

Notice 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 Littlejohn's Tree Frog *Litoria littlejohni* White, Whitford & Mahony 1994 as an ENDANGERED SPECIES under Part 2 of Schedule 1 of the Act and, as a consequence, to omit reference to Littlejohn's Tree Frog, *Litoria littlejohni* A.W. White, Whitford & Mahony (1994) from Part 3 of Schedule 1 (Vulnerable species) of the Act. Listing of Endangered species is provided for by Part 4 of the Act.

The NSW Threatened Species Scientific Committee is satisfied that Littlejohn's Tree Frog *Litoria littlejohni* White, Whitford & Mahony 1994 has been duly assessed by the Commonwealth Threatened Species Scientific Committee under the Common Assessment Method (Department of Agriculture, Water and the Environment (DAWE) 2022). The acceptance of this assessment is provided for by Part 4.14 of the Act.

Summary of Conservation Assessment

The Threatened Species Scientific Committee accepts the assessment undertaken by the Commonwealth Threatened Species Scientific Committee in its Conservation Advice for *Litoria littlejohni* (Littlejohn's Tree Frog) (DAWE 2022).

Litoria littlejohni White, Whitford & Mahony 1994 was found to be Endangered in accordance with the following provisions in the *Biodiversity Conservation Regulation 2017*: Clause 4.3(b)(d)(e i, ii, iii, iv). The main reasons for this species being eligible are: i) *L. littlejohni* has a highly restricted geographic range; ii) there are 3–5 locations; and iii) there is inferred continuing decline in the abundance, geographic distribution, and number of locations of the species, and in the area, extent and quality of its habitat, due to impacts from amphibian chytrid fungus (*Batrachochytrium dendrobatidis*), habitat loss, altered groundwater hydrology, and increasing bushfires, drought and heatwaves, and changed rainfall patterns as a result of anthropogenic climate change.

The NSW Threatened Species Scientific Committee has found that:

1. *Litoria littlejohni* White, Whitford & Mahony 1994 (Hylidae) is described by White *et al.* (1994) as "Moderately large brown frog (female S-V 52–68 mm; male S-V 40–51 mm). Head broader than it is long (HL/HW = 0.91). Distinctive red orange colouration in axillae, around the groin and along the undersurface of the thighs. *L. littlejohni* differs from all other *Litoria* species in its mating call (call duration 7–9 sec, notes/call 7.8–10.7, note duration 250–670 msec, pulse repetition rate 500–700 msec, and dominant frequency 1683–2500 Hz). Variation: *L. littlejohni* exhibits marked sexual dimorphism with females usually more than 30% longer than males. Mean S-V of males (N = 75) 45.8 mm. Mean S-V of females (N = 13) 59.1 mm. No significant differences were found between male and female specimens for other measurements. The combined means were: TL/S-V = 0.534 (range 0.48–0.58); HLK/HW = 0.910 (range 0.83–0.97); HL/S-V = 0.32 (range 0.30–0.37); HW/S-V = 0.35 (range 0.31–0.37); IN/E-N = 0.91 (range 0.87–0.94); ET = 1.83 (range 1.63–2.11). Colour in Life: Dorsum of body and flanks light brown with a

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broad dark band (which is indistinct in some specimens) from between the eyes to the cloaca; belly white or cream; anterior and posterior surfaces of the thighs and groin, and the axilla are bright orange red. Iris light golden brown. A dark brown bar occurs from the tip of the snout through the nostrils, on the lateral aspect of the canthus rostralis and of the supratympanic fold to the axilla of the arm.”

2. A recent taxonomic revision divided *Litoria littlejohni* into two distinct species: *L. littlejohni* (Littlejohn’s Tree Frog), which is now the species name for the northern species, and *L. watsoni* (Watson’s Tree Frog), the southern species (Mahony *et al.* 2020). *Litoria littlejohni* is very similar in appearance to *L. watsoni*, with the species physically distinguishable from each other only by small differences in morphometric measurements (DAWE 2022). *Litoria littlejohni* can more easily be identified by the male breeding call, which has a higher average number of pulses in each note (27.8) compared to *L. watsoni* (22.8) (Mahony *et al.* 2020).
3. *Litoria littlejohni* is endemic to NSW, with a patchy but widespread distribution within the Sydney Basin Bioregion at elevations from 100–1,160 m (Lemckert *et al.* 2005; DEWHA 2008; Lemckert 2009, 2010; Gillespie *et al.* 2016; Lemckert & Mahony 2018; Mahony *et al.* 2020 all in DAWE 2022). The species distribution extends from the Watagan Mountains, south to just north of Kangaroo Valley, and west to the Blue Mountains (OEH 2017a; ALA 2020; Mahony *et al.* 2020 all in DAWE 2022). The distributions of *L. littlejohni* and *L. watsoni* appear to meet at the southern boundary of the Sydney Basin Bioregion, an area characterised by steep escapements and valleys, and recognised as a biogeographic barrier for several species (Bryant and Krosch 2016). It is unknown whether the species co-occur where their distributions meet (Mahony *et al.* 2020). *Litoria littlejohni* has disappeared from several historic sites over the past three decades (Mahony *et al.* 2020).
4. There are three known locations based on the threat of fire, representing clusters of relatively continuous *L. littlejohni* records: Watagan National Park and surrounds; Blue Mountains National Park; and southern Sydney Basin Bioregion (DAWE 2022). All three locations are sparsely populated and fragmented, with little chance of recolonisation in event of local extinction due to the isolated nature of each location (DAWE 2022). It is possible that other sites exist, with large areas of seemingly suitable habitat between known locations (Lemckert 2010; Mahony *et al.* 2020 all in DAWE 2022). As a result, there are 3–5 plausible locations (DAWE 2022).
5. *Litoria littlejohni* is a forest-dependent habitat generalist (DAWE 2022). The species occurs in several different vegetation communities, from heathland, woodland, and bushland, to wet and dry forest (Lemckert *et al.* 2005; DEWHA 2008; Lemckert 2009, 2010; Lemckert & Mahony 2018; Mahony *et al.* 2020 all in DAWE 2022). The most important variable determining the presence of *L. littlejohni* is long lasting pools that allow tadpoles to reach metamorphosis (Lemckert 2009, 2010 in DAWE 2022). Surrounding habitat is characterised by leaf litter and low native vegetation (Lemckert *et al.* 2005; Lemckert 2009; 2010; OEH 2017a; Mahony *et al.* 2020 all in DAWE 2022). Within this habitat, the species is mostly found in moist, sunny, and relatively flat areas (Lemckert 2009, 2010; Lemckert & Mahony 2018 all in DAWE 2022) but has also been found sheltering under rocks on high exposed ridges during summer (DPE 2000).

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6. Breeding occurs throughout the year except in early summer, with peak calling in July–September and in February, triggered by heavy rain and water availability (White *et al.* 1994; Daly & Craven 2007; Lemckert 2009, 2010; Gillespie *et al.* 2016; Anstis 2017; OEH 2017a; Klop-Toker *et al.* 2022 all in DAWE 2022). Most breeding sites are ephemeral and permanent ponds along static water bodies (Lemckert 2009; DEPI 2014; Gillespie *et al.* 2016; Mahony *et al.* 2020 all in DAWE 2022). Breeding along streams occurs in isolated or larger connected pools (Mahony *et al.* 2020). Breeding site selection may be governed by fish avoidance, restricted to ponds that are high in the catchment and/or ephemeral enough to limit fish occupancy, yet large enough to persist throughout tadpole development (Klop-Toker *et al.* 2022). Metamorphosis can take 4–11 months and males reach maturity one year after metamorphosis (Klop-Toker *et al.* 2021 pers. comm 30 April in DAWE 2022). Non-breeding observations are rare, suggesting the species disperses into surrounding forest when not breeding (Gillespie *et al.* 2016).
7. Males call in small choruses of up to four individuals from branches and edges around breeding sites (Lemckert 2004 cited in Daly & Craven 2007; DEWHA 2008; Klop-Toker *et al.* 2022 all in DAWE 2022). Females are rarely seen unless breeding (Klop-Toker *et al.* 2021 pers. comm 30 April in DAWE 2022).
8. *Litoria littlejohni* has relatively low fecundity compared with similar-sized frogs, with ~70–100 eggs per clutch attached to submerged twigs or overhanging branches (Gould *et al.* 2020; DAWE 2022; Klop-Toker *et al.* 2022). Tadpoles grow to 88 mm in length, and are primarily black to very dark grey, gradually turning dark brown as they develop (Anstis 2017 in DAWE 2022).
9. *Litoria littlejohni* has a highly restricted Area of Occupancy (AOO). The national AOO is estimated to be 272–296 km² following methods recommended by the IUCN 2022 (DAWE 2022). The minimum estimate is calculated using records from 2000–20 to account for suspected chytrid fungus induced decline from the 1990s, while the maximum estimate is calculated using records from 1980–2020 (DAWE 2022). Both estimates fall within the Endangered range as defined by the IUCN (<500 km²). The estimated extent of occurrence (EOO) is 10,122–12,084 km² following methods recommended by the IUCN 2022, using data from 2000–20 and 1980–20, for the minimum and maximum estimates, respectively (DAWE 2022).
10. There is insufficient data to determine population size for *Litoria littlejohni* (DAWE 2022). However, the population is thought to be small, with few records from a small number of scattered locations and the species absent from many apparently suitable sites (Lemckert 2010; McCall *et al.* 2018; ALA 2020; Mahony *et al.* 2020 all in DAWE 2022). Generation length is estimated to be six years, based on a similar species, *L. spenceri* (Spotted Tree Frog) (Gillespie 2010, 2011 in DAWE 2022).
11. The primary threats to *Litoria littlejohni* are amphibian chytrid fungus (*Batrachochytrium dendrobatidis*), habitat disturbance, alterations to groundwater hydrology, increasing bushfires, drought and heatwaves, and changed rainfall patterns as a result of climate change, and predation by the introduced fish and native fish outside of their natural range (DAWE 2022). ‘Anthropogenic Climate Change,’ ‘infection of frogs by amphibian chytrid causing the disease chytridiomycosis’ and ‘Predation by *Gambusia holbrooki* (Plague Minnow)’ are listed as Key Threatening Processes under the Act.

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12. Amphibian chytrid fungus is widespread along the east coast of Australia and is implicated in the severe decline and extinction of a number of Australian frog species (Klop-Toker *et al.* 2022). Mahony *et al.* (2020) identified that *L. littlejohni* population declines are consistent with chytrid-driven decline given that it appears to be most severe in the coldest, highest elevation region (Blue Mountains), where other threats are largely absent. Recent surveys indicate that *L. littlejohni* carries high chytrid loads (Klop-Toker *et al.* 2022). An observation of a deceased newly metamorphosed individual with high disease loads also suggests the species is vulnerable to chytrid (Klop-Toker *et al.* 2022).
13. As a forest-dependent species, habitat loss, fragmentation and disturbance pose a direct threat to *Litoria littlejohni*. Habitat disturbance can result in a loss of mature individuals and suitable habitat for shelter, foraging, and dispersal (DAWE 2022). The species has not been recorded in areas of cleared native forest, such as farmland or forest plantations (Gillespie *et al.* 2016). Most of the distribution lies outside protected areas, where primary industries activity including timber harvesting, and urban development, are risks (DAWE 2022). In particular, logging continues at the northern limit of the distribution (Lemckert & Mahony 2018 in DAWE 2022).
14. Altered hydrological regimes from activities such as longwall mining, damming, groundwater extraction, water pollution, and sediment runoff, can reduce breeding habitat by decreasing the area and duration of ponding, and impact metamorphosis (deMaynadier and Hunter 1995; Welsh and Ollivier 1998; Bell & Donnelly 2006; Gorissen *et al.* 2016 all in DAWE 2022). In particular, longwall mining within the Southern Sydney Coalfields threatens sites in the Woronora catchment and Newnes Plateau (Klop-Toker *et al.* 2021 pers. comm 30 April in DAWE 2022).
15. Bushfires, drought, and heatwaves, which are becoming increasingly severe and frequent due to the effects of anthropogenic climate change, as well as changed rainfall patterns, are expected to negatively impact recruitment by reducing the availability of breeding habitat and altering its seasonality (Lemckert and Penman 2012; DEPI 2014; Lowe *et al.* 2015 all in DAWE 2022). The 2019–20 fires overlapped with ~21% of the species distribution (Legge *et al.* 2021). In general, frogs have low tolerance for extreme temperatures and desiccation, and minimal defences against fire (Gillespie *et al.* 2016; DAWE 2022). As a non-burrowing species, *L. littlejohni* is particularly vulnerable to fire impacts, through direct exposure to heat and smoke, reduced leaf-litter for foraging and shelter, and water contamination by ash (Lyon & O'Connor 2008; Alexandra & Finlayson 2020 all in DAWE 2022).
16. Predation by the introduced Plague Minnow (*Gambusia holbrooki*) and Mosquito Fish (*G. affinis*), as well as native fish outside of their natural range, threatens *L. littlejohni* recruitment (DAWE 2022). Fish are known to predate both frog eggs and tadpoles (Daly and Craven 2007). *Litoria littlejohni* tadpoles have not been recorded in ponds where fish are present, while breeding ceased at one site in Olney State Forest following the release of native fish (Klop-Toker *et al.* 2021 pers. comm 30 April in DAWE 2022).
17. *Litoria littlejohni* is estimated to be undergoing a moderate population reduction over three generations, with recent droughts and bushfires compounding impacts from chytrid fungus and habitat disturbance and leaving the species vulnerable to stochastic events

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(DAWE 2022). These threats are implicated in inferred continuing decline in the *Litoria littlejohni* population and in the quality of its habitat (DAWE 2022).

18. *Litoria littlejohni* White, Whitford & Mahony 1994 is eligible to be listed as an Endangered species as, in the opinion of the NSW Threatened Species Scientific Committee, it is facing a very high risk of extinction in Australia in the near 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(b)(d)(e i, ii, iii, iv).

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

Assessment Outcome: Vulnerable under Clause 4.2(1 c)(2 c, e).

(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: Endangered under Clause 4.3(b)(d)(e i, ii, iii, iv).

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,

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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 Clause C)

Assessment Outcome: Data Deficient.

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: 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.

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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: Data Deficient.

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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Supporting Documentation:

Department of Agriculture Water and the Environment (DAWE) (2022) Conservation Advice for *Litoria littlejohni* (Littlejohn’s Tree Frog). Australian Government, Canberra.

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