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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 Lord Howe Island wood-feeding cockroach *Panesthia lata* Walker, 1868 as a CRITICALLY ENDANGERED SPECIES in Part 1 of Schedule 1 of the Act and, as a consequence, to omit reference to The Lord Howe Island wood-feeding cockroach *Panesthia lata* Walker, 1868 in Part 2 of Schedule 1 (Endangered species) of the Act. Listing of Critically Endangered species is provided for by Part 4 of the Act.

Summary of Conservation Assessment

Panesthia lata Walker, 1868 was found to be Critically Endangered in accordance with the following provisions in the *Biodiversity Conservation Regulation 2017*: Clause 4.3(a)(d)(e iii) because: 1) the species has a very highly restricted geographic distribution with an estimated extent of occurrence (EOO) of 62 km^2 and an estimated area of occupancy (AOO) of 16 km^2; 2) the species is known from only one threat-defined location; and 3) there is inferred continuing decline in habitat area, extent and quality as a consequence of invasive weed encroachment and increased hydrological deficit and drought driven by climate change.

The NSW Threatened Species Scientific Committee has found that:

1. The Lord Howe Island wood-feeding cockroach *Panesthia lata* Walker, 1868 (family Blaberidae) is a large, flightless, burrowing cockroach. It is described as having the head puctulate, ocellar spots not round, vertex not foveolate, exposed. Pronotum convex, anterior margin very slightly concave, incrassate (male only), with a small mesal rounded elevation (male only); anterior half moderately depressed (female less depressed), the floor sparsely roughened and with fine transverse striae; laterally finely and sparsely punctate, mesal disc tubercles represented by low, rounded mounds (male) or round, slight depressions (female). Meso- and metanotum with very few, fine punctations. Mesonotum not reaching the margin of the body, the anterior half, or the entire lateral margin, covered by the tegmina. Tegmina lateral, reaching slightly beyond hind margin of mesonotum. Wings absent. Tergites hairless, shallowly punctate, the punctations more numerous on posterior segments; anterolateral corners of T5-T7 with small holes lacking setae, the opening on T5 very small. Lateral margin of segment 7 practically straight, the caudal angle short, stout, directed caudad. Supranal plate densely punctate, hind margin arcuate, entire, the lateral angle short, rounded. Sternites shallowly punctate, punctations most numerous on S7 whose hind margin is concave. Cercus subrectangular, dorsoapical surface punctulate but lacking setae, ventrally with a setose swelling below apex Anteroventral margin of front femur with 1–2 spines (always 2 in females) and a small distal spine, hind margin with a large distal spine. Genital phallomeres well developed. Total length 33–40 mm in males and 32.5–41 mm in females; pronotum length x width 7.8–9 x 13–14.5 mm in males and 7.5– 9.2 x 12.5–16 mm in females; tegmen length x width 4.5–5.7 x 2.8–3.6 mm in males and 5–6.4 x 3–3.8 mm in females. The overall colouration is somewhat metallic, shiny. Head reddish to black, apex of clypeus and base of

labrum tawny, remainder of labrum brownish, the apex darker. Pronotum with disc blackish, blending into reddish. Meso- and metanotum and anterior abdominal tergites blackish. Mesal edge of tegmen pale. Abdominal sternites black, legs reddish. The female is generally blacker than the male, showing less of the reddish tinge and lacking the metallic shine. The female nymph (18 mm) has meso- and metanotum and abdominal tergites densely punctate, holes in anterolateral corners of T5-T7, and hind margin of the supranal plate entire (Roth 1977).

2. *Panesthia lata* is endemic to four islands in the Lord Howe Island Group of New South Wales (NSW), each considered to harbour one subpopulation per the IUCN (2024) definition: Blackburn Island, Roach Island, Lord Howe Island, and Ball's Pyramid (Carlile *et al*. 2018; Flemons *et al*. 2018; Adams 2023).

3. *Panesthia lata* has a very highly restricted geographic distribution. The extent of occurrence (EOO) is estimated to be 62 km^2 and is based on a minimum convex polygon enclosing all mapped occurrences of the species, the method of assessment recommended by IUCN (2024). The area of occupancy (AOO) was estimated to be 16 km^2 using 2 x 2 km grid cells, the scale recommended by IUCN (2024).

4. The minimum number of mature individuals is estimated to be 12,410, with the largest subpopulation found on Blackburn Island (Carlile *et al*. 2018; Adams 2023). *Panesthia lata* has not been collected on Ball's Pyramid since 1969 (Flemons *et al*. 2018), and as a consequence no estimate is available for this subpopulation, however the habitat structure of the island and low detection rate suggests this subpopulation is likely to be very small.

5. *Panesthia lata* is found primarily in leaf litter habitat under Australian banyan trees (*Ficus macrophylla* forma *columnaris*), which appears to provide food and moisture (Carlile *et al*. 2018; Adams 2023). A single Australian banyan tree on Blackburn Island supports 48–72% of the species' total population, despite covering just 1% of its range (Adams 2023; M. Adams *in litt*. July 2023). *Panesthia lata* also persists at lower densities in leafy flat sedge (*Cyperus lucidus*) (Carlile *et al*. 2018) and, at lower still densities in habitats with exotic Rhodes grass (*Chloris gayana*) and native sallywood (*Lagunaria patersonia*) (Carlile *et al*. 2018).

6. Little is known about *Panesthia lata*'s ecology, life cycle, or behaviour. *Panesthia lata* likely relies on moist soil and decaying vegetation for habitat and food, like other wood-eating cockroaches (Rugg and Rose 1990; Lo *et al*. 2016; Carlile *et al*. 2018). Its life cycle remains undescribed, but, as with all other Panesthiinae species, *P. lata* is likely ovoviviparous (incubating eggs internally). Observations suggest *P. lata* may live in family groups (Carlile *et al*. 2018), as do several other *Panesthia* species (Roth 1977). *Panesthia lata* may also be long-lived, with the closely related Australian wood cockroach (*P. cribrata*) potentially reaching maturity at six years and living over 10 years (Rugg and Rose 1990). One tracking study appears to show that *P. lata* is nocturnal as it seeks daytime refuge under soil, rocks, logs, tree roots and leaf litter, only becoming active at night to forage (Carlile *et al*. 2018). The same study suggests *P. lata* has high site fidelity and low mobility (Carlile *et al*. 2018), which means the species may not easily spread between subpopulations or colonise new areas.

7. The main threats to *Panesthia lata* are hydrological deficit and resulting habitat loss as a consequence of climate change, decline in habitat quality as a consequence of drought, habitat degradation as a consequence of weed invasion, exotic invertebrates, predation by introduced rodents such as ship rats (*Rattus* rattus) which have caused significant historical declines, and habitat degradation as a consequence of the root-rot pathogen *Phytophthora cinnamomi*. Of these 'Anthropogenic Climate Change', 'Invasion of native plant communities by exotic perennial grasses', 'Predation by the Ship Rat on Lord Howe Island', and 'Dieback caused by the root-rot fungus Phytophthora cinnamomi' are listed as Key Threatening Processes under the Act. Additionally, predation by, or competition with, exotic invertebrates poses a potential threat across subpopulations. Invertebrates that pose a potential threat should they make it to Lord Howe Island include, but are not limited to, red imported fire ants (*Solenopsis invicta*), yellow crazy ants (*Anoplolepis gracilipes*) and African big-headed ant (*Pheidole megacephala*).

8. The species is considered to occur at one threat-defined location, based on the threats of increased hydrological deficit and drought associated with climate change, which are likely to affect all subpopulations simultaneously, as highlighted by the 2018–2019 drought that adversely affected all islands in the group (Reid and Hutton 2019; Reid *et al*. 2020).

9. Observed and projected reductions in rainfall driven by climate change, and associated weed encroachment compounded by removal of rodents are inferred to be causing continuing decline in the quality of the habitat of *Panesthia lata* across its range. This is a particularly severe threat where subpopulations are dependent on banyans, which can be severely affected by hydrological deficit and drought (IUCN 2020). Weed encroachment into the footprint of these trees is also likely to severely affect the availability of high-quality habitat for *P. lata*, and greatly reduce the carrying capacity of these areas. While there is broad uncertainty in the projected range and severity of climate change on Lord Howe Island and nearby islands, Auld and Leishman (2015) determined that there was evidence for an ongoing increase in air and sea temperature and a decrease in overall rainfall on Lord Howe Island over the last 50 years. Habitat is likely to become increasingly dry and less suitable for *P. lata* as rainfall declines, and high-quality habitat more susceptible to the threat of encroachment by generalist weed species (Lord Howe Island Board 2016b; NSW Government Saving our Species 2021a).

10. Wood-eating cockroaches like *Panesthia lata* are generally dependant on moist soil and decaying leaf-litter for habitat and food (Rugg and Rose 1990; Lo *et al*. 2016; Carlile *et al*. 2018). As a result, any reduction in available moisture is likely to adversely affect habitat quality and extent by reducing food availability for *P. lata*. A hotter, drier climate is likely to affect plant communities across the Lord Howe Group, further reducing habitat quality for *P. lata*. The majority of plants endemic to Lord Howe Island are reliant on high humidity and are threatened by an increasingly dry environment (Auld and Leishman 2015). A less humid environment will likely favour the less specialised invasive weed species that already compete with habitat plants and may further affect the distribution of food plant availability and moist soil on which *P. lata* relies (Auld and Leishman 2015; Carlile *et al.* 2018).

11. *Panesthia lata* Walker, 1868 is eligible to be listed as a Critically Endangered species as, in the opinion of the NSW Threatened Species Scientific Committee, it is facing an extremely high risk of extinction in Australia in the immediate 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: Endangered under Clause 4.3(a)(d)(e iii)

Clause 4.2 – Reduction in population size of species
(Equivalent to IUCN criterion A)
Assessment Outcome: Data Deficient

(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:			
	(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.
(2) - The determination of that criteria is to be based on any of the following:			
	(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.	

Clause 4.3 – Restricted geographic distribution of species and other conditions
(Equivalent to IUCN criterion B)
Assessment Outcome: Critically Endangered under Clause 4.3(a)(d)(e iii)

The geographic distribution of the species is:			
	(a)	for critically endangered species	very highly restricted, or
	(b)	for endangered species	highly restricted, or
	(c)	for vulnerable species	moderately restricted.
and at least 2 of the following 3 conditions apply:			
	(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 Clause C)
Assessment Outcome: Not Met

The estimated total number of mature individuals of the species is:						
	(a)	for critically endangered species				very low, or
	(b)	for endangered species				low, or
	(c)	for vulnerable species				moderately low.
and either of the following 2 conditions apply:						
	(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:			
			(A)	the number of individuals in each population of the species is:		
				(I)	for critically endangered species	extremely low, or
				(II)	for endangered species	very low, or
				(III)	for vulnerable species	low,
			(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

The total number of mature individuals of the species is:			
	(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

The probability of extinction of the species is estimated to be:			
	(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: Vulnerable under Clause 4.7

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.

Professor Caroline Gross
Chairperson
NSW Threatened Species Scientific Committee

Supporting Documentation:

Rowell T (2024) Conservation Advice for the Lord Howe Island Wood-feeding Cockroach *Panesthia lata* Walker, 1868. NSW Threatened Species Scientific Committee.

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