Notice of Preliminary Determination

The NSW Threatened Species Scientific Committee (NSW TSSC), established under the *Biodiversity Conservation Act 2016* (the Act), has made a Preliminary Determination to support a proposal to list the 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 *Panesthia lata* Walker in Part 2 of Schedule 1 (Endangered Species) of the Act.

How to make a submission

The NSW TSSC welcomes public involvement in the assessment process and places preliminary determinations on public exhibition on the NSW TSSC pages on the NSW Department of Climate Change, Energy, the Environment and Water (NSW DCCEEW) website. This public exhibition provides an opportunity for the public to comment on this preliminary determination as well as provide any additional information that is relevant to the assessment.

Postal submissions regarding this Preliminary Determination may be sent to:

Secretariat
NSW Threatened Species Scientific Committee
Locked Bag 5022
Parramatta NSW 2124.

Email submissions in Microsoft Word or PDF formats to:
scientific.committee@environment.nsw.gov.au

Submissions close 28/09/2024

What happens next?

After considering any submissions received during the public exhibition period the NSW TSSC will make a Final Determination and a notice will be placed on the NSW DCCEEW website to announce the outcome of the assessment. If the Final Determination is to support a listing, then it will be added to the Schedules of the Act when the Final Determination is published on the legislation website. www.legislation.nsw.gov.au.

Privacy information

The information you provide in your submission may be used by the NSW TSSC in the assessment to determine the conservation status and listing or delisting of threatened or extinct species, threatened populations and threatened or collapsed ecological communities or to assess key threatening processes.

The NSW TSSC may be asked to share information on assessments with NSW Government agencies, the Commonwealth Government and other State and Territory governments to collaborate on national threatened species assessments using a common assessment method and to assist in the management of species and ecological communities.

If your submission contains information relevant to the assessment it may be provided to state and territory government agencies and scientific committees as part of this collaboration.

If you wish your identity and personal information in your submission to be treated as confidential you must:

- *request your name be treated as confidential*, and
- *not include any of your personal information in the main text of the submission or attachments so that it can be easily removed.*

Senior Professor Kristine French
Chairperson
NSW Threatened Species Scientific Committee

Public Exhibition period: 28/06/2024 - 28/09/2024

Preliminary Determination

The NSW Threatened Species Scientific Committee, established under the *Biodiversity Conservation Act 2016* (the Act), has made a Preliminary Determination to support a proposal to list the 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 *Panesthia lata* Walker 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)(eiii).

The NSW Threatened Species Scientific Committee has found that:

1. The Lord Howe Island Wood-feeding Cockroach *Panesthia lata* is a large, flightless, burrowing cockroach endemic to the Lord Howe Island Group of New South Wales (NSW). *Panesthia lata* was initially described by Walker (1868), and then subsequently by Roth (1977) as part of a broad taxonomic revision of cockroaches of the sub-family Panesthiinae *(*Roth*,* 1977).

2. Roth 1977 describes *Panesthia lata* as: Male: Head punctulate, ocellar spots not round, vertex not foveolate, exposed. Pronotum convex, anterior margin very slightly concave, incrassate, with a small mesal rounded elevation; anterior half moderately depressed, the floor sparsely roughened and with fine transverse striae; laterally finely and sparsely punctate, mesal disc tubercles represented by low, rounded mounds. 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 and a small distal spine, hind margin with a large distal spine. Genital phallomeres well developed. Total length 33–40 mm; pronotum length x width 7.8–9 x 13–14.5 mm; tegmen length x width 4.5–5.7 x 2.8–3.6 mm.

   Colouration: 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.

Female differs from male as follows: Anterior pronotal margin slightly concave, but not incrassate and lacking the mesal elevation. Anterior half of the pronotum less depressed and punctate and without elevated mounds of tubercles; in their place may be a pair of round, slight depressions. The female is generally blacker than the male, showing less of the reddish tinge and lacking the metallic shine. The apical clypeal band is also much narrower than in the male. Anteroventral margin of front femur with 2 spines. Total length 32.5–41 mm; pronotal length x width 7.5–9.2 x 12.5–16 mm; tegmen length x width 5–6.4 x 3–3.8 mm.

Nymph: 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'.

3. Genetic studies support the original description of *Panesthia lata* as representing a single species across the Lord Howe Island Group, despite restricted gene flow between islands (Adams, 2023; Lo *et al*., 2016). A preliminary 2016 study incorporating a single individual from each of Blackburn and Roach islands found there was evidence to support the idea that subpopulations on different islands may have diverged sufficiently to constitute species level classification (Lo *et al.*, 2016). However, a follow-up study by the same lab in 2023 examined a larger sample from a broader range of subpopulations finding that although subpopulations showed divergence between islands, this divergence is relatively recent (17.0 to 43.7 ka), and not sufficient to warrant species level reclassification (Adams, 2023).

4. *Panesthia lata* has been collected from four islands; Lord Howe Island (-31.553, 159.082), Roach Island (*-31.499, 159.068*), Blackburn Island (*-31.535, 159.060*), and Ball's Pyramid (-31.754, 159.250).

5. AOO for *Panesthia lata* is 16 km^2. The entire population of *P. lata* occurs in an area that can be contained within four 2 km x 2 km grid squares*,* which is the smallest standard grid resolution recommended for assessments of AOO under the IUCN Standards and Petitions Committee (2022)

6. EOO for *Panesthia lata* is 62 m^2. The subpopulations on Blackburn, Roach, and Lord Howe islands are all closely clustered, and with these subpopulations alone EOO is much smaller, at only 4.5 km^2. However, the subpopulation on Ball's Pyramid is ~23 km from the main island, which contributes to the much larger final EOO for the species.

7. Combined population estimates for all confirmed subpopulations provide a minimum total mature population estimate of 12,410 (Blackburn, 9,809; Roach, 601, Lord Howe Island, 2,000), and a maximum of 50,556 (Blackburn, 40,445; Roach, 6,111, Lord Howe Island, 4,000) *(Adams, 2023; Carlile et al., 2018)*. *Panesthia lata* has not been collected on Ball's Pyramid since 1969 (Flemons *et al.*, 2018), and as a consequence no population 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.

8. There has only been one formal study into the ecology of *Panesthia lata.* Exact details concerning life cycle, diet, habitat use, population dynamics and behaviour remain generally unexplored, although *Panesthia lata* appears dependant on moist soil and decaying vegetation for habitat and food, in common with other wood-eating cockroaches (Carlile *et al*., 2018; Lo *et al.,* 2016; Rugg & Rose, 1990).

9. There is no formal description of the life cycle of *Panesthia lata*. Cockroaches (Blattodea) typically have three life stages; eggs are deposited into an ootheca, eggs hatch as nymphs, nymphs moult several times eventually becoming adults. However, some species of cockroach have evolved to become ovoviviparous (eggs are hatched inside the body of the parent) or viviparous (live-bearing), with offspring incubated internally rather than deposited into an ootheca (Roth, 1977). All other members of Panesthiinae are ovoviviparous, and this has been used as an identifying taxonomic feature of the group, so this is likely in *P. lata* (Roth, 1977).

10. Related mainland species *Panesthia australis* and *P. cribrata* appear to live in 'family groups', with a pair of adults accompanied by up to 20 nymphs (Roth, 1977). This may also be true of *P. lata*, with observers noting adults accompanied by juveniles (Carlile *et al.,* 2018).

11. *Panesthia* species and other large cockroaches can be relatively long lived, and it is possible that this is also true of *P. lata*. Laboratory studies in *P. cribrata* found individuals could take up to 6 years to reach maturity and live for over 10 years in total (Rugg & Rose, 1990).

12. There is no information available about dispersal in *Panesthia lata,* however adults appear to show high site fidelity and low mobility. A tracking experiment found that individuals appear to rely on fixed daytime refuges, only moving short distances from their refuge to forage (Carlile *et al*., 2018) Apparently high site fidelity suggests *P. lata* may be unlikely to easily move between subpopulations or colonise new sites where suitable habitat exists.

13. Australian Banyan trees (*Ficus macrophylla* forma *columnaris*) appear to form the most significant habitat component for *Panesthia lata* across its range, and degradation or loss of these trees would be likely to contribute to population decline in *P. lata*. These trees drop thick layers of leaf litter, providing food and the moist environment on which *P. lata* are likely to depend. The footprint of the single Australian Banyan tree on Blackburn Island supports the largest surveyed subpopulation of *P. lata* known, contributing 48 - 72% of the total estimated population for *P. lata*, despite forming only around 1% (1515 m^2) of the total estimated occupied habitat area for *P. lata* across its range (137,110 m^2). Similarly, the two sites recently rediscovered on Lord Howe Island are entirely restricted to the footprint (~100 m^2) of two Australian banyans, with no individuals observed outside this area, despite targeted surveys in surrounding habitat, and beneath other banyans on the island (Adams, 2023; M. Adams in litt. July, 2023)

14. *Panesthia lata* persists at moderate densities in sub-optimal leafy flat sedge (*Cyperus lucidus*) habitat. Leafy flat sedge is considered by Carlile *et al.* (2018) to be a key habitat type for *P. lata*, although the cockroach occurs in far lower densities in this habitat (2.3+/- 1.8 per m^2) than in preferred habitat under the

Australian Banyan trees (Carlile *et al.,* 2018) Banyans and other trees are absent from the smaller islands in the group, including Roach island, while leafy flat sedge is broadly distributed across the group, and is likely to constitute the crucial habitat for *P. lata* where it occurs on these islands.

15. *Panesthia lata* also persists in lower-quality habitat on Roach and Blackburn islands, in particular exotic Rhodes grass (*Chloris gayana*) and native sallywood (*Lagunaria patersonia*). However the density in these habitats is extremely low.

16. Diet in *Panesthia lata* has not been thoroughly explored, however they appear to feed on moist vegetable matter, particularly leaves, and in one case on cardboard (Carlile *et al.,* 2018) On Blackburn Island *P. lata* were observed to preferentially feed on leaf matter from Australian Banyan trees, and this may be a contributing factor in their general restriction to the footprint of Australian Banyan trees on both Blackburn and Lord Howe Islands (Carlile *et al.,* 2018).

17. 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, 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*', these '*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 NSW *Biodiversity Conservation Act 2016*. Additionally, predation by, or competition with, exotic invertebrates poses a 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*) and yellow crazy ants (*Anoplolepis gracilipes*), both of which are described in KTPs under the NSW *Biodiversity Conservation Act 2016* and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

18. Hydrological deficit and resulting habitat loss as a consequence of climate change poses a severe and ongoing threat to *Panesthia* lata across its range. Wood-eating cockroaches like *P. lata* are generally dependant on moist soil and decaying leaf-litter for habitat and food (Carlile *et al.,* 2018; Lo *et al.,* 2016; Rugg & Rose, 1990). While there is broad uncertainty in the projected range and severity of climate impacts on Lord Howe Island and across the group, Auld and Leishman (2015) determined that there was evidence for an ongoing increase in temperature and a decrease in overall rainfall on Lord Howe Island over the last 50 years. As a result, increasing aridity and reduction in available moisture is likely to impact habitat quality, extent, and food availability for *P. lata*.

19. A hotter, drier climate is also likely to affect plant communities further affecting habitat for *Panesthia lata*. The majority of plants endemic to Lord Howe Island are reliant on high moisture availability and are threatened by an increasingly dry environment (Auld & Leishman, 2015). An environment with less available moisture will likely favour the less specialised invasive weed species that already compete with habitat plants and may further impact the distribution of food plant availability and moist soil on which *P. lata* relies (Auld & Leishman, 2015; Carlile *et al*., 2018).

Acute drought poses a severe threat to habitat for *P. lata*. Of particular concern is the impact of the general increase in aridity coupled with drought on the welfare of the island group's Australian Banyan trees, which supports the vast majority of the total population of *P. lata* across the island group.

20. The small EOO for *Panesthia lata* means that changes in weather and climate are likely to affect all islands and subpopulations, as highlighted by the 2018-2019 drought which affected all islands in the group, including Ball's Pyramid (Reid *et al.* 2020; Reid & Hutton 2019).

21. Invasive weeds pose an ongoing threat to the habitat of *Panesthia lata* (Lord Howe Island Board, 2016a). Weeds encroach on the habitat of *P. lata* on every island, changing habitat composition and availability, outcompeting native plants for resources and space, and inhibiting native plant recruitment by reducing the likelihood seeds will find sufficient space and resources to germinate (Lord Howe Island Board, 2016a). Of particular concern are Rhodes grass, crofton weed (*Ageratina adenophora*), Formosan lily (*Lilium formosanum*), Kikuyu grass (*Cenchrus clandestinus*), and ground asparagus (*Asparagus aethiopicus*) (Lord Howe Island Board, 2016; T. Auld pers. comm. 2022).

22. *Panesthia lata* only occurs at extremely low densities in habitat dominated by weed species, in particular Rhodes grass, and so any encroachment of these species into patches of high-quality habitat leafy flat sedge or the footprint of Australian banyans is likely to have severe consequences for habitat quality and availability for *P. lata*, and lead to significant decline in the species.

23. The introduction of exotic invertebrates, in particular ant species, is a severe future threat to species across the Lord Howe Island Group, including *Panesthia lata*. Introduced invertebrates have been devastating for other island groups worldwide, causing extinction in native invertebrates through catastrophic predation, and are a key concern for the conservation of endangered species in the Lord Howe Island Group (Department of Environment and Climate Change (NSW), 2007; Hoffmann *et al*., 2017; Wetterer, 2012). Numerous species are of concern (for example yellow crazy ant, *Anoplolepis gracilipes*; African big-headed ant, *Pheidole megacephala*, and red imported fire ant, *Solenopsis invicta*) which heavily predate and compete with native terrestrial invertebrates, posing a severe extinction risk for species like *P. lata* (Wetterer, 2012). An introduced huntsman spider (*Heteropoda sp*.) has also become extremely common in lowland forest on Lord Howe Island and is likely to pose a predation threat to *P. lata* (Reid & Hutton, 2019b).

24. While rodents appear to have been extirpated from Lord Howe Island as a result of an intensive eradication program, there is an ongoing risk of reintroduction to the island group. Introduced ship rats *Rattus rattus*, have had a devastating effect on ecosystem of the main island since their introduction following a shipwreck in 1918, and were a driving factor in the extinction of at least 5 bird species and decline in other vertebrates, decline and extinction of at least 10 invertebrates, and continued consumption of plants and seeds by rats drove broad ecosystem change across the island (Department of Environment and Climate Change (NSW), 2007). *Rattus rattus* was likely to be the driving factor in the almost complete extirpation

of *Panesthia lata* from the main island and continued acting as a constraint to the recovery and growth of the few tiny cockroach populations that persisted there.

25. *Phytophthora cinnamomi* has been recorded on Lord Howe Island (Auld & Hutton 2004). It poses a threat to high-quality habitat for *Panesthia lata. Phytophthora cinnamomi* is an introduced fungal pathogen that has had a devastating effect on plant communities world-wide, causing catastrophic dieback in many species, and is listed as a Key Threatening Process 'Dieback caused by the root-rot fungus *Phytophthora cinnamomi*' under both the NSW BC Act, and Commonwealth EPBC Act. *Phytophthora cinnamomi* affects a huge variety of plants, including *Ficus* species like the Australian banyans on Blackburn and Lord Howe Island (Türkölmez *et al*., 2019; Weste, 1974; Weste *et al*., 1973). The majority of *Panesthia lata* individuals and subpopulations are dependent on Australian Banyan trees for high quality habitat and food, so infection and death of these trees would have severe consequences for *P. lata*.

26. *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:
Panesthia lata was found to be Critically Endangered under Clause 4.3 (a)(d)(eiii) and Vulnerable under Clause 4.7

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)(eiii)

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 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

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 Kristine French
Chairperson
NSW Threatened Species Scientific Committee

Supporting Documentation:

Rowell, T. (2024) Conservation Assessment of *Panesthia lata* Walker, 1868. NSW Threatened Species Scientific Committee.

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