

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 Watson's Tree Frog *Litoria watsoni* Mahony, Moses, Mahony, Lemckert & Donnellan 2020 as an ENDANGERED SPECIES under Part 2 of Schedule 1 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 Watson's Tree Frog *Litoria watsoni* Mahony, Moses, Mahony, Lemckert & Donnellan 2020 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

Litoria watsoni Mahony, Moses, Mahony, Lemckert & Donnellan 2020 was found to be Endangered in accordance with the following provisions in the *Biodiversity Conservation Regulation 2017*: Clause 4.2(1 b)(2 c, e) and Clause 4.3(b)(d)(e i, ii, iii, iv). The main reasons for this species being eligible are: i) *L. watsoni* is suspected to be undergoing a large reduction in population size due to the impacts of drought, bushfire, amphibian chytrid fungus (*Batrachochytrium dendrobatidis*), fragmentation and habitat disturbance; ii) the species has a highly restricted geographic range; iii) there are three 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 the aforementioned threats.

The NSW Threatened Species Scientific Committee has found that:

1. *Litoria watsoni* Mahony, Moses, Mahony, Lemckert & Donnellan 2020 (Hylidae) is described by Mahony *et al.* (2020) as "Male SVL [snout-to-vent length] 42–59 mm female SVL 50–64 mm; head length relative to head width variable (HL/HW range 0.66–0.97). The tympanum diameter is variable in size relative to eye length (TYM/EYE range 0.44–0.72). Legs relatively long (TBL [tibia length]/SVL 0.44–0.59). Dorsal surfaces of body and limbs light brown mottled with dark and lighter flecking of brown and yellow. The side of the face and extending back beneath the tympanum to the axil is a lighter shade of the dorsal colouring. Colour on back of upper and lower leg and onto the foot, groin and posterior flanks, and on the upper axil of the forelimb is an immaculate reddish-orange wash. A darker brown to black line extends from the external nostril along the canthus rostralis to the eye, continuing less intensely behind the eye over the tympanum and then onto the flank where it gradually dissipates. Ventral surface white, with the exception of the upper legs which have an orange wash. The gular region has a yellowish wash. Iris is yellowish gold."
2. A recent taxonomic revision identified *L. watsoni* as a distinct species, separate from *L. littlejohni* (Littlejohn's Tree Frog) (Mahony *et al.* 2020). Where *L. littlejohni* is referred to below it reflects the updated taxonomic split, with both species mentioned where they are synonymised and cannot be distinguished. *Litoria watsoni* shares several morphological

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characteristics with other members of the *L. ewingii* species group sensu Tyler & Davies (1978) but can be distinguished from all other members except *L. littlejohni* by the orange markings on the femur, tibia, groin and posterior flanks, and by its larger size (Mahony *et al.* 2020). *Litoria watsoni* can be distinguished from *L. littlejohni* by its call, which has a lower average number of pulses in each note (22.8) compared to *L. littlejohni* (27.8), and by genetic differences (Mahony *et al.* 2020).

3. *Litoria watsoni* has a patchy, but widespread distribution from southeastern NSW to eastern Victoria at elevations from ~100–1,100 m (Mahony *et al.* 2020; Klop-Toker *et al.* 2022). The species distribution extends from Budderoo National Park in the Illawarra region of NSW, along the eastern fall of the Great Dividing Range, south to the East Gippsland region of Victoria (Mahony *et al.* 2020). *Litoria watsoni* has been subject to low monitoring effort relative to other Australian frog species (Scheele and Gillespie 2018). However, the species appears to be most abundant in the Shoalhaven River catchment in NSW, at the northern extent of its distribution (Mahony *et al.* 2020). *Litoria littlejohni* occurs to the north of *L. watsoni*. The distributions of the two species appear to meet at the southern boundary of the Sydney Basin Bioregion, an area characterised by steep escapements, rivers 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).
4. There are three distinct locations based on the threat of fire, representing clusters of relatively continuous *L. watsoni* records separated by wide expanses of unoccupied or unsuitable habitat: one on the south-eastern margin of the Sydney Basin Bioregion, a second on the NSW south-coast, and a third in far south-east NSW into East Gippsland, Victoria (DAWE 2022). All three locations are sparsely populated and fragmented, with the lack of connectivity leaving *L. watsoni* at risk of inbreeding (DAWE 2022; Klop-Toker *et al.* 2022). Together with the low dispersal ability and poor recolonisation potential of *L. watsoni* (assessed in 2000 as *L. littlejohni*) this reduces the resilience of the species to threatening processes (NSW Department of Planning and Environment 2000; DAWE 2022). The species has disappeared from a number of historic sites over the past three decades (Mahony *et al.* 2020).
5. *Litoria watsoni* is a forest-dependent habitat generalist (Gillespie *et al.* 2016; Mahony *et al.* 2020). The species occurs in several different vegetation communities, from heathland, to dry sclerophyll and wet forest (Gillespie *et al.* 2016; Mahony *et al.* 2020). Breeding has been observed in static forest pools, slow moving permanent streams passing over sandstone, and ephemeral pools with clay and sandy bases (Daly and Craven 2007; Gillespie *et al.* 2016; Mahony *et al.* 2020). Preferred streams are shallow, with isolated or larger connected pools (Mahony *et al.* 2020). Breeding site selection appears to 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). In captivity metamorphosis has been recorded after 109 days but can take 5–6 months (Anstis 2017 in DAWE 2022; Klop-Toker *et al.* 2022). Surrounding habitat is characterised by leaf litter and low native vegetation (Mahony *et al.* 2020; Lemckert *et al.* 2005; Lemckert 2009; 2010; OEH 2017a all in DAWE 2022). Non-breeding observations are rare, suggesting the species disperses into surrounding forest when not breeding (Gillespie *et al.* 2016).

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6. Males call throughout the year, often during or after rain (Gillespie *et al.* 2016), with peak calling in NSW in winter (K Klop-Toker *et al.* 2021. pers comm 30 April cited in DAWE 2022). Males call in small choruses of up to 20 individuals from vegetation at the edge of streams and ponds, often from deep within clumps of reeds and bushes (Mahony *et al.* 2020; Klop-Toker *et al.* 2022; Klop-Toker *et al.* 2021. pers comm 30 April in DAWE 2022). Females are rarely seen unless breeding (K Klop-Toker *et al.* 2021. pers comm 30 April in DAWE 2022).
7. *Litoria watsoni* 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 are distinctive, growing 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).
8. *Litoria watsoni* has a highly restricted Area of Occupancy (AOO). The national AOO is estimated to be 224–332 km² based on 2 x 2 grid cells, as recommended by 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 extent of occurrence (EOO) is estimated to be 29,062 km² based on a minimum convex polygon enclosing all species occurrences recorded between 2000–2022 (DAWE 2022).
9. There is insufficient data to determine population size for *Litoria watsoni* (DAWE 2022). However, the population is thought to be small as it is fragmented and absent from apparently suitable habitat, including several national parks (Gillespie *et al.* 2016; Mahony *et al.* 2020; 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).
10. The primary threats to *Litoria watsoni* are amphibian chytrid fungus (*Batrachochytrium dendrobatidis*), habitat disturbance, increasing bushfires and drought 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.
11. 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 *Litoria watsoni* population declines are consistent with the spread of chytrid, with disease impacts in Australia typically most widespread in the cooler and wetter regions which *L. watsoni* occupies (DAWE 2022; Klop-Toker *et al.* 2022). Recent NSW surveys indicate that *L. watsoni* carries high chytrid loads (Klop-Toker *et al.* 2022). An observation of a deceased newly metamorphosed individual of sister species, *L. littlejohni*, with high disease loads also suggests the species is vulnerable to chytrid (Klop-Toker *et al.* 2022).
12. As a forest-dependent species, habitat disturbance, loss and fragmentation pose a direct threat to *Litoria watsoni*. *L. watsoni* has not been recorded in heavily modified landscapes, such as urban areas, farmland, or plantations (Gillespie *et al.* 2016; Mahony *et al.* 2020).

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Most of the species' distribution lies outside protected areas, where primary industries activity including timber harvesting, and urban development, are risks (DAWE 2022). Altered hydrological regimes from activities such as damming, ground water 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 all in DAWE 2022).

13. Bushfires and heatwaves, which are becoming increasingly severe and frequent due to the effects of anthropogenic climate change, are expected to negatively impact recruitment by reducing the availability of breeding habitat (Lemckert and Penman 2012; DEPI 2014; Lowe *et al.* 2015 all in DAWE 2022). In general, frogs have low tolerance for extreme temperatures and desiccations, and minimal defences against fire (Gillespie *et al.* 2016; DAWE 2022). Recent fires have burnt extensive areas of the *L. watsoni* distribution, including the 2019–20 fires, which overlapped with ~85% of the species distribution, with 44% of the distribution subject to high and very high severity fire (Legge *et al.* 2021). As a non-burrowing species, *L. watsoni* is particularly vulnerable to direct and indirect fire impacts, including direct mortality, as well as habitat alteration, reduced prey availability, and water contamination by ash (DAWE 2022).
14. 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. watsoni* recruitment (DAWE 2022). Fish are known to predate both frog eggs and tadpoles (Daly and Craven 2007). *Litoria watsoni* tadpoles have not been recorded in ponds where fish are present (K Klop-Toker *et al.* 2021. pers comm 30 April in DAWE 2022).
15. These threats are implicated in a suspected ongoing population reduction in *Litoria watsoni* of >50% over three generations, with impacts of recent droughts and bushfires compounding impacts from chytrid fungus, fragmentation and habitat disturbance (DAWE 2022). Continuing decline in the geographic distribution and habitat of the species is also inferred due to the impacts from these ongoing threats.
16. *Litoria watsoni* Mahony, Moses, Mahony, Lemckert & Donnellan 2020 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*:

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Assessment against *Biodiversity Conservation Regulation 2017* criteria

The Clauses used for assessment are listed below for reference.

Overall Assessment Outcome: Endangered under Clause 4.2(1 b)(2 c, e) and 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: Endangered under Clause 4.2(1 b)(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,
		(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,

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		(iii)	the number of locations in which the species occur or of populations of the species.
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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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Professor Kristine French
Chairperson
NSW Threatened Species Scientific Committee

Supporting Documentation:

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

References:

Bryant LM, Krosch MN (2016) Lines in the land: a review of evidence for eastern Australia's major biogeographical barriers to closed forest taxa. *Biological Journal of the Linnean Society*, **119**, 238–264.

Daly G, Craven P (2007) Monitoring populations of Heath Frog *Litoria littlejohni* in the Shoalhaven region on the south coast of NSW. *Australian Zoologist* **34**(2), 165–172.

Gould J, Beranek C, Valdez J, Mahony M (2020) Quality versus quantity: The balance between egg and clutch size among Australian amphibians is related to life history and environmental conditions. *BioRxiv*, 1–35.

Gillespie GR, McNabb E, Gaborov R (2016) The biology and status of the large brown tree frog "*Litoria littlejohni*" in Victoria. *Victorian Naturalist* **133**, 128–138.

Klop-Toker K, Wallace S, Stock S, Hayward MW, Mahony M (2022) The Decline of Australian Heath Frogs and Summary of Current Threats. *Imperiled: The Encyclopedia of Conservation*.

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Legge S, Woinarski JCZ, Garnett ST, Geyle H, Lintermans M, Nimmo DG, Rumpff L, Scheele BC, Southwell DG, Ward M, Whiterod NS, Ahyong S, Blackmore C, Bower D, Brizuela Torres D, Burbidge AH, Burns P, Butler G, Catullo R, Dickman CR, Doyle K, Ensby M, Ehmke G, Ferris J, Fisher D, Gallagher R, Gillespie G, Greenlees MJ, Hayward-Brown B, Hohnen R, Hoski, C, Hunter D, Jolly C, Kennard M, King A, Kuchinke D, Law B, Lawler I, Loyn R, Lunney D, Lyon J, MacHunter J, Mahony M, Mahony S, McCormack R, Melville J, Menkhorst P, Michael D, Mitchell N, Mulder E, Newell D, Pearce L, Raadik T, Rowley J, Sitters H, Spencer R, Lawler S, Valavi R, Ward M, West M, Wilkinson D, Zukowski S (2021) Estimates of the impacts of the 2019-2020 fires on populations of native animal species. Report by the NESP Threatened Species Recovery Hub. Brisbane, Australia. Available at:

<https://www.nespthreatenedspecies.edu.au/publications-and-tools/estimates-of-the-impacts-of-the-2019-20-fires-on-populations-of-native-animal-species>.

(Accessed: 31 August 2022).

Mahony M, Moses B, Mahony SV, Lemckert FL, Donnellan S (2020) A new species of frog in the *Litoria ewingii* species group (Anura: Pelodyadidae) from south-eastern Australia. *Zootaxa* **4858**, 201–230.

NSW Department of Planning and Environment (2000). Littlejohn's tree frog (*Litoria littlejohni*) – vulnerable species listing. Available at:

<https://www.environment.nsw.gov.au/Topics/Animals-and-plants/Threatened-species/NSW-Threatened-Species-Scientific-Committee/Determinations/Final-determinations/2000-2003/Littlejohns-Tree-Frog-Litoria-littlejohni-vulnerable-species-listing>.

(Accessed: 31 August 2022).

Scheele BC & Gillespie GR (2018). The extent and adequacy of monitoring for Australian threatened frog species. In 'Monitoring threatened species and ecological communities' (Eds. S Legge, N Robinson, B Scheele, D Lindenmayer, D Southwell & B Wintle). pp 57-68. (CSIRO Publishing: Clayton South Victoria). Available at:

<https://www.publish.csiro.au/book/7720/>. (Accessed: 31 August 2022).