



Consultation Document on Listing Eligibility and Conservation Actions

Litoria nyakalensis (mountain mistfrog)

You are invited to provide your views and supporting reasons related to:

- 1) the eligibility of *Litoria nyakalensis* (mountain mistfrog) for inclusion on the EPBC Act threatened species list in the Critically Endangered category; and
- 2) the necessary conservation actions for the above species.

Evidence provided by experts, stakeholders and the general public are welcome. Responses can be provided by any interested person.

Anyone may nominate a native species, ecological community or threatening process for listing under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) or for a transfer of an item already on the list to a new listing category. The Threatened Species Scientific Committee (the Committee) undertakes the assessment of species to determine eligibility for inclusion in the list of threatened species and provides its recommendation to the Australian Government Minister for the Environment.

Responses are to be provided in writing either by email to:
species.consultation@environment.gov.au

or by mail to:

The Director
Marine and Freshwater Species Conservation Section
Wildlife, Heritage and Marine Division
Department of the Environment
PO Box 787
Canberra ACT 2601

Responses are required to be submitted by 2 March 2018.

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General background information about listing threatened species

The Australian Government helps protect species at risk of extinction by listing them as threatened under Part 13 of the EPBC Act. Once listed under the EPBC Act, the species becomes a Matter of National Environmental Significance (MNES) and must be protected from significant impacts through the assessment and approval provisions of the EPBC Act. More information about threatened species is available on the department's website at:

<http://www.environment.gov.au/biodiversity/threatened/index.html>.

Public nominations to list threatened species under the EPBC Act are received annually by the department. In order to determine if a species is eligible for listing as threatened under the EPBC Act, the Threatened Species Scientific Committee (the Committee) undertakes a rigorous scientific assessment of its status to determine if the species is eligible for listing against a set of criteria. These criteria are available on the Department's website at:

<http://www.environment.gov.au/biodiversity/threatened/pubs/guidelines-species.pdf>.

As part of the assessment process, the Committee consults with the public and stakeholders to obtain specific details about the species, as well as advice on what conservation actions might be appropriate. Information provided through the consultation process is considered by the Committee in its assessment. The Committee provides its advice on the assessment (together with comments received) to the Minister regarding the eligibility of the species for listing under a particular category and what conservation actions might be appropriate. The Minister decides to add, or not to add, the species to the list of threatened species under the EPBC Act. More detailed information about the listing process is at:

<http://www.environment.gov.au/biodiversity/threatened/nominations.html>.

To promote the recovery of listed threatened species and ecological communities, conservation advices and where required, recovery plans are made or adopted in accordance with Part 13 of the EPBC Act. Conservation advices provide guidance at the time of listing on known threats and priority recovery actions that can be undertaken at a local and regional level. Recovery plans describe key threats and identify specific recovery actions that can be undertaken to enable recovery activities to occur within a planned and logical national framework. Information about recovery plans is available on the department's website at:

<http://www.environment.gov.au/biodiversity/threatened/recovery.html>.

Information about this consultation process

Responses to this consultation can be provided electronically or in hard copy to the contact addresses provided on Page 1. All responses received will be provided in full to the Committee and then to the Australian Government Minister for the Environment.

In providing comments, please provide references to published data where possible. Should the Committee use the information you provide in formulating its advice, the information will be attributed to you and referenced as a 'personal communication' unless you provide references or otherwise attribute this information (please specify if your organisation requires that this information is attributed to your organisation instead of yourself). The final advice by the Committee will be published on the department's website following the listing decision by the Minister.

Information provided through consultation may be subject to freedom of information legislation and court processes. It is also important to note that under the EPBC Act, the deliberations and recommendations of the Committee are confidential until the Minister has made a final decision on the nomination, unless otherwise determined by the Minister.

Privacy notice

The Department will collect, use, store and disclose the personal information you provide in a manner consistent with the Department's obligations under the Privacy Act 1988 (Cth) and the Department's Privacy Policy.

Any personal information that you provide within, or in addition to, your comments in the threatened species assessment process may be used by the Department for the purposes of its functions relating to threatened species assessments, including contacting you if we have any questions about your comments in the future.

Further, the Commonwealth, State and Territory governments have agreed to share threatened species assessment documentation (including comments) to ensure that all States and Territories have access to the same documentation when making a decision on the status of a potentially threatened species. This is also known as the '[common assessment method](#)'. As a result, any personal information that you have provided in connection with your comments may be shared between Commonwealth, State or Territory government entities to assist with their assessment processes.

The Department's Privacy Policy contains details about how respondents may access and make corrections to personal information that the Department holds about the respondent, how respondents may make a complaint about a breach of an Australian Privacy Principle, and how the Department will deal with that complaint. A copy of the Department's Privacy Policy is available at: <http://environment.gov.au/privacy-policy>

Litoria nyakalensis

(mountain mistfrog)

Taxonomy

Conventionally accepted as *Litoria nyakalensis* (Liem 1974). The mountain mistfrog is related to *L. rheocola* (common mistfrog) and *L. nannotis* (waterfall frog), with the former thought to be the most primitive and the latter the most specialised. *L. nyakalensis* is intermediate between these two species and probably the immediate ancestral stock of *L. nannotis* (Liem 1974).

Species Information

Description

The mountain mistfrog is a moderate sized, robust treefrog 30 – 48 mm snout-to-vent length. It is a uniform olive-brown or grey-brown on the back, sometimes with irregular darker olive markings. The skin is smooth above, with scattered tubercles on the head and back. The belly is granular, cream in colour with a reddish-pink flush on the limbs and pectoral region, and sometimes dotted or flecked with brown. The finger and toe disks are large and conspicuous. The fingers have slight webbing, and the toes are fully webbed. The forearm is robust in the male, with a large nuptial pad with coarse spinules. The tympanum (ear disc) is small and indistinct, and more or less covered by skin (Liem 1974; Richards 1993; Cogger 2014).

The male mating call has been described as a regularly repeated, rasping, single note call (Liem 1974), or a soft, slow, popping growl (McDonald 1992).

Tadpoles have a depressed body, and are light brown in colour with a cream patch between the eyes (less distinct in large specimens). The tail muscle is very robust, and a cream colour with distinct light brown blotches that extend into the anterior portion of the clear fins. The tail fin is low anteriorly, high posteriorly and broadly rounded at the tip. The large suctorial oral disc is surrounded with marginal and submarginal papillae. There are two tooth rows anterior to the mouth, and three posterior to it (Richards 1992; Anstis 2013).

Distribution

Historically the mountain mistfrog occurred across two-thirds of the Wet Tropics Biogeographical Region between Douglas Creek, Kirrama State Forest and Alexandra Creek in north-east Queensland (McDonald 1992). The historical extent of occurrence for this species was approximately 6000 km². It was only known from locations above 300 m altitude (Northern Queensland Threatened Frogs Recovery Team 2001).

The last recording of the mountain mistfrog was in 1990 (Northern Queensland Threatened Frogs Recovery Team 2001). Surveys in the Wet Tropics conducted in 1991–1992, 1993 and 2011–2013 failed to locate the species from a number of historic locations and other potentially suitable habitat (Ingram & McDonald 1993; Richards et al. 1993; Trenerry et al. 1994; Hoskin & Puschendorf 2014). Hoskin & Puschendorf (2014) concluded that the mountain mistfrog should be considered to be extinct.

Relevant Biology/Ecology

The mountain mistfrog is a poorly known species. It inhabits fast-flowing streams near riffles and cascades in upland rainforest, and is usually found perched on rocks or overhanging vegetation adjacent to the water (Liem 1974). Mating calls have been heard from October to March (Liem 1974). Large unpigmented eggs are laid under rocks in riffles (Richards 1993).

Tadpoles are restricted to swiftly flowing rainforest streams. Within these streams, they graze on algal-covered rocks and may be found clinging to rocks in riffles and torrents, and in highly oxygenated pools below waterfalls (Richards 1992). They will burrow into loose sand under

rocks, which may help them to withstand the intense floods that often occur in rainforest streams (Richards 1992). They commonly over-winter in upland streams, although those hatching in early summer can metamorphose before the next autumn (Richards 1992).

Threats

The mountain mistfrog is one of seven species of frogs occurring in upland rainforest streams in north-eastern Queensland that experienced substantial range contractions and population declines between 1988 and late 1994 (Ingram & McDonald 1993; Richards et al. 1993; Northern Queensland Threatened Frogs Recovery Team 2001). These species share the common characteristics of having low fecundity, a high degree of habitat specialisation, and reproduction in fast flowing streams (Williams & Hero 1998). The declines are believed to be caused by the chytrid fungus (Northern Queensland Threatened Frogs Recovery Team 2001) although dead or dying individuals of the mountain mistfrog specifically were not found (Berger et al. 1999).

The table below lists the threats impacting the species in approximate order of severity of risk, based on available evidence.

Threat factor	Consequence rating	Extent over which threat may operate	Evidence base
Disease - Chytrid fungus	Severe	Whole of range	<p>Chytridiomycosis is an infectious disease caused by the amphibian chytrid fungus (<i>Batrachochytrium dendrobatidis</i>) that affects amphibians worldwide, causing mass die-offs and some species extinctions (Department of the Environment and Energy 2016). Chytridiomycosis has become endemic in the Wet Tropics of Queensland, with infection prevalence higher during winter and at higher elevations (600–800 m)(Woodhams & Alford 2005).</p> <p>There is considerable circumstantial evidence to support the hypothesis that chytridiomycosis, caused by the chytrid fungus or a viral infection, has contributed to the decline of upland stream-dwelling frog species (Laurance et al. 1996; Berger et al. 1998). Declines have been rapid, occurring over 2–3 month periods (McDonald & Alford 1999), and there is little evidence that environmental changes such as adverse weather, habitat destruction or pollution were responsible.</p> <p>While no dead or dying individuals of mountain mistfrog were found to confirm chytrid as the cause, it is inferred from the</p>

			coincident decline with other species and the nature of the mountain mistfrog's habitat requirements.
Invasive species	Severe	Most of range	Yellow crazy ants spray formic acid to subdue prey, which causes burns and irritates the skin and eyes of animals. They can have severe impacts on a range of ecological processes and lead to significant loss of biodiversity. Yellow crazy ants were detected within the World Heritage Area and Little Mulgrave National Park in 2012 and now cover up to 61 ha (WTMA 2016) within these protected areas. In December 2013 yellow crazy ants were also detected in the Kuranda area (WTMA 2016).
Climate change (temperature increase, extreme weather events e.g. cyclones, droughts)	Moderate	Whole of range	Climate change is predicted to result in increased rainfall across northern Australia (Haylock & Nicholls 2000). This may alter the hydrology and breeding frequency of stream-dwelling frogs, and make them vulnerable to being dislodged in high flows. Changes in hydrology and other effects of climate change (e.g. reduction in food supply) may also alter the susceptibility of frogs to the chytrid fungus, but these impacts are likely to be variable among species and sites (DoEE 2016).
Habitat loss and degradation (e.g. clearing, trampling, fragmentation, altered hydrology, salinity)	Moderate	Part of range	Feral pigs are responsible for riparian habitat damage and potentially cause adult frog mortality. However there is very little research into their impacts on native frog populations (Richards et al. 1993).

Assessment of available information in relation to the EPBC Act Criteria and Regulations

Criterion 1. Population size reduction (reduction in total numbers)			
Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4			
	Critically Endangered Very severe reduction	Endangered Severe reduction	Vulnerable Substantial reduction

A1	≥ 90%	≥ 70%	≥ 50%
A2, A3, A4	≥ 80%	≥ 50%	≥ 30%
<p>A1 Population reduction observed, estimated, inferred or suspected in the past and the causes of the reduction are clearly reversible AND understood AND ceased.</p> <p>A2 Population reduction observed, estimated, inferred or suspected in the past where the causes of the reduction may not have ceased OR may not be understood OR may not be reversible.</p> <p>A3 Population reduction, projected or suspected to be met in the future (up to a maximum of 100 years) [(a) cannot be used for A3]</p> <p>A4 An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.</p>	<p>based on any of the following</p> <p>(a) direct observation [except A3]</p> <p>(b) an index of abundance appropriate to the taxon</p> <p>(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat</p> <p>(d) actual or potential levels of exploitation</p> <p>(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites</p>		

Evidence:

While there was a substantial decline in both abundance and extent of occurrence of this species, it occurred in the early 1990s, over 15 years ago. While there is no estimate of generation length for this species, it is maybe similar to two similar-sized *Litoria* species found in similar habitats (Red-eyed Tree Frog (*L. chloris*), Lesueur's Tree Frog (*L. lesueuri*))(Morrison et al. 2004) and thus less than approximately four years. The initial decline in abundance of this species is thus outside of the timespan stipulated for this criterion.

The mountain mistfrog was only formally described in 1974. At that time it was known from three localities: Henrietta Creek (Palmerston NP, south of Mackay); Beatrice Creek (Palmerston NP); and Tinaroo Creek Road 15 km south of Mareeba, in the Atherton Tablelands (Liem 1974).

In the early 1990s the species was reported to occur across two-thirds of the Wet Tropics: from Douglas Creek near Cardwell, to Alexandra Creek on Thornton Peak (Hero & Fickling 1994), at altitudes of 380–1020 m a.s.l (McDonald 1992). However, it was already on the decline. Adults were last recorded in April 1990, and tadpoles and metamorphs last recorded in November 1990, on the Carbine Tableland in the northern Wet Tropics (Richards et al. 1993).

Surveys 1989–1992

Richards et al. (1993) conducted regular intensive sampling of adult and tadpole populations of frogs at four sites (Mt Spec, Kirrama, Danbulla (Atherton Tablelands) and Mt Lewis (Carbine Tablelands)) in the Wet Tropics Biogeographic Region over four years from 1989 to 1992. The mountain mistfrog was recorded at three of the sites; it was not recorded at Danbulla State Forest.

Surveys 1991–1992

Between 15 December 1991 and 30 September 1992, Richards et al. (1993) conducted a survey of frog distributions in tropical rainforest between Townsville and Cooktown. The survey covered 47 sites over a range of altitudes and rainforest types. Sites were selected based on those which were more accessible and which had available historical records of species occurrence. At each site they surveyed a 100 m length of stream, by undertaking visual searches during the day and night, and intensively searching the stream with a dip net to survey for tadpoles. Nearby streams were also examined. The mountain mistfrog was not recorded at any sites.

Richards et al. (1993) noted that the data set was not extensive, but the declines recorded in many frog species were likely real and not the result of natural fluctuations. Tadpoles of all the upland stream-dwelling frogs examined occur in streams throughout the year, and are confined to a limited habitat which is easily sampled. The absence of tadpoles indicates that breeding did not occur during the survey period.

Surveys 1993

Trener et al (1994) surveyed more extensive portions of stream systems, in a study designed to build upon the study by Richards et al. (1993). There was strong concordance between the results of the two studies.

Between July 1993 and November 1993, Trener et al (1994) intensively surveyed tadpoles of upland frog species at 62 sites, along six stream systems spanning most of the latitudinal range of the WTBR. Five relatively remote, upland rainforest streams were surveyed at 11-13 sites each, while an additional stream was opportunistically sampled at a single site. Each site consisted of a 20 m long stream segment sampled using dip nets, with adjacent sites along the same stream separated by about 200 m. The total section of each stream sampled was 2.4-2.8 km. No mountain mistfrogs were recorded.

Surveys 2011–2013

Following observations that some endangered rainforest frog species were surviving in upland dry forests adjacent to rainforest, Hoskin & Puschendorf (2014) conducted a survey of over 50 sites in peripheral areas (ecotones and isolated rainforest patches) around the Wet Tropics (between Townsville and Cooktown) and Eungella (west of Mackay). The study region in the Wet Tropics extended from Mt Elliot (halfway between Townsville and Ayr) in the south, to Cape Melville (north of Cooktown) in the north, with a focus on the Carbine and Windsor Tablelands. Sites included both historical rainforest sites and sites in peripheral areas, and included remote areas which were accessed by helicopter then by foot.

Surveys were primarily conducted during September to February. Approximately 2 km of stream habitat were surveyed at each site over 3 days and 2 nights, covering a transition from dry, open forest habitat up the stream to the rainforest. All surveys were simple searches (not involving traps, call-backs etc.), and nocturnal searches were performed with head-torches for eyeshine. Additional automatic call recorders were deployed at Mt Lewis and Mt Bellenden Ker to target *Taudactylus rheophilus* (tinkling frog).

They found that several endangered frog species were persisting better in these peripheral areas than 'core' rainforest areas, with evidence for recovery of frog populations in some areas, despite the presence of chytrid fungus. However, four rainforest frog species, including the mountain mistfrog, were not detected and the authors concluded that these species were extinct.

Conclusions

Despite multiple targeted surveys over more than 20 years, which have been successful in re-discovering several other sympatric species that had declined or disappeared due to chytrid fungus, no individuals of mountain mistfrog have been found since 1990. The targeted surveys covered multiple locations across the species' historic range, and included both known and potential habitat. They were undertaken at appropriate times of the year, over a timeframe appropriate to the species' life cycle and life form, and used methods appropriate to the species' detectability. The species is therefore likely to be extinct.

However, the surveys were not exhaustive as they did not cover all known or likely habitat throughout the species' historic range. Surveys in peripheral areas (Hoskin & Puschendorf 2014), where the species is most likely to persist, were undertaken using visual searches only.

Given the extensive area of potential habitat, difficult to access terrain in some parts, and the persistence of similar species in the presence of chytrid fungus, there is a small chance that the mountain mistfrog still exists. To be eligible for listing under the Extinct category, there must be 'no reasonable doubt that the last individual has died' (IUCN Standards and Petitions Subcommittee 2017). Another consideration is that many of the peripheral areas surveyed by Hoskin & Puschendorf (2014) fall outside the Wet Tropics World Heritage Area; listing under the Extinct category means that the species would be unprotected if it were found in these areas in the future.

The data presented above appear to demonstrate that the species is **eligible for listing as Critically Endangered** under Criterion A2(a)(c)(e). However, the purpose of this consultation document is to elicit additional information to better understand the species' status. This conclusion should therefore be considered to be tentative at this stage, as it may be changed as a result of responses to this consultation process.

Criterion 2. Geographic distribution as indicators for either extent of occurrence AND/OR area of occupancy			
	Critically Endangered Very restricted	Endangered Restricted	Vulnerable Limited
B1. Extent of occurrence (EOO)	< 100 km²	< 5,000 km²	< 20,000 km²
B2. Area of occupancy (AOO)	< 10 km²	< 500 km²	< 2,000 km²
AND at least 2 of the following 3 conditions indicating distribution is precarious for survival:			
(a) Severely fragmented OR Number of locations	= 1	≤ 5	≤ 10
(b) Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals			
(c) Extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals			

Evidence:

Despite multiple targeted surveys over more than 20 years, which have been successful in re-discovering several other sympatric species that had declined or disappeared due to chytrid fungus, no individuals of mountain mistfrog have been found since 1990. If extant, the extent of occurrence is very likely to be less than 100 km² and the distribution likely to be severely fragmented. The most recent records for this species are from 1990 – with figures for this period – AOO (12 sq km) and EOO (140 sqkm). However, there is little information from which to infer population trends.

The 20 year calculated extent of occurrence is 0 km², and the area of occupancy is 0 km² (DoEE 2017). These figures are based on the mapping of point records from post-1997 observations, compiled from state and Commonwealth agencies along with museums, herbaria, research institutions and non-government organisations. The EOO was calculated using a minimum convex hull, and the AOO calculated using a 2x2 km grid cell method, based on the IUCN Red List Guidelines 2014.

The data presented above appear to demonstrate that there are insufficient data to determine eligibility for listing under this criterion. However, the purpose of this consultation document is to elicit additional information to better understand the species' status. This conclusion should therefore be considered to be tentative at this stage, as it may be changed as a result of responses to this consultation process.

Criterion 3. Population size and decline			
	Critically Endangered Very low	Endangered Low	Vulnerable Limited
Estimated number of mature individuals	< 250	< 2,500	< 10,000
AND either (C1) or (C2) is true			
C1 An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future)	Very high rate 25% in 3 years or 1 generation (whichever is longer)	High rate 20% in 5 years or 2 generation (whichever is longer)	Substantial rate 10% in 10 years or 3 generations (whichever is longer)
C2 An observed, estimated, projected or inferred continuing decline AND its geographic distribution is precarious for its survival based on at least 1 of the following 3 conditions:			
(i) Number of mature individuals in each subpopulation	≤ 50	≤ 250	≤ 1,000
(a) (ii) % of mature individuals in one subpopulation =	90 – 100%	95 – 100%	100%
(b) Extreme fluctuations in the number of mature individuals			

Evidence:

Despite multiple targeted surveys over more than 20 years, which have been successful in re-discovering several other sympatric species that had declined or disappeared due to chytrid fungus, no individuals of mountain mistfrog have been found since 1990. There is a small chance that the species may be extant, but there is no information from which to infer population size or trends.

The data presented above appear to demonstrate that there are insufficient data to determine eligibility for listing under this criterion. However, the purpose of this consultation document is to elicit additional information to better understand the species' status. This conclusion should therefore be considered to be tentative at this stage, as it may be changed as a result of responses to this consultation process.

Criterion 4. Number of mature individuals			
	Critically Endangered Extremely low	Endangered Very Low	Vulnerable Low
Number of mature individuals	< 50	< 250	< 1,000

Evidence:

Despite multiple targeted surveys over more than 20 years, which have been successful in re-discovering several other sympatric species that had declined or disappeared due to chytrid fungus, no individuals of mountain mistfrog have been found since 1990. There is a small chance that the species may be extant, but there is no information from which to infer population size or trends.

The data presented above appear to demonstrate that there are insufficient data to determine eligibility for listing under this criterion. However, the purpose of this consultation document is to

elicit additional information to better understand the species' status. This conclusion should therefore be considered to be tentative at this stage, as it may be changed as a result of responses to this consultation process.

Criterion 5. Quantitative Analysis			
	Critically Endangered Immediate future	Endangered Near future	Vulnerable Medium-term future
Indicating the probability of extinction in the wild to be:	≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)	≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)	≥ 10% in 100 years

Evidence:

Population viability analysis appears not to have been undertaken. Therefore, there are insufficient data to demonstrate if the species is eligible for listing under this criterion. However, the purpose of this consultation document is to elicit additional information to better understand the species' status. This conclusion should therefore be considered to be tentative at this stage, as it may be changed as a result of responses to this consultation process.

Note: if the species is found to be eligible for listing as extinct under the EPBC Act, the following section of this consultation document will not be relevant

Conservation Actions

Recovery Plan

A decision about whether there should be a recovery plan for this species has not yet been determined. The purpose of this consultation document is to elicit additional information to help inform this decision.

Conservation and Management priorities

Disease

- Minimise the spread of the chytrid fungus by implementing suitable hygiene protocols to protect priority populations, as described in the Threat abatement plan for infection of amphibians with chytrid fungus resulting in chytridiomycosis (DotEE 2016).
- Provide disease identification and prevention protocols (methods of handling, diagnostic keys, etc) to researchers and land managers for use in the field.

Invasive species (including threats from grazing, trampling, predation)

- Reduce the impacts of habitat destruction by feral pigs on existing populations by using fencing (where feasible) and reducing pig numbers.
- Control yellow crazy ants by baiting at critical stages of the ants' life cycle.

Stakeholder Engagement

- Collaborate with land managers bordering (outside of) the Wet Tropics World Heritage Area to protect and manage dry forest areas where the species occurs, or which contain potential habitat for the species, from threats due to disease and invasive species.
- Interested nature conservation, land management and land holder groups could be engaged in conservation management activities, such as survey and monitoring, but should be made aware of the need to follow correct field practices and hygiene protocols to mitigate the risks

of trampling and disease transmission. If necessary, use workshops to aid stakeholders in developing the skills and knowledge required to manage threats to this species while undertaking these activities.

- Inform the public about the status and recovery efforts for the species, e.g. by providing information to visitors to the Wet Tropics World Heritage Area and publicising the species through the media.

Survey and Monitoring priorities

- Monitor the abundance at selected monitoring sites over time, to more precisely assess population size, and to ensure that population densities are self-sustaining and remain at or increase above current levels.
- Monitor the health of the existing population(s) to ensure that diseases or other factors are not threatening the species, and to improve understanding of how the species can survive through disease outbreaks.
- Undertake targeted surveys in suitable habitat and potential habitat to locate any additional populations.

Information and research priorities

- Investigate the ecological requirements (e.g. habitat use, diet, movement patterns) and life history characteristics of the species relevant to its persistence.
- Improve understanding of the impact of infection by chytrid fungus on the waterfall frog to better inform existing or new conservation actions. This includes knowledge on:
 - the different strains of the fungus;
 - levels of virulence;
 - mechanisms for resistance to the disease;
 - treatment options; and
 - the potential of other species (e.g. freshwater crayfish) to act as reservoirs or vectors for transmission of the fungus (DotEE 2016).
- Improve understanding of how climate change will likely impact the waterfall frog due to altered temperatures, rainfall, environmental stressors and diseases.
- Improve understanding of the impacts of feral pigs and yellow crazy ants on the waterfall frog.
- Improve understanding of husbandry methods for the species.
- Improve understanding of the impacts of environmental toxins.

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Consultation questions

1. Do you agree with the current taxonomic position of the Australian Faunal Directory for this taxon (as identified in the draft conservation advice)?
2. Can you provide any additional references, information or estimates on longevity, age of maturity, average life span and generation length?
3. Has the survey effort for this taxon been adequate to determine its national distribution and adult population size?
4. Do you accept the estimate provided in the nomination for the current population size of the taxon?
5. For any population with which you are familiar, do you agree with the population estimate provided? If not, are you able to provide a plausible estimate based on your own knowledge? If so, please provide in the form:
 - Lower bound (estimated minimum):
 - Upper bound (estimated maximum):
 - Best Estimate:
 - Estimated level of Confidence: %
6. Can you provide any additional data, not contained in the current nomination, on declines in population numbers over the past or next 10 years or 3 generations, whichever is the longer?
7. Is the distribution as described in the nomination valid? Can you provide an estimate of the current geographic distribution (extent of occurrence or area of occupancy in km²) of this taxon?
8. Has this geographic distribution declined and if so by how much and over what period of time?
9. Do you agree that the taxon is eligible for inclusion on the threatened species list, in the category listed in the nomination?
10. Do you agree that the threats listed are correct and that their effects on the taxon are significant?
11. To what degree are the identified threats likely to impact on the taxon in the future?
12. Can you provide additional or alternative information on threats, past, current or potential that may adversely affect this taxon at any stage of its life cycle?
13. In seeking to facilitate the recovery of this taxon, can you provide management advice for the following:
 - What individuals or organisations are currently, or need to be, involved in planning to abate threats and any other relevant planning issues?
 - What threats are impacting on different populations, how variable are the threats and what is the relative importance of the different populations?
 - Would the development and implementation of a translocation strategy be of benefit?

- What recovery actions are currently in place, and can you suggest other actions that would help recover the taxon? Please provide evidence and background information.

14. Can you provide additional data or information relevant to this assessment?

15. Can you advise as to whether this species is of cultural significance to Indigenous Australians?