The Minister's delegate approved this Conservation Advice on 13/07/2017.

Conservation Advice

Litoria lorica

armoured mistfrog

Conservation Status

Litoria lorica (armoured mistfrog) is listed as Critically Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act) effective from the 1 February 2007.

The armoured mistfrog is listed as Endangered in Queensland under the *Nature Conservation Act 1992*.

The species is eligible for listing as it has a restricted geographic distribution, and has experienced a very severe reduction in numbers of greater than 80 percent over the past 10 years, likely due to chytridiomycosis (TSSC 2007). Populations have disappeared from five sites, with only a single known population on the Carbine Tablelands, which was discovered in 2008 (Hoskin & Puschendorf 2014).

Description

The armoured mistfrog is a medium sized frog, with males reaching 33 mm in snout-to-vent (SVL) length, and females reaching 37 mm SVL (Davies & McDonald 1979). It is a uniform grey or grey-brown colour on the back, and white on the belly with peppered dark brown areas on the throat (Cogger 2000). The skin has fine bumps along the back, the upper eyelids and sides of the head. The skin on the lower surfaces is grainy along the throat, belly and backs of the thighs, but smooth elsewhere. The fingers have basal webbing, and the toes have full webbing (Davies & McDonald 1979).

The tadpoles have not been described, but are probably similar to those of *L. nannotis* (waterfall frog), which have large suctorial mouths for adhering to rocks in fast-flowing streams (Davies & McDonald 1979). The male mating call has not been described for this species (Anstis 2013).

Other common names include little waterfall frog, Thornton Peak tree frog.

Distribution

The armoured mistfrog is a rainforest species endemic to the Wet Tropics Bioregion of north-east Queensland (Williams & Hero 1998, 2001). It was first recorded and described in the 1970s and considered rare due to its restricted distribution (Davies & McDonald 1979). It was historically known from five localities: three on the Thornton uplands at Roaring Meg Creek, Alexandra Creek and Hilda Creek; and two on the Carbine Tablelands at Bluff Creek and Mossman Gorge (Hero & Fickling 1994; Cunningham 2002). The historical extent of occurrence was approximately 120 km^2 (Cunningham 2002).

The species had not been recorded since 1994 (Hero et al., 1998, 2001; Ingram & McDonald 1993) until the discovery of a single population in 2008 on the Carbine Tablelands, in a dry forest site well outside its historic range (JCU 2008; Puschendorf et al., 2011). The population is restricted to 4 km of stream habitat in Mt Lewis National Park, at an altitude of approximately 648 m a.s.l (ERIN pers. comm., 2017). The total population size is estimated at 600−1000 individuals from surveys undertaken during 2011−2014 (Hoskin & Puschendorf 2014). The species is one of a number of endangered rainforest frog species which appear to be persisting

better in hotter, drier ecotonal forest than in cooler, wetter core rainforest areas (Hoskin & Puschendorf 2014).

Relevant Biology/Ecology

The armoured mistfrog is a poorly known species. It dwells in fast flowing streams in upland rainforest between 640 m and 1000 m altitude (McDonald 1992; Hero & Fickling 1994), although it may have been present at lower altitudes historically (Cunningham 2001 pers. comm., cited in SPRAT). Adults have usually been found on granite boulders in notophyll vine forest in the splash zone near turbulent fast flowing water (Davies & McDonald 1979).

Females carry large (about 2.3 mm in length) unpigmented eggs (Davies & McDonald 1979).

Threats

The armoured 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; NQTFRT 2001). These species have low fecundity, a high degree of habitat specialisation and deposit their eggs in fast flowing streams (Williams & Hero 1998). The declines are believed to be due to the chytrid fungus (NQTFRT 2001). Threats and their effects on the armoured mistfrog are described in the table below. Each of the threats have corresponding conservation priorities and actions.

Table 1 – Threats impacting the armoured mistfrog in approximate order of severity of risk, based on available evidence.

Threat factor	Threat type and status	Evidence base
Disease		
Chytridiomycosis caused by chytrid fungus (*Batrachochytrium dendrobatidis*)	suspected past and current	Chytridiomycosis is an infectious disease that affects amphibians worldwide, causing mass die-offs and some species extinctions (DotEE 2016). The pathogen has become endemic in the Wet Tropics of Queensland, with infection prevalence higher during winter and at higher elevations (600−800 m) (Woodmans & Alford 2005). 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 (Dennis & Mahoney 1994, Laurance et al., 1996; Berger et al., 1998; NQTFRT 2001). 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 (McDonald 1992; Richards et al., 1993; Laurence 1996). There has been no clearing or logging of forests in the Wet Tropics World Heritage Area since 1988 (NQTFRT 2001). However, disease might not be the sole cause of the declines, as there is some evidence that the health of adults began to decline before populations crashed (Alford & Richards 1997; Alford et al., 1997). The population of the armoured mistfrog discovered in 2008 was found to be healthy, despite most individuals being

		infected with the chytrid fungus (JCU 2008). This may be due to the hotter environmental (rock surface) temperatures of dry forest sites compared to rainforest sites (Puschendorf et al., 2011; Hoskin & Puschendorf 2014).
Invasive species		
Destruction of habitat by feral pigs (*Sus scrofa*)	known current	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).
Yellow crazy ants (*Anoplolepis gracilipes*)	potential current	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 Wet Tropics 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		
Increased rainfall	potential future	Climate change is predicted to result in changes to 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 (DotEE 2016).

Conservation Actions

Conservation and Management priorities

Translocations and other ex situ recovery actions

- Establish at least one additional self-sustaining population in parts of its former range (a re-introduction was undertaken during 2013−2014 and is currently being monitored: Hoskin & Puschendorf 2014).
- Investigate and where appropriate apply assisted reproductive strategies such as captive breeding and/or head-starting (rearing juvenile stages in captivity until they can be released when translocation success will be higher). Follow appropriate protocols and guidelines for translocation, including acclimation, pre and post release training, health screening, genetic management and long term monitoring (Griffiths & Pavajeau 2008), noting the importance of avoiding the introduction of diseases into any existing amphibian populations.

Disease

- 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.

Climate Change

- Improve the management of stream flows, water quality and riparian environments throughout catchments, particularly upstream of existing and potential sites by monitoring erosion and clearing events and implementing rehabilitation of riparian vegetation.

Stakeholder Engagement

- 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 of the existing population(s) over time, to more precisely assess population size, and to ensure that population densities are self-sustaining and remain at or increase above the levels at which originally detected.
- 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

- Identify options for expanding the distribution of the existing population, and/or establishing additional populations – ensuring that measures to prevent the spread of chytrid fungus are included in any translocation strategies, as described in the *Threat abatement plan for infection of amphibians with chytrid fungus resulting in chytridiomycosis* (DotEE 2016).
- 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 armoured mistfrog 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;
  - husbandry methods;

    - environmental toxins; 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 armoured mistfrog due to altered temperatures, rainfall, environmental stressors and diseases.
- Improve understanding of the impacts of feral pigs and yellow crazy ants on the armoured mistfrog.

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