

## Notice and reasons for the 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 earthworm *Pericryptodrilus nanus* Jamieson, 1977 as a CRITICALLY ENDANGERED SPECIES in Part 1 of Schedule 1 of the Act and, as a consequence, to omit reference to *Pericryptodrilus nanus* Jamieson, 1977 from 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

*Pericryptodrilus nanus* Jamieson, 1977 (family Megascolecidae) 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). The main reasons for this species being eligible are i) It has a very highly restricted geographic range (Area of Occurrence is 4 km<sup>2</sup>); ii) It is found at only a single location in a 27 ha area of Gnarled Mossy Cloud Forest (which is itself listed as a Critically Endangered ecological community); and, iii) There is inferred continuing decline in habitat quality as a consequence of climate change, as well as ongoing threats from invasive species.

The NSW Threatened Species Scientific Committee has found that:

1. The Lord Howe earthworm *P. nanus* was described from 10 specimens along with other Lord Howe Island earthworm species by Jamieson 1977, and has undergone no subsequent revisions. It is an exceptionally small (25-32 mm) earthworm for the Megascolecidae, a family commonly associated with giant species (potentially up to 3 m, *Megascolides australis*) (Jamieson, 1977; Van Praagh and Yen, 2010). In its original Final Determination for *P. nanus* (2001), the NSW Scientific Committee stated that: "*Pericryptodrilus nanus*, which is found on Lord Howe Island, was described in the Records of the Australian Museum 1977 vol 30:272-308 Figs. 1-7 by Jamieson 1977 as: Length 25-32 mm. Width (mid-clitellar) 1.0-1.5 mm. Segments 111-123. Prostomium broadly epilobous. First dorsal pore 6/7 or 10/11. Setae perichaetine, >30 per setiger. Nephropores 3 straight series on each side. Clitellum annular, in segments 1/2 XIII, XIV- XVI. Small slit-like combined male and prostatic pores a pair in XVIII approximately in b on prominent papillae. Accessory genital markings 2 midventral presetal circular glandular areas, with indistinct pore like centres, one in XX, the other in XXI. Female pore unpaired, midventral, anteriorly on XIV. Spermathecal pores 2 pairs, in 7/8 and 8/9, between the third and fourth setal rows. Dorsal blood vessel single. Hearts 3 pairs, in X-XII. A rudimentary gizzard in segment V; calciferous glands at least extramurally absent; intestine commencing in XVI. Three subspherical slightly bilobed nephridial bladders present on each side per segment, those in the tenth setal lines large, the others (above and below) small. The nephridia of the intermediate series each with a preseptal funnel near the nerve cord; no funnels demonstrable for the dorsal and ventral series. Pharyngeal, or other enteronephric nephridia, and tufted

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nephridia absent. Testes and funnels in X and XI; seminal vesicles in IX and XII. Ovaries and oviducal funnels in XIII. Large multiloculate ovisacs in XIV. Prostates thickly tubular, in XVIII and extending into XIX; ducts median, slender; vas deferens joining each gland at its junction with the duct. Penial setae absent. Spermathecae in VIII and IX; each with a subspherical ampulla, conical, and a large clavate inseminated lateral diverticulum which joins the duct at mid length; the diverticulum with or without a subsidiary less well developed or knoblike diverticulum of similar width at its base or all simple. This earthworm can be easily distinguished from all other earthworms on the island by the presence of the median accessory genital markings and three rows of nephridiopores.” (NSW Threatened Species Scientific Committee 2001).

- Pericryptodrilus nanus* is endemic to Lord Howe Island, the largest of a collection of small volcanic islands in the Tasman Sea, 760 km northeast of Sydney (Department of Environment and Climate Change (NSW) 2007). The island is around 11 km long, and only 2.8 km at its widest point, with a total area of 1455 ha and a maximum elevation of 875 m on its highest peak, Mt Gower (Department of Environment and Climate Change (NSW) 2007).
- There have been no assessments of distribution, abundance, or taxonomy for *P. nanus* since the original 1970s surveys described in Jamieson (1977). While there have been surveys for other invertebrates across Lord Howe Island (including Mount Gower; C. Stehn pers. comm. February 2022), there have been no more recent surveys for earthworms, and no incidental collection of additional earthworm specimens. Identification of *P. nanus* requires a close examination of morphology that would be challenging in the field, and this may contribute to the lack of observations since the original intensive surveys in the 1970s.
- All current records of occurrence of *Pericryptodrilus nanus* are from Gnarled Mossy Cloud Forest, a Critically Endangered Ecological Community that occurs only on the summit and ridgelines of Lord Howe Island’s two southern peaks, Mount Gower and Mount Lidgbird (Auld and Leishman 2015). *Pericryptodrilus nanus* has only been found on the peak of Mount Gower, where Gnarled Mossy Cloud Forest covers approximately 27 ha, and has not been found on the small, remnant patch on Mount Lidgbird (Jamieson 1977).
- Pericryptodrilus nanus* has a very highly restricted geographic range, with both an Extent of Occurrence (EOO) and Area of Occupancy (AOO) of only 4 km<sup>2</sup>. It occurs at only one location, in Gnarled Mossy Cloud Forest, covering an area of 27 ha (Jamieson 1977; Auld and Leishman 2015). As a consequence, the entire known population of *P. nanus* occurs in an area that can be contained within a single 2 km x 2 km grid square, based on 2 km x 2 km grid cells, the scale recommended for assessing area of occupancy by IUCN (2019). Restricted to one very small site results in an EOO for *P. nanus* less than the estimate of AOO. Where EOO is less than or equal to AOO then IUCN guidelines recommend EOO estimates be changed to be equal to AOO to ensure consistency with the definition of AOO as an area that fits within EOO (IUCN Standards and Petitions Committee (2019)).

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6. There has been no intensive study of behaviour, genetics, or population dynamics in *P. nanus*, but they are likely similar to related or similarly sized earthworm species. The presence of sperm-producing male reproductive organs in *P. nanus* suggests that it reproduces bi-parentally, however some other species of worm reproduce both bi-parentally and parthenogenically, so it is possible that *P. nanus* may also do so (Dyne and Jamieson 2004). Earthworms are generally dependent on stable, moist environments for habitat, feeding on organic matter (Schmidt and Curry 2001; Eggleton *et al.* 2009; Uvarov *et al.* 2011). Species population size is often closely related to changes in temperature and moisture content, with populations dramatically reducing in dry conditions or in response to large fluctuations in temperature (Schmidt and Curry 2001; Eggleton *et al.* 2009; Uvarov *et al.* 2011). Given general similarities in habitat and ecology between earthworm species it is likely that *P. nanus* populations follow similar patterns.
7. The main threats to *P. nanus* are habitat loss as a result of climate change, invasive weeds, and fungal infections of key plant species, as well as predation by introduced predators, and competition with introduced species. 'Anthropogenic Climate Change', 'Infection of Native Plants by *Phytophthora cinnamomi*', and 'Predation by the Ship Rat on Lord Howe Island' are Key Threatening Processes under the Act.
8. Climate change poses a major and ongoing threat to Gnarled Mossy Cloud Forest, the ecosystem to which *P. nanus* is both confined to and dependant on. While there is uncertainty in the projected range and severity of climate impacts in Lord Howe Island, data over the last 50 years shows there has been an ongoing decrease in rainfall and cloud cover, and an increase in overall temperature (Auld and Leishman 2015). Reduction in cloud formation and moisture availability is likely to result in a decline in quality and range of Gnarled Mossy Cloud Forest on Lord Howe Island (Auld and Leishman 2015). A warming climate also increases the ongoing risk of loss of canopy species, reducing shade and contributing to changes in microclimate, and general drying due to lack of rainfall on the summit. Earthworms across taxa show dramatic declines when confronted with loss of soil moisture or fluctuations in temperature, and decline of Gnarled Mossy Cloud Forest and ongoing changes in temperature and moisture availability as a result of climate change on Lord Howe Island pose a severe threat to populations of *P. nanus* (Schmidt and Curry 2001; Eggleton *et al.* 2009; Uvarov *et al.* 2011).
9. Climate change may increase the likelihood and severity of sub-tropical storms on and around Lord Howe Island, posing an additional severe threat to Gnarled Mossy Cloud Forest (Auld and Leishman 2015). These storms damage standing trees, reducing canopy cover and affecting the microclimate of the surrounding area, posing a threat to the entire ecological community (Auld and Leishman 2015). Any damage to the ecological community is likely to reduce the quality or extent of the already severely restricted habitat available to *Pericryptodrilus nanus*.

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10. Invasive weeds threaten *P. nanus* habitat. *Psidium cattleianum* var. *cattleianum* (Cherry Guava) and *Asparagus aethiopicus* (Ground Asparagus) have both been observed in proximity to, and at similar altitude to Gnarled Mossy Cloud Forest (Lord Howe Island Board 2016). These species have been severely detrimental to other ecological communities on the island, and invasion would reduce the habitat available to *P. nanus* (Lord Howe Island Board 2016). Weed management programs currently underway across the Lord Howe Island group may reduce the threat posed by weeds in the future (Lord Howe Island Board 2016).
11. Two fungal pathogens threaten *P. nanus* habitat: root-rot, *Phytophthora cinnamomi*, and Myrtle Rust, *Austropuccinia psidii*. Both pathogens affect key tree species in Gnarled Mossy Cloud Forest and could result in significant declines (Weste *et al.* 1973; Weste 1974; Makinson 2018; T. Auld pers. comm. December 2021). There have been outbreaks on the island in the past that have been effectively controlled, but these infections remain an ongoing threat (Auld and Leishman 2015; T. Auld pers. comm. December 2021).
12. Predation and competition with exotic invertebrates are ongoing threats. Introduced earthworms *Allobophora caliginosa*, *Amyntas diffringens*, and one unidentified species are all suspected to compete with *P. nanus* (NSW Scientific Committee (2001), Department of Environment and Climate Change (NSW) 2007). In addition, since 2017, invertebrate surveys have noted an increase in at least three endemic and two introduced planarian flatworm species at the summit of Mount Gower that are all likely predators of *P. nanus* (C. Stehn pers. comms. February 2022).
13. Introduced rodents, in particular the Ship Rat (*Rattus rattus*) and House Mouse (*Mus musculus*), have had a devastating effect on the native fauna of Lord Howe Island, and are a suspected predator of *P. nanus*. Rats have also severely impacted plant communities on Lord Howe, including Gnarled Mossy Cloud Forest. Rats eat seeds and seedlings of many key structural species, clearing young standing plants, and reducing the seedbank and future generations of key species. This affects the health and distribution of the Gnarled Mossy Cloud Forest on which *P. nanus* depends (Auld and Leishman 2015). An extensive program of rodent eradication on the main island began in 2019 (Harper *et al.* 2020). This program appears to have been successful and rodents (rats and mice) have been eradicated from the island, however the program has not yet been officially declared successful and ongoing monitoring is in place, both for rodents and to quantify the benefits and/or ecosystem changes resulting from the pest eradication. As a predator of earthworms, the introduced Common Blackbird (*Turdus merula*) is also a suspected predator of *P. nanus* on Lord Howe Island, however no formal study has been conducted to assess their impact (Csurhes and Markula 2016).

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14. *Pericryptodrilus nanus* Jamieson, 1977 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:** *Pericryptodrilus nanus* was found to be Critically 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

<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.	

### 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)

<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,

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	(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: Data Deficient**

<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:	
		(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.

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## Clause 4.5 - Low total numbers of mature individuals of species (Equivalent to IUCN criterion D)

**Assessment Outcome: Data Deficient**

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: 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

### Supporting Documentation:

Rowell, T. (2022) Conservation Assessment of *Pericryptodrilus nanus* Jamieson, 1977 (Megascolecidae). NSW Threatened Species Scientific Committee.

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