

## Notice of and reasons for the Final Determination

The NSW Threatened Species Scientific Committee, established under the *Biodiversity Conservation Act 2016* (the Act), has made a Final Determination to list the Shorter Rainforest Ground-beetle *Nurus brevis* Motschulsky, 1865 as a VULNERABLE SPECIES in Part 3 of Schedule 1 of the Act and, as a consequence, to omit reference to the beetle *Nurus brevis* Motschulsky, 1865 from Part 2 of Schedule 1 (Endangered species) of the Act. Listing of Vulnerable species is provided for by Part 4 of the Act.

### Summary of Conservation Assessment

*Nurus brevis* Motschulsky, 1865 (family Carabidae) was found to be Vulnerable in accordance with the following provisions in the *Biodiversity Conservation Regulation 2017*: Clause 4.3 (c)(d)(e, ii). The main reasons for this species being eligible are i) it has a highly restricted geographic range (Extent of Occupancy 1,106 km<sup>2</sup> and Area of Occupancy 68 km<sup>2</sup>); ii) it only occurs at 7-9 locations; and iii) there is an inferred continuing decline in the geographic distribution (Extent of Occurrence and Area of Occupancy) from loss of small habitat remnants caused by the combined impact of weed infestation, stormwater discharge, extreme events associated with climate change, and the small size of some remnants leading to increased edge effects, microclimate change and susceptibility to stochastic events.

The NSW Threatened Species Scientific Committee has found that:

1. *Nurus brevis* Motschulsky, 1865 is a large flightless ground beetle from the family Carabidae. The species is broad-bodied, with a black pronotum that can contain some subtle metallic green. Overall length is 23.5–28.2 mm and greatest width of elytra is 9.5–11.6 mm. It has prominent, straight jaws and a strong bite. *Nurus brevis* can be distinguished from the closely related *Nurus popplei* by a pronotal basal margin which is distinctly concave and an elytra basal margin which is clearly sinuate (Will and Monteith 2018). There are eight *Nurus* species and phylogenetic analyses show three well-supported clades. *Nurus brevis* is grouped with *N. popplei*, *Nurus latipennis* and *Nurus baehri*. The species ranges do not overlap.
2. *Nurus brevis* is only found in rainforest habitat in the Lismore-Richmond Range region in northeast NSW. There are nine known sites, which has increased from five following targeted surveys conducted in 2019. *Nurus brevis* has a highly disjunct distribution. The Richmond Range is the species stronghold, containing most of the total population in five sites, as well as the majority of potential habitat. There are four other known sites approximately 50 km east of the Richmond Range in the Lismore–Bungabee area. The sites around Lismore are small, fragmented rainforest remnants (8.8 - 22 ha) in an urban landscape (Charley and Andren 2021). Based on a limited ability to dispersal and distance between sites *N. brevis* is likely to have 7-9 subpopulations.

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3. *Nurus brevis* has a 1,106 km<sup>2</sup> Extent of Occurrence (EOO), calculated as a minimal convex polygon containing all known occurrences, the method of assessment recommended by IUCN (2022). The Area of Occupancy (AOO) is estimated to be 68 km<sup>2</sup> based on 2 x 2 km grid cells, the scale recommended for assessing AOO by IUCN (2022).
4. The *Nurus brevis* population is estimated to contain hundreds of thousands of mature individuals, based on burrow counts and density data collected for each known site and extrapolated across the area of suitable habitat (Charley and Andren 2021).
5. *Nurus* beetles use their mandibles to construct a fixed, deep burrow with a distinctive, cleared entrance stage where they ambush prey. Burrows are built under rocks, logs, and tree roots, and are only found where there is an open understorey. They are generally absent from areas where there is deep or complete cover of leaf litter (Charley and Andren 2018). The two sexes live separately and only one individual occupies a burrow, which is used throughout its life. *Nurus* beetles are nocturnal and are presumed to spend the day in the terminal chamber (G. Monteith pers. comm. January 2022).
6. *Nurus brevis* is a flightless ground-beetle. Both sexes remain in their burrows for much of the year. During pitfall surveys, most *Nurus* beetles are caught in summer and many more males than females are detected. Males are particularly active outside of their burrows on warm, wet nights. Likewise, newly emerged adults (i.e., with soft cuticle) of both sexes are taken in pitfall traps. These are assumed to be seeking burrow sites (G. Monteith pers. comm. January 2022.). Individuals rarely disperse more than a few hundred metres, as seen in other flightless carabids (Den Boer 1990). It is unlikely that there is substantial connectivity between sites (D. Charley pers. comm. December 2021).
7. *Nurus brevis* is predatory and feeds on leaf litter invertebrates (M. Andren pers. comm. December 2021). *Nurus* beetles typically only become active at their burrow entrances at night, where they wait for small passing prey. *Nurus* do not hunt in the wider landscape (Lloyd 2021). The remains of large millipedes have been observed at the entrances of burrows (Charley and Andren 2018) and form a major part of the diet, likely because they are slow moving (G. Monteith pers. comm. January 2022).
8. Adult lifespan is likely to be between two and four years (G. Monteith pers. comm. January 2022), and the generation length is one year, as is seen in other carabid species (Lawrence and Slipinski 2013). *Nurus* beetles have an extraordinarily low reproductive output for an insect. Females lay a maximum of 10 large eggs in the summer/wet season (G. Monteith pers. comm. January 2022). The eggs hatch within a few weeks, producing five to 10 larvae. The larval period is unknown but is likely to be between three and six months. It is assumed that larvae pupate in April – May and overwinter as pupae. The pupal period ends at the start of summer/the wet season when soil is soft, enabling newly emerged adults to dig their burrows (G. Monteith pers. comm. January 2022).

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9. The main threats to *Nurus brevis* are: the small size of some remnants leading to increased edge effects, microclimate changes and susceptibility to stochastic events; Cane Toad competition and predation; weeds; stormwater discharge; fragmentation and isolation of remnants, and extreme events associated with climate change. There are 7-9 threat-defined locations when considering the most serious plausible threat of small remnant size: the four small remnants from the Lismore–Bungabee area plus 3-5 subpopulations from the the Richmond Range as locations not affected by any threat. ‘Anthropogenic climate change’, ‘Clearing of native vegetation’ and ‘Invasion and establishment of the Cane Toad (*Bufo marinus*)’ are listed as Key Threatening Processes under the Act.
10. *Nurus brevis* decline is most likely in the four small and isolated eastern sites around Lismore, that occur in a predominantly cleared landscape and are subject to multiple threats. Small sized remnants are susceptible to increased edge effects, microclimate change and to stochastic events including extreme events associated with climate change (such as extended drought or high severity fire) (D. Charley and M. Andren pers. comm. December 2021, Grimbacher *et al.* 2006). This is supported by *N. brevis* being abundant in large areas of habitat that are relatively undisturbed (e.g., Cambridge Plateau) and patchy in small, disturbed remnants such as Rotary Park (Charley and Andren 2021). Decline in carabid diversity has been documented in habitat remnants in urban and agricultural landscapes (Homburg *et al.*, 2019; Sadler *et al.*, 2006). Fragmentation and small remnant size can lead to high population densities of competing native and introduced species and exacerbate the negative impact of climate events such as drought, severe storms and localised flooding and environmental impacts such as stormwater.
11. The introduced Cane Toad (*Rhinella marina*) is known to be present in the Lismore–Bungabee rainforest remnants and is considered a threat to *Nurus brevis*. Cane Toads are likely to compete with the species for food resources, as well as directly reducing *N. brevis* populations through predation. *Nurus brevis* is particularly vulnerable to predation by toads during two critical periods: 1) when adult males emerge on warm wet nights; and 2) after pupa hatch and young adults have not yet dug their first burrow (Charley and Andren 2018). *Nurus brevis* is long-lived and has a low reproductive rate for an invertebrate, so predation of adult beetles by Cane Toads will reduce the population over time (G. Monteith pers. comm. January 2022).
12. Some *Nurus brevis* sites have significant weed infestations. The species is rare or absent where weeds dominate. *Nurus brevis* requires an open understorey, therefore understorey weed infestations create unsuitable habitat conditions (Charley and Andren 2021). Targeted weed control programs would help to mitigate this threat and secure populations.
13. There are stormwater discharge issues in some sites, reducing the area of suitable habitat and increasing the threat of inundation (Charley and Andren 2021).
14. Climate change predictions for northern NSW include more frequent and intense drought, increasing likelihood of extreme rainfall and thunderstorm events, and modified fire regimes (Herold *et al.* 2018; Hennessy *et al.* 2004). *Nurus* beetles are

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sensitive to dry conditions and become more difficult to find during periods of drought (M. Andren pers. comm. December 2021). *Nurus brevis* is most likely to be impacted by drought in the small, fragmented rainforest remnants around Lismore (Oliver *et al.* 2013). The Lismore-Richmond Range region is susceptible to flooding rains, and while *N. brevis* habitat is generally above the flood zone, prolonged rainfall could impact the species by inundating burrows (M. Andren pers. comm. June 2022), however there is currently no evidence of flood impact on this species. To date, fire has not had a negative effect on *N. brevis*. However, changed fire regimes represent a potential future threat, particularly when combined with increased frequency and intensity of drought.

15. *Nurus brevis* Motschulsky, 1865 is not eligible to be listed as an Endangered or Critically endangered species.
16. *Nurus brevis* Motschulsky, 1865 is eligible to be listed as a Vulnerable species as, in the opinion of the NSW Threatened Species Scientific Committee, it is facing a high risk of extinction in Australia in the medium-term future as determined in accordance with the following criteria as prescribed by the *Biodiversity Conservation Regulation 2017*:

## Assessment against *Biodiversity Conservation Regulation 2017* criteria

The Clauses used for assessment are listed below for reference.

### Overall Assessment Outcome:

*Nurus brevis* was found to be Vulnerable under Clause 4.3 (c)(d)(e, ii).

### Clause 4.2 – Reduction in population size of species (Equivalent to IUCN criterion A)

Assessment Outcome: Not met

| <b>(1) - The species has undergone or is likely to undergo within a time frame appropriate to the life cycle and habitat characteristics of the taxon:</b> |     |   |   |
|--|-----|---|---|
|  | (a) | for critically endangered species   | a very large reduction in population size, or |
|  | (b) | for endangered species  | a large reduction in population size, or      |
|  | (c) | for vulnerable species  | a moderate reduction in population size.      |
| <b>(2) - The determination of that criteria is to be based on any of the following:</b>  |     |   |   |
|  | (a) | direct observation,   |   |
|  | (b) | an index of abundance appropriate to the taxon,   |   |
|  | (c) | a decline in the geographic distribution or habitat quality,                                    |   |
|  | (d) | the actual or potential levels of exploitation of the species,                                  |   |
|  | (e) | the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites. |   |

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**Clause 4.3 - Restricted geographic distribution of species and other conditions  
(Equivalent to IUCN criterion B)**

**Assessment Outcome:** Vulnerable under 4.3 (c)(d)(e, ii)

| <b>The geographic distribution of the species is:</b>      |     |   |   |
|--|-----|---|---|
|  | (a) | for critically endangered species   | very highly restricted, or  |
|  | (b) | for endangered species  | highly restricted, or   |
|  | (c) | for vulnerable species  | moderately restricted,  |
| <b>and at least 2 of the following 3 conditions apply:</b> |     |   |   |
|  | (d) | the population or habitat of the species is severely fragmented or nearly all the mature individuals of the species occur within a small number of locations, |   |
|  | (e) | there is a projected or continuing decline in any of the following:   |   |
|  |     | (i)   | an index of abundance appropriate to the taxon,                                       |
|  |     | (ii)  | the geographic distribution of the species,   |
|  |     | (iii)   | habitat area, extent or quality,  |
|  |     | (iv)  | the number of locations in which the species occurs or of populations of the species, |
|  | (f) | extreme fluctuations occur in any of the following:   |   |
|  |     | (i)   | an index of abundance appropriate to the taxon,                                       |
|  |     | (ii)  | the geographic distribution of the species,   |
|  |     | (iii)   | the number of locations in which the species occur or of populations of the species.  |

**Clause 4.4 - Low numbers of mature individuals of species and other conditions**

**(Equivalent to IUCN criterion C)**

**Assessment Outcome: Not met**

| <b>The estimated total number of mature individuals of the species is:</b> |     |   |   |                |
|--|-----|---|---|----------------|
|  | (a) | for critically endangered species   | very low, or  |                |
|  | (b) | for endangered species  | low, or   |                |
|  | (c) | for vulnerable species  | moderately low,   |                |
| <b>and either of the following 2 conditions apply:</b>                     |     |   |   |                |
|  | (d) | a continuing decline in the number of mature individuals that is (according to an index of abundance appropriate to the species): |   |                |
|  |     | (i)   | for critically endangered species   | very large, or |
|  |     | (ii)  | for endangered species  | large, or      |
|  |     | (iii)   | for vulnerable species  | moderate,      |
|  | (e) | both of the following apply:  |   |                |
|  |     | (i)   | a continuing decline in the number of mature individuals (according to an index of abundance appropriate to the species), and |                |
|  |     | (ii)  | at least one of the following applies:  |                |

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|--|--|-------|--|
|  |  | (A)   | the number of individuals in each population of the species is:                  |
|  |  | (I)   | for critically endangered species  |
|  |  | (II)  | for endangered species   |
|  |  | (III) | for vulnerable species   |
|  |  | (B)   | all or nearly all mature individuals of the species occur within one population, |
|  |  | (C)   | extreme fluctuations occur in an index of abundance appropriate to the species.  |

**Clause 4.5 - Low total numbers of mature individuals of species  
(Equivalent to IUCN criterion D)  
Assessment Outcome: Not met**

|  |     |                                   |                   |
|--|-----|-----------------------------------|-------------------|
| <b>The total number of mature individuals of the species is:</b> |     |                                   |                   |
|  | (a) | for critically endangered species | extremely low, or |
|  | (b) | for endangered species            | very low, or      |
|  | (c) | for vulnerable species            | low.              |

**Clause 4.6 - Quantitative analysis of extinction probability  
(Equivalent to IUCN criterion E)  
Assessment Outcome: Data Deficient**

|   |     |                                   |                    |
|---|-----|-----------------------------------|--------------------|
| <b>The probability of extinction of the species is estimated to be:</b> |     |                                   |                    |
|   | (a) | for critically endangered species | extremely high, or |
|   | (b) | for endangered species            | very high, or      |
|   | (c) | for vulnerable species            | high.              |

**Clause 4.7 - Very highly restricted geographic distribution of species–  
vulnerable species  
(Equivalent to IUCN criterion D2)  
Assessment Outcome: Not met**

|                         |  |
|-------------------------|--|
| For vulnerable species, | the geographic distribution of the species or the number of locations of the species is very highly restricted such that the species is prone to the effects of human activities or stochastic events within a very short time period. |
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Chairperson  
NSW Threatened Species Scientific Committee

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## Supporting Documentation:

Collett, R. (2022) Conservation Assessment of *Nurus brevis* Motschulsky, 1865 (Carabidae). NSW Threatened Species Scientific Committee.

## References:

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