The Minister's delegate approved this Conservation Advice on 16/12/2016.

Conservation Advice

Thersites mitchellae

Mitchell's rainforest snail

Conservation Status

Thersites mitchellae (Mitchell's rainforest snail) is listed as Critically Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act) effective from 23 July 2002.

Species can also be listed as threatened under state and territory legislation. For information on the current listing status of this species under relevant state or territory legislation, see http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

The main factors that are the cause of the species being eligible for listing in the Critically Endangered category are its restricted and fragmented geographic distribution, with the area inhabited by the species estimated to be no more than 5 km^2, and a low number of individuals. Ongoing decline is projected due to continuing degradation of habitat.

Description

The shell of the Mitchell's rainforest snail is large to very large (diameter up to 45 mm), yellowish with broad, brown and dark brown spiral bands (Stanisic et al., 2010). The spire is strongly raised, giving it a triangular profile. The apex of the shell bears vague radial ridges and the shell is smoother lower down. The shell bears microsculpture of fine radial wrinkles and ridgelets that become obsolete on the last (largest) whorl (Stanisic et al., 2010). The animal is slate grey with a yellow dorsal stripe (Stanisic et al., 2010). Eggs are round and white (Murphy 2002).

Distribution

Mitchell's rainforest snail is endemic to northeastern New South Wales, where it occurs in remnant vegetation on the coastal plain between the Richmond River and Tweed River (NSW OEH 2014). This species has also been recorded from adjacent mid-elevation areas including Wilsons River and Mount Jerusalem (NSW OEH 2014). The largest known population and largest remaining single area of suitable habitat is in Stotts Island Nature Reserve near Murwillumbah, which was declared critical habitat for this species in 2001 under the New South Wales *Threatened Species Conservation Act 1995* (NSW OEH 2015). A complex of smaller populations and habitat fragments has also been identified in remnant areas around Cumbebin Wetland at Byron Bay (NSW NPWS 2001). Andrade et al. (2011) reported a total population size of between 350 and 500 individuals at that time.

Preferred habitat at lower altitudes are areas of lowland subtropical rainforest and swamp forest on alluvial soils. On higher ground the species occurs around the edges of wetlands with an overstorey of palms and fig trees (NSW OEH 2014). During periods of activity, Mitchell's rainforest snail is typically found amongst leaf litter on the forest floor, and occasionally under the bark of trees (Andrade et al., 2011, NSW OEH 2014).

Relevant Biology/Ecology

Mitchell's rainforest snail is a nocturnal species, sheltering in cryptic microhabitats during the day (Parkyn et al., 2014). Nocturnal activity increases with humidity, and individuals can move up to 15 m in one night. Individuals select particular microhabitats in which to retreat during the

day, such as *Gahnia clarkei* (tall saw-sedge) in rainforest and *Melaleuca quinquenervia* (swamp paperbark) wetland. The species also shelters within litter in palm fronds in *Archontophoenix cunninghamiana* (Bangalow palm) forest, and in coarse woody debris in all habitats (Parkyn et al., 2014).

Mitchell's rainforest snail is a generalist feeder whose food source varies with the substrate (Parkyn et al., 2015). Fungal material contributes a high proportion of the diet (Andrade et al., 2011), suggesting that coarse woody debris – a common fungal substrate – may be an important requirement for this species in rainforest-associated habitats (Parkyn et al., 2015). One field observation reported a clutch of 70 eggs laid within leaf litter in November (Murphy 2002).

Threats

Habitat loss, fragmentation and disturbance have been cited as the main threats to Mitchell's rainforest snail, and these threats have likely had the greatest historical impact on the species (NSW NPWS 2001). Additional cited threats are the impacts of fire, invasion of exotic weeds, and predation by feral animals (NSW NPWS 2001, NSW OEH 2014). However, there are no quantitative data on the extent of decline of this species.

Table 1 – Threats impacting Mitchell's rainforest snail in approximate order of severity of risk, based on available evidence.

Threat factor	Threat type and status	Evidence base
Habitat loss and fragmentation		
Land clearing	known current	By 2001, land clearing had been extensive across the species' range, and many of the small areas of surviving habitat were reported as being still at risk (NSW NPWS 2001). The threat of clearing of lowland rainforest, swamp forest, and wetland margins for urban development and agriculture is continuing (NSW OEH 2014).
Habitat degradation and disturbance	known current	Desiccation is the greatest threat to land snails. Undisturbed habitat ameliorates the effects of drought events as tree cover ensures a level of environmental moisture. The majority of populations occur in small areas of remnant rainforest including narrow strips of rainforest bordering coastal wetlands (NSW NPWS 2001). These small remnant areas, with a high perimeter to area ratio, are at risk from changes to hydrology, and edge effects including desiccation, habitat disturbance, frequent fire and invasion by exotic weeds and feral animals (NSW OEH 2014). The species has limited dispersal capacity and may be unable to move between habitat fragments, limiting the viability of its network of populations.
Impacts of domestic species		
Grazing by cattle (*Bos taurus*)	known current	Grazing by cattle is a known threat to remnant areas of vegetation (NSW OEH 2014). Cattle are also likely to directly trample the snails and destroy valuable microhabitat (logs and timber), which provides feeding and refuge habitat.

Fire		
Intensity and frequency	known potential	Any fire can cause loss of individuals and negatively impact their remnant habitat. Fires may not only affect canopy structure but also tend to eliminate ground debris, which is essential habitat for snails. The low mobility of land snails means they are especially susceptible to the effects of fire.
Invasive species		
Predation by rats (*Rattus* spp.)	known potential	Rats are known to prey on land snails. The incidence of predation is likely to be high, as rats are nocturnal scavengers, and Mitchell's rainforest snail is also nocturnal. In 2001, predation was cited as a threat at all locations, although the impact on abundance was not reported (NSW NPWS 2001). This threat of predation by rats is ongoing (NSW OEH 2014).
Invasion by weeds	known potential	Disturbance by exotic weeds has been cited as a threat (e.g. NSW NPWS 2001), although the impact is unknown. The use of herbicides to control weeds in and near habitat areas is also a threat (NSW OEH 2014), as glyphosate and glufosinate-based herbicides are known to affect the development to maturity of other land snail species (Druart et al., 2011).

Conservation Actions

Conservation and Management priorities

Land clearing

- Prevent clearing of all lowland subtropical rainforest and swamp forest habitat within the species' range.
- Seek to increase the level of legislative protection and active management planning for localities where this species occurs. For crown and private land investigate and/or secure inclusion in reserve tenure if possible.
- Encourage landholders to enter formal conservation arrangements, land management agreements and covenants on private land that promote the protection and rehabilitation of lowland rainforest, swamp forest and wetland margins.

Habitat degradation and disturbance

- Liaise with relevant land managers to maintain natural hydrological flows through vegetation buffers of at least 100 m around lowland rainforest and swamp areas where possible. Target properties that increase habitat connectivity with formal reserves.
- Within the habitat for Mitchell's rainforest snail, retain a buffer of native vegetation and leaf litter around all occurrences of this species. Allow fallen timber and coarse woody debris to remain on the ground in all known habitat, and leave dead trees standing.
- If undertaking restoration and augmentation planting, include species from the ground layer and understorey (e.g. tall saw-sedge and ferns) in areas of degraded habitat where weeds are managed. Revegetation should focus on expanding existing smaller areas of suitable habitat.
- Manage any other likely, potential or emerging threats to habitat quality and causes of habitat modification, such as further invasion of weeds and any removal of wood.

- Erect appropriate signage to indicate conservation of individuals or groups of this species, and to help prevent accidental trampling.
- Ensure land managers are aware of the species' occurrence and provide protection measures against key and potential threats.

Impacts of domestic species

- If livestock occur in the area, manage trampling and potential grazing of native vegetation at important sites through exclusion fencing or other barriers. Fence rainforest remnants and wetland margins.

Fire

- Fires must be managed to ensure that prevailing fire regimes do not disrupt the life cycle of Mitchell's rainforest snail, that they support rather than degrade the habitat necessary for this species, that they do not promote invasion of exotic species, and that they do not increase impacts of grazing or predation.
- Avoid burning in areas of known snail habitat. If fire operations are necessary, physical damage to the habitat and individuals of Mitchell's rainforest snail must be avoided.
- Fire management authorities and land management agencies should use suitable maps and install field markers to avoid damage to Mitchell's rainforest snail.

Invasive species

- Where possible, manage predation by rats using appropriate methods (e.g. DEWHA 2009). Consider monitoring the impact of feral predator control after any large fire or large rain event.
- Control rats in urban areas that adjoin areas of known or potential habitat.
- Control or remove exotic weeds that alter the vegetation structure of the lower shrub and ground layer in Mitchell's rainforest snail habitat. Avoid the use of herbicides in or near known and potential habitat. Minimise any mechanical disturbance to the litter layer and fallen logs associated with mechanical control. Ensure that weed control work is conducted in a staged manner, maintaining a moist microclimate.
- Prevent ornamental plants and weeds in urban areas from escaping into native forest and wetland areas.
- Avoid the use of snail baits and pesticides in urban areas that adjoin or are near known and potential habitat.

Stakeholder engagement

- Continue to raise awareness of Mitchell's rainforest snail within the local community (e.g. Landcare and other bush regeneration groups). Engage with the relevant land managers (especially managers of private land) and encourage these key stakeholders to contribute to the implementation of conservation management actions, such as removing exotic weeds.
- Land managers should be given information about managing fire for the benefit of this species.
- Prepare a management strategy with input from local experts.

Survey and Monitoring priorities

- Conduct targeted surveys throughout the range of Mitchell's rainforest snail to better define population distribution and abundance. Accurately identify potentially suitable habitat and undertake survey work to locate and map any additional populations. Ensure that appropriate microhabitats are searched during periods of snail activity (e.g. leaf litter on the forest floor and under forest debris) and when snails are inactive (cryptic sites such as within sedges, litter in palm fronds, and amongst coarse woody debris). The best times for survey are during periods of high humidity and rain. The snail is nocturnal, suggesting that night surveys would be preferable; however, given the difficulty with night observation of snails in their habitat, daylight searching can be equally effective. At all times disturbance should be minimised to avoid damage to live snails.
- Establish and maintain a monitoring programme based on these data to:
    - determine trends in population size and distribution, mortality and timing of life history stages;
    - determine threats and their relative impacts; and
    - monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary.
- Precise fire history records must be kept for the habitat and current populations (confirmed and suspected) of Mitchell's rainforest snail.

Information and research priorities

- Prioritise management actions at all sites based on the currency, degree and nature of threats.
- Address deficiencies in biological knowledge, such as life history, and the environmental and other likely factors influencing breeding.
- Assess the species' ecological requirements relevant to its persistence. Investigate the impact of microhabitat and substrate on presence and abundance of Mitchell's rainforest snail at each locality. Assess the relative importance of: coverage of the canopy layer, coverage of the herbaceous layer, size and percentage of on-ground timber cover, and leaf litter cover. Assess how they affect moisture/relative humidity at each locality. Assess the presence and abundance of co-occurring species at each locality.
- Where possible, assess the disturbance history at all localities, differentiate between the time since disturbance, type of disturbance (e.g. fire history, mechanical disturbance, etc.), and presence of Mitchell's rainforest snail.

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