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Targeted surveys for two threatened, short-range endemic land snails in the southern MacDonnell Ranges, Northern Territory

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Abstract. The MacDonnell Ranges bioregion in the southern Northern Territory is a centre of land snail endemism in arid Australia, and a high proportion of species are listed as threatened under Northern Territory legislation. We sought to locate extant populations of two endemic and threatened land snails, each known only from a single location. We recorded the first live individuals of *Tateropa aemula* (Charopidae, Stylommatophora) at Penny Springs in Watarrka National Park since the type material was collected 131 years ago. We did not detect this species at other spring sites in this national park. We also located *Divellomelon hillieri* (Camaenidae, Stylommatophora) alive at one of two sites where it was previously recorded in Palm Valley, Finke Gorge National Park. The total area of occupancy at this site was ~0.6 hectares. Excluding wildfire from the habitat of both species through strategic fire breaks is a high priority, as well as removal of invasive buffel grass (*Cenchrus ciliaris*) at the *D. hillieri* site. We recommend that an updated conservation assessment is undertaken for *T. aemula* based on current knowledge of its distribution and threats. Further targeted survey should be undertaken for *D. hillieri* before undertaking a revised conservation assessment. We also report on other land snail species recorded during our surveys at both national parks.

Introduction

Extensive areas of arid upland terrain can function as centres of persistence and diversification, and thus harbor distinctive endemic biotas (Elías & Aagesen, 2016; McDonald *et al.*, 2021; Noroozi *et al.*, 2018). The MacDonnell Ranges bioregion (Thackway & Cresswell 1995) in the Northern Territory is an ancient upland in the centre of the Australian arid zone. This elevated region (315–1531 m. a.s.l.) produces a cooler and wetter climate than the lower surrounding plains, while the complex topography and geological diversity provide unique microhabitats and a refuge from landscape disturbance processes (e.g. wildfire) not afforded in the flat and relatively homogenous sandy deserts (McDonald *et al.*, 2021; 2024). These factors underpin the status of the MacDonnell Ranges as an evolutionary refugium for plants, aquatic invertebrates, land snails, and vertebrates, with the region supporting lineages of these taxonomic guilds through periods of aridification at least dating back to the mid-Miocene (Christidis *et al.*, 2010; Oliver *et al.*, 2010, 2014; Ingham *et al.,* 2013; Pepper *et al.*, 2013; Criscione & Köhler, 2016; Oliver & McDonald, 2016; Cardillo *et al.*, 2017; Razeng *et al.*, 2017; Ashman *et al.*, 2018). The region is particularly notable as an arid zone hotspot for land snail species richness and endemism (Slatyer *et al.*, 2007), as well for the high proportion of snail species that are listed as threatened (McDonald *et al.*, 2021).

Historically, the first major contribution to knowledge of the MacDonnell Ranges land snail fauna was made by the 1894 Horn Expedition. This scientific expedition conducted targeted zoological collections across the region for the first time and increased the number of land snail species known

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from central Australia from three to 25 (Tate, 1896). The small charopid land snail *Tateropa aemula* (Tate, 1896) was collected by the Horn Expedition 'At Penny Springs, in George Gill's Range, on damp earth in the shade of cycads' (Tate, 1896), a locality now contained within Watarrka National Park (NP). The only subsequent record was made by Vince Kessner and Chris Palmer, who collected a few dead specimens at Penny Springs in 1987 and 2010, respectively (Solem, 1988; DLPE unpub. data). This species is listed as Vulnerable under the *Territory Parks and Wildlife Conservation Act 1976* (TPWC Act), and there is concern that it was impacted by an intense wildfire that burnt all of its known habitat in 2013 (Wilson *et al.*, 2006; DLPE, unpub. data). Assessing the status of *T. aemula* at Penny Springs and determining whether there are additional populations at other sites are thus priorities for the management of this species.

The Horn Expedition also revealed the significance of Palm Valley in the Krichauff Range for snails, as Spencer (1896: Page 116) noted that: 'Out of a total of twenty-five species secured during the expedition fourteen were found in and about Palm Creek, of which four…were found nowhere else'. While some of these species have since been synonymised, Palm Valley remains a site of exceptional species richness in the MacDonnell Ranges (McDonald *et al.*, 2021). One land snail overlooked by the expedition at Palm Valley is *Divellomelon hillieri* (Smith, 1910). This distinctive camaenid was collected by J. H. Hillier as a series of worn bleached shells 'from the neighbourhood of Hermannsburg' in 1909 (Smith, 1910; Solem, 1993). The species has since been intermittently collected in the Palm Valley area in Finke Gorge National Park between 1958 and 2010 (Atlas of Living Australia, 2025). Most or even all of these records appear to be spatially inaccurate, however, as the location descriptions often do not match the recorded spatial coordinates. This is particularly true for older pre-GPS records and/or records with low spatial precision (PJM pers. obs.). *Divellomelon hillieri* is listed as Vulnerable under the TPWC Act, with increased wildfire frequency and intensity, fuelled by the invasive buffel grass (*Cenchrus ciliaris*), considered the key threat (Northern Territory Government, 2021). It is therefore a priority to accurately determine the location of extant *D. hillieri* populations to assess the conservation status of this species and to identify and address any threatening processes.

Here we report on the results of a joint Northern Territory Government and Australian Museum survey trip targeting *T. aemula* and *D. hillieri* in October 2025. The main objectives of this trip were: 1) Assess the current status of *T. aemula* at Penny Springs and elsewhere in Watarrka National Park; 2) Locate the population(s) of *D. hillieri* at Palm Valley; 3) Make recommendations for conservation assessment and management for both species; and 4) report on observations and collections of other land snail taxa in both locations.

Methods

Watarrka National Park

We surveyed land snails at Watarrka NP between 6-8 October 2025. We first visited Penny Springs, the type locally for *T. aemula* (Fig. 1). At the main spring site (-24.27901°, 131.58442°), we collected small samples (about a handful each) of damp soil from multiple positions under ferns and cycads (*Macrozamia macdonnellensis*) and placed these in a single zip lock bag labelled with the site location. We also collected damp soil samples from a smaller spring c. 250 m to the south-east of the main spring (-24.27987°, 131.58499°) in a separate labelled bag. We repeated this sampling approach at two other springs in Watarrka NP, Kathleen Springs (-24.33376°, 131.68147°) and Stokes Gorge (right arm -24.34917°, 131.75807°; left arm -24.34819°, 131.75260°). We also collected a small number of shells and live snails from underneath rocks and litter below fig trees at all three springs locations and from Wanya Gorge (-24.32447°, 131.66587°). Back at our accommodation, we carefully searched the soil samples for snails by placing a small amount of soil on a white plate and systematically working through the soil with fine forceps. We placed any located shells or live snails into a single vial for each site. Land snails were collected under a permit from NT Parks and Wildlife (Permit no. 71982).

Finke Gorge National Park

We surveyed land snails at Finke Gorge NP between 9-12th October 2025. With our focus on *D. hillieri*, we restricted our searching to Palm Valley and immediate surrounds (Fig. 1). Given the spatial inaccuracies of previous records mentioned

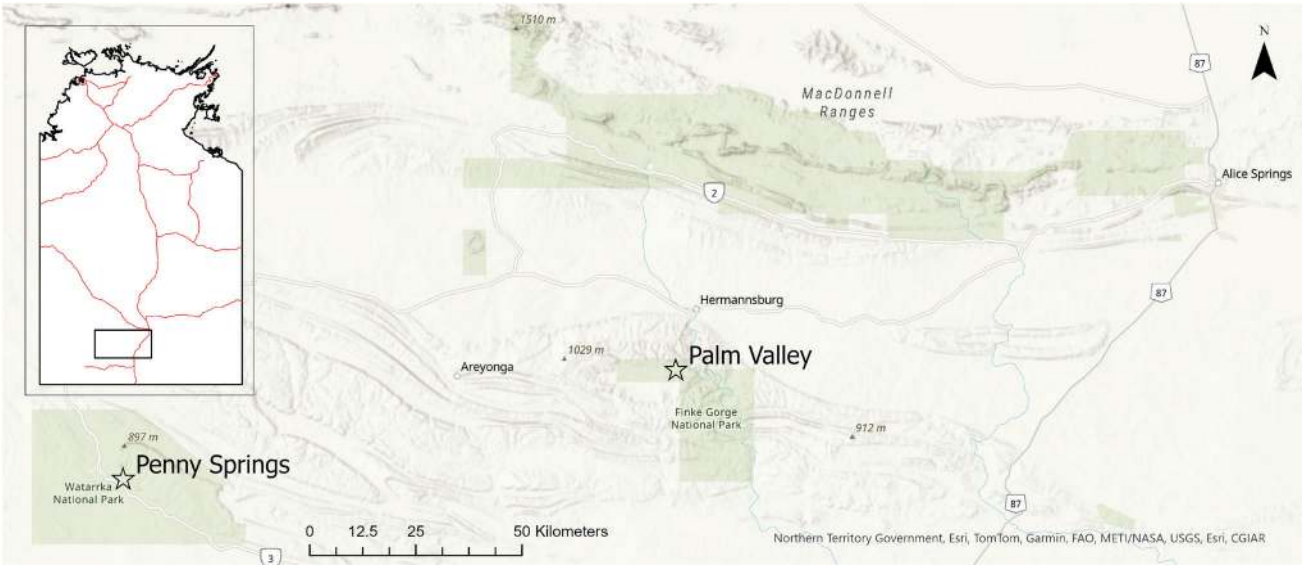


Figure 1. Main map shows the location of the two main survey areas in the MacDonnell Ranges – Penny Springs at Watarrka National Park and Palm Valley at Finke Gorge National Park. Inset map shows the extent of the main map in relation to highways in the Northern Territory.

in the introduction, we determined two locations from those records based on site descriptions: 1) escarpment on the northern side of Palm Creek opposite the visitor information shelter (-24.05510°, 132.758735°; MAGNT P062093 from 2010; NMV F107143-F107145 from 1994-1995), and 2) in or near Cycad Gorge (-24.04796, 132.72412; AM C.346188 from 1983; NMV F107142, F107146-F107147 from 1994-1995; SAMA D18083 from 1983). We searched these sites thoroughly for *D. hillieri*, as well as areas of escarpment and fig trees in the intervening areas and in Palm Valley itself upstream of the car park. We also collected a small number of shells and live snails from underneath rocks and litter below fig trees at various locations. All specimens collected during the survey have been lodged in the malacological collection of the Australian Museum (Köhler & McDonald, 2026).

Results

Watarrka National Park

We recorded 13 live individuals of *T. aemula* from damp soil samples collected at the main spring at Penny Springs (Fig. 2). The identity of *T. aemula* was confirmed by comparison with shell photographs and descriptions of this species given by Stanisic *et al*. (2018: 190-191). Two live *T. aemula* were recorded from soil samples collected at the second, smaller spring at this location. Both springs appeared to be in good ecological condition with no obvious sustained effects of the 2013 wildfire and no sign of large feral herbivore disturbance (Fig. 2). The invasive weed Buffel grass (*Cenchrus ciliaris*) was prevalent on nearby slopes but absent from the wetter

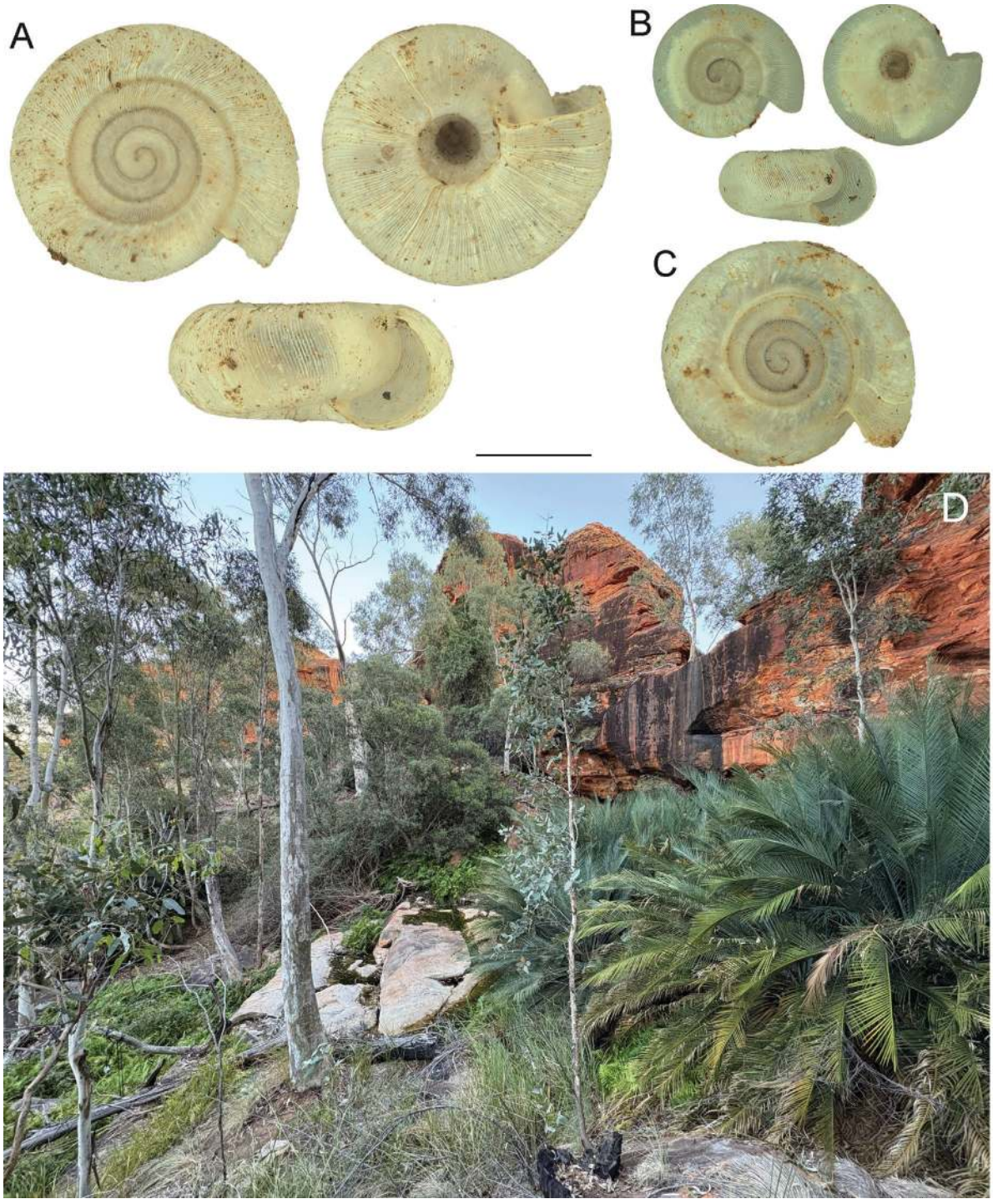


Figure 2. A-C) Shell variation in *Tateropa aemula* (photos by C. Eades-formica, AM). Scale bar = 1 mm; and D) Penny Springs at Watarrka National Park, the only location known to support *T. aemula* (photo by P. McDonald).

soil of the springs themselves (Fig. 2). No *T. aemula* were detected from soil samples collected at Kathleen Springs or in the east and western arms of Stokes Gorge.

We also recorded the following additional land snail species at Watarrka NP: *Catellotrachia bagoti*, *Eremopeas interioris*, *Pupoides beltianus, Sinumelon gillense*, *Gastrocopta mussoni*, and *Paralaoma retinoides* (Köhler & McDonald, 2026). Most of these species were found in sheltered places, such as under fig trees (*Ficus brachypoda*), in rocky talus or near seepages.

Finke Gorge National Park

We recorded *D. hillieri* shells at a single site in the Palm Valley area where the species had previously been recorded (northern side of Palm Creek opposite the visitor information shelter; Fig. 3). Habitat at this site is south-facing escarpment, including ledges, overhangs and boulders with extensive bare rock. Geology is Hermannsburg Sandstone with calcrete impregnation, of Devonian origin (Donnellan *et al*., 2023). Plant species on the site included *Acacia kempeana*, *Callitris glauchophylla*, *Cheilanthes lasiophylla, F. brachypoda*, *Indigofera keucotricha*, and *Pandorea doratoxylon*. The invasive weed buffel grass (*Cenchrus ciliaris*) was the dominant groundcover over much of the site. While the fig trees (*F. brachypoda*) on site supported concentrations of other land snail species, no *D. hillieri* shells were located under them. Based on the occurrence of shells, the total area of occupancy for *D. hillieri* at this site was ~0.6 hectares. We found no *D. hillieri* shells at the other previously known site at Cycad Gorge. One of us (FK) also reports finding no shells of this species while searching the same site with Vince Kessner in 2012. We also failed to locate *D. hillieri* at additional sites in the Palm Valley area (Köhler & McDonald, 2026).

Palm Valley experienced storms on the 10th and 11th October, with the nearby ranger station (1.6 km south west of the *D. hillieri* site) receiving a cumulative 14 mm of rainfall across the two storm events. We visited the confirmed *D. hillieri* site about 30 minutes before sunrise on 12th October and found 12 live *D. hillieri* active on bare rock surfaces, most of which were damp with water seepage. We followed one adult *D. hillieri* until it entered a narrow rock crevice 15 minutes after sunrise. The front of the crevice was covered in moss and calcrete was notably present on the surface of the rock (Fig. 3).

We also recorded the following additional land snail species at Finke Gorge NP (TPWC Act threatened species and their status identified in brackets): *Bothriembryon spenceri* (Vulnerable), *Catellotrachia elleryi* (Vulnerable), *Catellotrachia esau* (Vulnerable), *Eremopeas interioris*, *Gastrocopta mussoni, Gastrocopta larapinta*, *Granulomelon adcockianum*, *Granulomelon squamulosum* (Vulnerable), *Pupoides eremicolus*, and *Sinumelon expositum* (Fig. 4; Köhler & McDonald, 2026). Most of these species were recorded under litter and rocks beneath fig trees, many of which had dense buffel grass encroaching. Land snail abundance and richness was noticeably higher in areas where calcrete was visible on sandstone.

Discussion

Key findings

This study confirmed that *T. aemula* is extant at Penny Springs, Northern Territory, more than a decade after a wildfire burnt all its known habitat and 131 years since the collection of the type material. We also confirmed the persistence of *D. hillieri* at one site in Palm Valley but did not locate it at a second previously occupied site. The invasive buffel grass was pervasive at both locations and likely presents the most significant threat to these and other threatened land snail species across the MacDonnell Ranges. Our joint expedition highlights the value of taxonomic guild experts from museums collaborating with conservation practitioners in the field to locate wild populations of threatened species and to identify priorities for management and further survey.

Conservation recommendations

While the invasive weed buffel grass was absent from the wet parts of Penny Springs, including where we found *T. aemula*, it is becoming an increasingly dominant component of the surrounding slopes and creek lines. The establishment of buffel grass is driving more frequent and intense wildfires (Miller *et al*., 2010) and leading to the progressive loss of old woody plants in the alluvial systems of the MacDonnell Ranges (Schlesinger *et al*., 2013; Schlesinger & Westerhuis, 2021). While the persistence of *T. aemula* following an intense wildfire in 2013 indicates some level of resilience to such events, this resilience could be tested with the further encroachment of buffel grass around Penny Springs coupled with the climate trend of more extreme drought and heatwave events (Wright *et al*., 2023). Given the relatively remote setting, buffel grass management on site would be challenging and we recommend fire exclusion through prescribed burning breaks in the hills and sand country south of the springs.

Buffel grass was also pervasive at the single site where we located *D. hillieri* at Palm Valley. While aestivating snails in rock crevices are likely to be protected from wildfire, impact to foraging habitat is of some concern. While *D. hillieri* diet is unknown, given the large expanses of bare rock where we located shells and live snails, we speculate they feed on biofilm on rock surfaces. Given that higher intensity wildfire can lead to reductions in biofilm (e.g. lichens, Miller *et al*., 2018), high intensity wildfire driven by buffel grass fuel loads could impact *D. hillieri* foraging habitat. We recommend that the single known extant *D. hillieri* site is protected from wildfire through strategic fire breaks and that fuel loads are reduced within the occupied site through management of buffel grass. Given the potential negative impacts of herbicide on land snails (Druart *et al*., 2011; Omran & Salama, 2016), manual removal of buffel grass will likely be required.

The significance of fig trees for the land snail fauna of the MacDonnell Ranges has long been recognised (Solem, 1993). During our surveys, we found that most land snail species were more abundant, or only detected from, under fig trees. We also observed many examples of dense buffel grass encroaching fig trees and some instances where buffel grass-driven wildfire had damaged or killed these trees. Given their clear status as a keystone species in the MacDonnell Ranges, we recommend the removal of buffel grass underneath and immediately surrounding large fig trees in accessible locations. This management is particularly important at Palm Valley where individual fig trees typically supported multiple threatened land snail species.

Further survey and conservation assessment

We confirmed that *T. aemula* is extant at Penny Springs but did not locate it at two other spring localities within Watarrka National Park. While a fourth major spring at

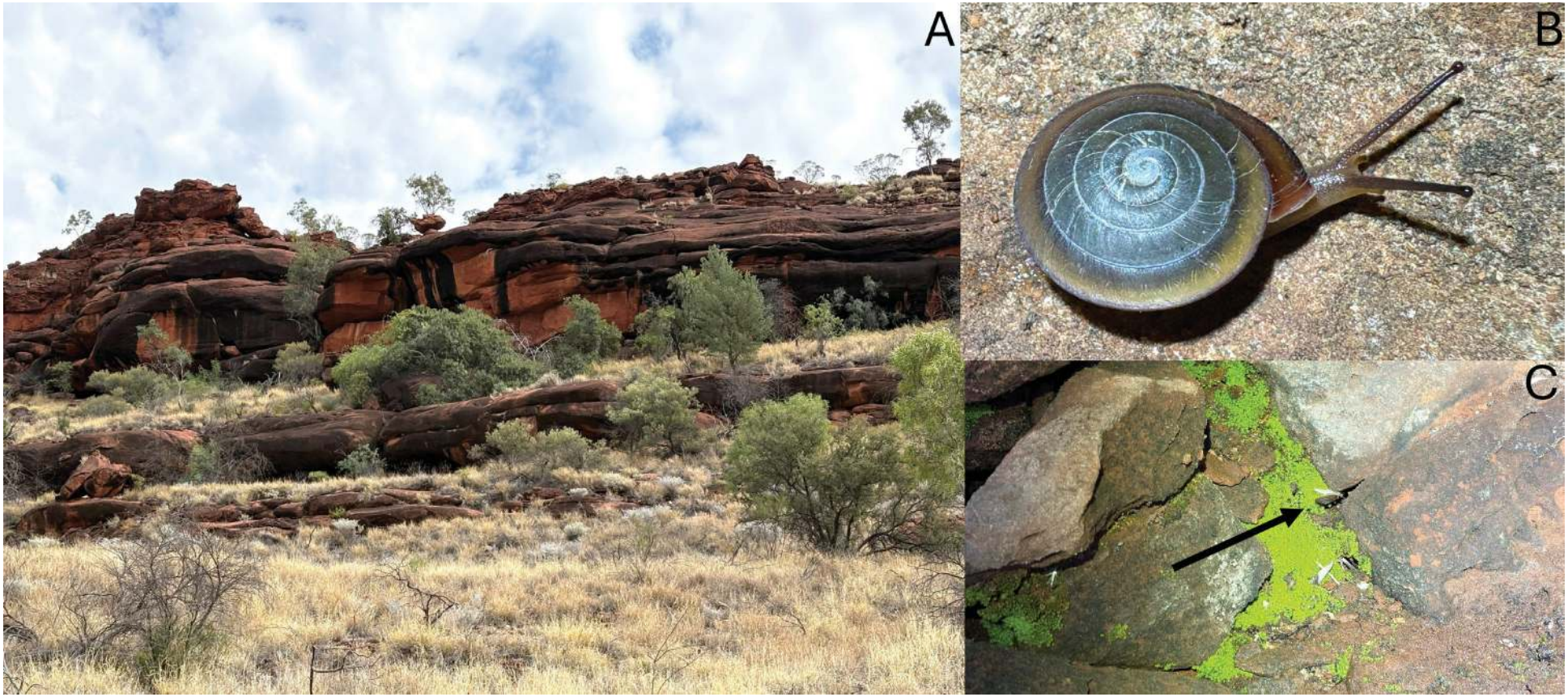


Figure 3. A) Habitat where we located *Divellomelon hillieri* near Palm Valley at Finke Gorge National Park. Shells and live snails were located along the sandstone escarments in an area totalling 0.6 hectares. Note the prevelance of the highly invasive weed Buffel grass (*Cenchrus ciliaris*) across the site, B) An adult *D. hillieri* located active at dawn following overnight storms, and C) An adult *D. hillieri* entering a rock-crevice, presumably its aestivation microhabitat, shortly after sunrise. Note the presence of white calcrete on the sandstone surface (all photos by P. McDonald).



Figure 4. Examples of the other snail fauna encountered during our surveys: A) *Catellotrachia bagoti* from Penny Springs, Watarrka National Park, and B) *Catellotrachia elleryi*, C) *Granulomelon adcockianum*, and D) *Sinumelon expositum* from Palm Valley, Finke Gorge National Park (all photos by P. McDonald).

Bagot Creek was not surveyed, this site has previously had some targeted land snail sampling, including during the Horn Expedition (Tate, 1986). While there are a number of springs in the sandstone geologies of the neighbouring Urrampinyi Iltjiltjarri Aboriginal Land Trust (ALT), none are known to have similar characteristics to Penny Springs (Brim Box *pers. comm.*). Therefore, it remains plausible that *T. aemula* is endemic to Penny Springs. We recommend prioritising management of Penny Springs coupled with monitoring to check for persistence following stochastic events such as extreme drought or wildfire. Surveying for *T. aemula* at springs on the neighbouring ALT would also be worthwhile if opportunities arise with the Central Land Council. We recommend proceeding with an updated conservation assessment of *T. aemula* based on current knowledge of distribution and threats.

We recommend further targeted survey for *D. hillieri* at Palm Valley and surrounds before undertaking a revised conservation assessment. Further survey effort should include a thorough search of Cycad Gorge in Palm Valley to establish whether the species has indeed been extirpated from this site since the last known record in 1995. Surveys elsewhere in Palm Valley and the surrounding area should focus on similar habitat to the extant Palm Valley site, specifically; south facing escarpments in Hermannsburg Sandstone with abundant calcrete deposits. The distribution of endemic flora with similar habitat requirements may help direct targeted survey at new sites (e.g. *Olearia* sp. Waterhouse Range; David Albrecht *pers. comm.*).

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