenous groups within Australia? If so, to which groups? Provide information on the nature of this significance if publicly available.

It is not known if Indigenous people attach any particular cultural significance to *Euastacus eungella*. Eungella National Park is the Traditional Land are the Wiri people who have a strong connection to it (Reef Catchments 2015). The word “Eungella”, which names both the species and the national park, is a Wiri name meaning “land of cloud” (Ashton et al. 2020).

FURTHER STUDIES

Identify relevant studies or management documentation that might relate to the species (e.g. research projects, national park management plans, recovery plans, conservation plans, threat abatement plans, etc.).

ADDITIONAL COMMENTS/INFORMATION

Please include any additional comments or information on the species such as survey or monitoring information, and maps that would assist with the consideration of the nomination.

Click or tap here to enter text.

IMAGES OF THE SPECIES

Please include or attach images of the species if available, and indicate if you are in a position to authorise their use.

Fig. 4: *Euastacus eungella*, Dalrymple Heights area (Pioneer Basin), Eungella National Park. Photo by Stephen Zozaya (James Cook University). Used with permission.

Reviewers and references

REVIEWER(S)

Has this nomination been peer-reviewed? Have relevant experts been consulted on this nomination? If so, please include their names, current professional positions and contact details.

This nomination has been peer-reviewed by Dr. James Furse (Griffith University) and was read and commented on by Dr. Jonathan Marshall (Water Planning Ecology, DES).

A number of experts were consulted in preparing this nomination, all of whom kindly provided specific data, background information, advice or guidance. These include Harry Hines (QPWS), Rob McCormack (Australian Aquatic Biological), Jason Coughran (Sheridan College), James Furse (Griffith University), Conrad Hoskin (James Cook University), Stephen Zozaya (James Cook University), Dan Ferguson (Queensland Herbarium), Melanie Venz (Queensland Herbarium), Greg Lennox (QPWS), and Keith McDonald.

REFERENCE LIST

Please list key references/documentation you have referred to in your nomination.

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Publication approval and citation

I approve my name being retained on the nomination form for publication and provision outside the nomination process.

Timothy J. Page

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Nominator's Details

Note: Your 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 include details below for all nominators.

TITLE (e.g. Mr/Mrs/Dr/Professor/etc.)

Dr

FULL NAME

Timothy J. Page

ORGANISATION OR COMPANY NAME (IF APPLICABLE)

Griffith University

CONTACT DETAILS

DECLARATION

I declare that, to the best of my knowledge, the information in this nomination and its attachments is true and correct.

Signed: Click here to enter text. * *If submitting by email, please attach an electronic signature*	Date: 9/07/2020 (original submission) 5/10/2021 (minor revision)

Lodging your nomination

Completed nominations may be lodged either:
1. by email in Microsoft Word format to: SpeciesTechnical.Committee@des.qld.gov.au
2. by mail to: The Chair
   Species Technical Committee
   Queensland Herbarium
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   Toowong QLD 4066

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