

# A biodiversity survey of a remnant semideciduous forest at East Barron, Atherton Tablelands

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## Abstract

“Mabi forests” are endangered and highly fragmented tropical semideciduous forests that occur on basalt-derived soils in the upland regions of the Atherton Tablelands, Queensland. While Mabi forest flora and fauna are generally well-described, species lists of localised remnant patches, which can provide important information for landowners managing such patches, are lacking. We studied an eight hectare (21 acre) privately-owned Mabi forest remnant in East Barron between late March to mid-April 2025. We surveyed vascular and non-vascular plants, conducted leaf litter collections and baited pitfall trapping for ground invertebrates, and light-sheeting for nocturnal invertebrates. To survey birds and other vertebrates we undertook non-intrusive daytime and nighttime observations. To complement our dataset, we compiled the available bird and mammal data for the patch from the Atlas of Living Australia. The combined plant and animal diversity documented is significant considering the small size of the Mabi forest patch, and included bryophytes (33 spp.), ferns (15), flowering plants (152), invertebrates (192), birds (123), other vertebrates (12), protozoans (3), protists (1), and fungi (66). Of these, at least 14 plant and three animal species are of conservation significance in Queensland. Although the sampling was intensive, some groups of organisms such as fungi and invertebrates remain under-represented, and our survey data should be considered

as a snapshot of the biodiversity of these groups. We conclude that remnant forest patches can provide important habitat for multiple species, and we recommend similar surveys of other Mabi forest localities and remnants of other forest types on the Atherton Tablelands to better understand the distribution of native biodiversity in these habitats.

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## Introduction

The Wet Tropics bioregion ranks among Australia's most biodiverse geographical areas with a large portion of it inscribed in 1988 as a UNESCO World Heritage Area due to its significant biodiversity (UNESCO 2024). Although much of the region's tropical rainforests are now protected, many areas have been deforested and occur as fragmented remnants. In the upland region of the Atherton Tablelands, a unique semideciduous forest type known as "Mabi forest" was once dominant. Mabi forest is a closed canopied forest named after the local Ngadjon-Jii and Yidinji Australian Aboriginal peoples' name, "Mapie/Mabi" for the Lumholtz's Tree-Kangaroo (*Dendrolagus lumholtzi*) (Campbell 2014). It is also known as complex notophyll vine forest 5b—a technical typology which classifies forests partly by their structure, average size of the canopy leaves and presence of conspicuous lifeforms such as robust lianas (Webb *et al.* 1976; Tracey 1982). Specifically, Mabi forests are characterised by a component of deciduous to semi-deciduous trees amongst evergreen species, a complex understorey, and occurrence over basalt-derived soils (Tracey 1982). Mabi forests also receive lower rainfall than other rainforest types (Tracey 1982; Wet Tropics Management Authority n.d.). This unique rainforest type provides habitat for various threatened plant and animal species including the Lumholtz's Tree-Kangaroo (*Dendrolagus lumholtzi*).

In the late 1800s, the basalt-derived soils of the Atherton Tablelands over which Mabi forests predominated were initially coveted by European colonists for timber, agriculture and pasture, leading to their widespread clearing encouraged by the then government. Later, after WWI, soldier settlement schemes continued the practice. As a

result, Mabi forests have become highly fragmented, and their area has declined from 19,000-24,000 hectares (ha) pre-European contact to 954 ha today (Latch, 2008); remnants were spared from clearing due to their rockier topography (Lynch *et al.* 2020). This drastic reduction (~96%) of original vegetation led to Mabi forest being listed in 2002 as a critically endangered ecological community under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (DCCEEW 2023). While the importance of Mabi forest patches is formally recognised and protected, introduced species, weeds, and the effects of isolation still threaten the survival and health of individual patches and the vegetation type as a whole (DCCEEW 2023).

Although the ecological significance of Mabi forest is recognised, there are only a few published surveys on the biodiversity of this rainforest community; many taxonomic groups of plants and animals, such as non-vascular plants and invertebrates, are poorly sampled. For instance, there are very few studies on the fungi and invertebrates of Mabi forest, even though these groups are very diverse in tropical rainforests. Details are lacking, even for well-studied groups such as vascular plants and birds, and species occurrence data are often patchy. Having site-specific biodiversity information is crucial for landowners wishing to understand, conserve, and manage the biodiversity and natural vegetation within their properties, and for special interest groups, naturalists, and researchers who want to study the biodiversity of specific remnants. Publicly available biodiversity information can also serve as a resource for educating the public and local

communities about the biological diversity of the land around them and fosters a stronger sense of place (Lowman *et al.* 2019).

Biological surveys of specific localities can help fill knowledge gaps in species occurrence data; however many of these surveys are conducted as part of environmental consultancy work, which typically targets particular groups of organisms most commonly vascular plants or birds, or focus only on species of conservation significance (although see Anthony *et al.* 2019; Cameron 2015). Consequently, the outcomes of these surveys remain as grey literature (e.g. Keighery & Keighery 2013) which is of limited access to the public. Given these limitations, nature-based biodiversity observation platforms such as eBird (Sullivan *et al.* 2009) and iNaturalist (Mesaglio & Callaghan 2021) that allow researchers to record, collate and organise species distribution data could be a useful way to fill data gaps in biodiversity knowledge. iNaturalist also facilitates biodiversity surveys by enabling researchers to solicit species identifications from a large pool of experts or by obtain identification suggestions through judicious use of the artificial intelligence functions available on the platform (Mesaglio & Callaghan 2021). Indeed, within the last two decades, such platforms have emerged as powerful tools for informing biodiversity conservation (Pocock *et al.* 2018; Callaghan *et al.* 2024).

At the behest of, and in collaboration with the property owners (Andi and Will Cairns, co-authors of this work), a group of research staff and undergraduate students from the School for Field Studies (Australia), conducted this biodiversity survey of a remnant Mabi forest patch in East Barron near Yungaburra, Atherton Tablelands. This property is under a statutory conservation covenant to protect, manage and rehabilitate the Mabi forest present; this conservation covenant will last in perpetuity and is binding on subsequent landowners.

We used the iNaturalist platform as our primary means to record and collate our observations, with the hope that the publicly accessible online material generated for the project, along with this article, will serve as baseline data that encourages follow-up surveys to monitor the health of this Mabi forest patch. We also envision that this work will encourage similar surveys in other areas of interest.

## Methods

### *Survey location and vegetation*

The survey was conducted within a ~8 ha (21 acre) remnant Mabi forest patch located on private property (Lot 11 SP295186) in East Barron near Yungaburra on the Atherton Tablelands, Queensland (17°15'55"S, 145°33'53"E; altitude: 748 to 769 m a.s.l.; Fig. 1).

The Atherton Tablelands incorporate the Atherton Basalt Province (Whitehead *et al.* 2007) which covers almost 2,500 km<sup>2</sup> across an elevated plateau (elevation 600–900 m.a.s.l.) to the southwest of Cairns, inland from Mount Bellenden Ker and Mount Bartle Frere. Derived from ancient lava flows, the fertile basalt-derived soils cover more than half of the Atherton Tablelands and support a diversity of tropical agriculture (Whitehead *et al.* 2007).

Compared to the surrounding flats, the soils found on the study site contain a high percentage of scoria and bear more similarity to that of other volcanic landforms such as the Seven Sisters and Quincan Crater which are conical-shaped cinder (scoria) cones that were formed during the Quaternary period (Whitehead *et al.* 2007). The closest of these formations to the study site are four cones located approximately 0.5 km to the north and west (see Appendix, Fig. S1).

Annual temperatures between 1968–2025 at Walkamin Research Station, the closest Meteorological Station to our study site (22 km away, at 17.13° S, 145.43° E) were 17.1°C (mean minimum) and 27.5°C (mean maximum). Mean annual rainfall between 1965–2025 was 1,047.7 mm (Bureau of Meteorology 2026).

The study site matches the technical description of “complex notophyll vine forest Type 5b” (Tracey 1982). The remnant Mabi forest has a 15–30 m canopy with scattered semi-deciduous to deciduous trees such as White Cedar (*Melia azedarach*) and *Ficus* spp. (Fig. 2B) among canopy trees such as the Red Tulip Oak (*Argyrodendron* spp.) (Fig. 2C). The study site also includes robust lianas (Fig. 2D) and abundant shrubs in the understorey. Smaller lifeforms such as ferns and bryophytes occupy epiphytic habitats and volcanic scoria rocks cover the forest floor (Fig 2E–F).

The remnant Mabi forest patch is flanked by pastures to the north, west and south, and is separated by Thomas Road and the Gillies Range



**Figure 1.** The Mabi forest survey site in East Barron, near Yungaburra, Queensland, Australia. The survey area is outlined in green dashed lines. The animal symbols in (A) denote focal observation spots where the depicted organisms were part of a targeted search. The 1949 aerial photograph (B) shows the same Mabi forest patch including some secondary regrowth (paler grey in the black and white photo) which was later cleared.

Road from another similarly sized Mabi forest patch to the east (Fig. 1A). Our study site is located approximately 650 m north of a much larger >300 ha Mabi forest patch at Curtain Fig National Park, managed by Queensland Parks and Wildlife Services.

#### *Recording observational data*

To record our observational data and to partially fulfill our data curation needs, we used the online

platform iNaturalist. This platform is currently the world's largest online nature observation curation site, with the total number of observations exceeding 302 million as of April 2026 (iNaturalist 2026). To produce scientifically valuable biodiversity data, the platform relies on publicly uploaded pictures of species and subsequent forum-based identification of these species (Mesaglio & Callaghan 2021). The platform has emerged as a powerful tool for collecting and

collating large quantities of observational data; for example, over 18,600 records of species with a conservation status of near threatened or above have been exported to the Atlas of Living Australia (Mesaglio & Callaghan 2021), a national database of biodiversity observations.

For our survey, we created four separate iNaturalist collection projects: for plants ([www.inaturalist.org/projects/plant-diversity-of-a-mabi-forest-on-thomas-road](http://www.inaturalist.org/projects/plant-diversity-of-a-mabi-forest-on-thomas-road)), animals ([www.inaturalist.org/projects/animal-diversity-of-a-mabi-forest-on-thomas-road](http://www.inaturalist.org/projects/animal-diversity-of-a-mabi-forest-on-thomas-road)), fungi ([www.inaturalist.org/projects/fungal-diversity-of-a-mabi-forest-on-thomas-road](http://www.inaturalist.org/projects/fungal-diversity-of-a-mabi-forest-on-thomas-road)), and miscellaneous lifeforms ([www.inaturalist.org/projects/miscellaneous-lifeforms-of-a-mabi-forest-on-thomas-road](http://www.inaturalist.org/projects/miscellaneous-lifeforms-of-a-mabi-forest-on-thomas-road)). For groups of organisms with fleeting observations, such as birds, butterflies or nocturnal animals, observations were made on field sheets and later entered as observations without photographs in iNaturalist (see next section).

### Sampling methods

Taking into consideration the availability of expertise and the different sampling requirements for different types of organisms, we organised our data collection into different categories as detailed below.

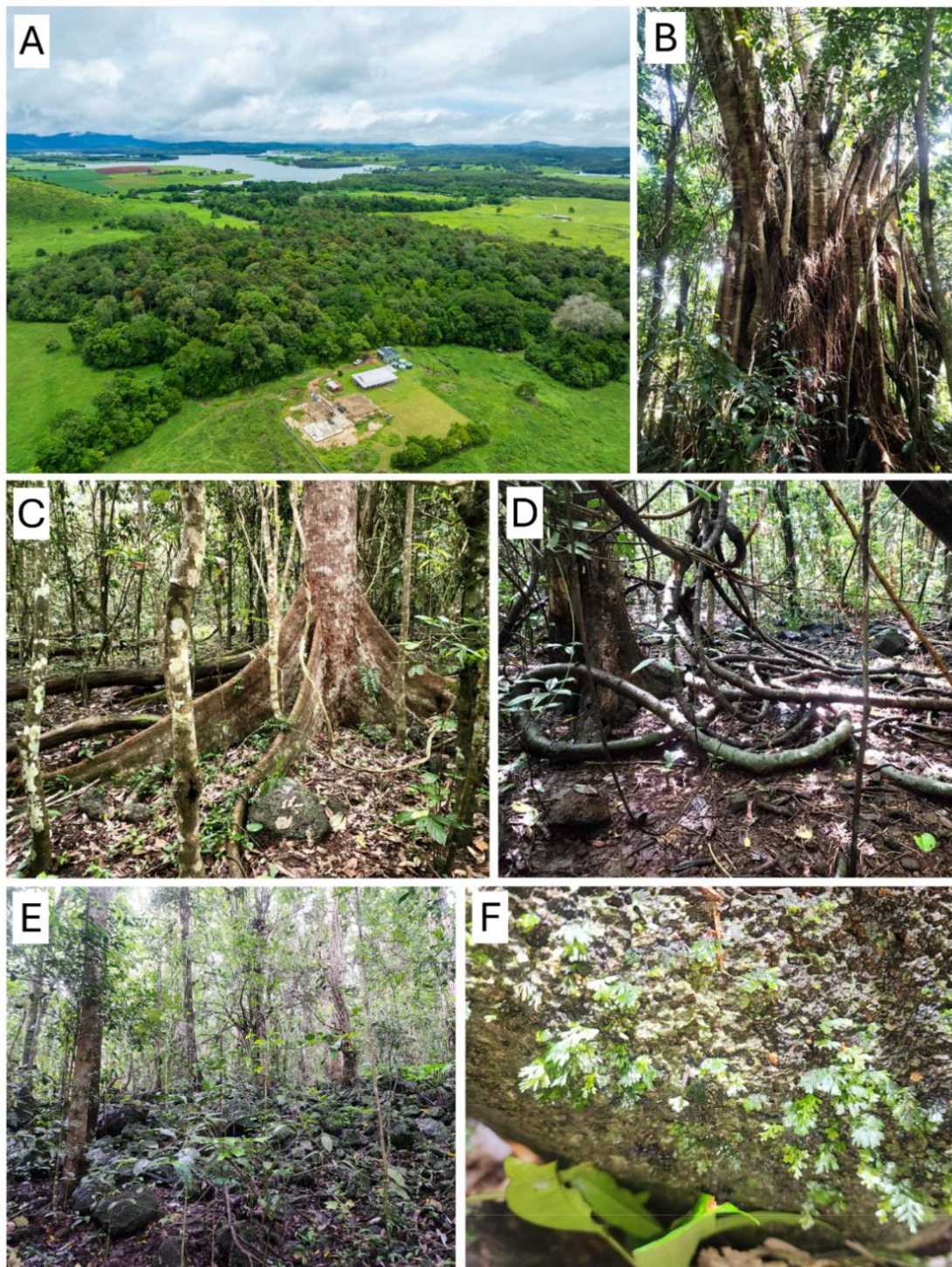
**Plants**—Plant surveys occurred between 26<sup>th</sup> March and 15<sup>th</sup> of April 2025 over four non-consecutive days. During these surveys, David Tng (D.T.) photographed and noted plants while exploring the forest patch on foot. A few observations were made in the pasture or open field outside the residential buildings; these observations are marked as being “not in forest” (see Supplementary file, Table S1) and were not included in the main reporting or analysis. In a few cases where plants could not be readily identified in the field, we collected cuttings and took them to the School for Field Studies laboratory, where we identified them using online identification keys for ferns (Field *et al.* 2022) or flowering plants (Zich *et al.* 2020).

To survey bryophytes we used the floristic habitat sampling method (Newmaster *et al.* 2005); this method involved thoroughly searching for species on all available bryophyte substrates including rocks (Fig. 2F), decaying logs and fallen branches or twigs, bark of the main stems, and the surface of leaves (i.e. epiphylls) (Newmaster *et al.* 2005; Tng

*et al.* 2025). We paid particular attention to fallen trees and boughs as representatives of the bryophyte flora in the forest canopy. Collections were taken back to the laboratory and were photographed under a dissecting and a light microscope. We identified bryophytes using relevant taxonomic keys and specialist literature. To identify liverworts, we used keys in Jackes & Cairns (2001), Lee & Gradstein (2021), and an informal liverwort key for the region written by David Meagher (unpublished manuscript); updated keys for specific liverwort genera such as *Plagiochila* (Renner 2018) were also consulted. To identify mosses, we used taxonomic keys available on the Australian Mosses Online website (Australian Biological Resources Study 2016) and other supplementary and updated taxonomic literature for specific moss taxa in the Lembophyllaceae (Meagher *et al.* 2020), Leucobryaceae (Tiwutanon *et al.* 2023), Pterobryaceae (Yu & Jia 2015), and Ptychomniaceae (During 1977) families.

**Fungi (including lichens) and miscellaneous protozoan lifeforms**—Surveys for these lifeforms were made opportunistically and specimens were photographed while the team was conducting surveys for plants and arthropods. We only surveyed for fungi with fruiting bodies, and for lichens (or lichenised fungi) on the bark of trees, fallen twigs, and rocks. Other lifeforms such as protozoans were observed opportunistically or collected as bycatch when we examined bryophyte collections. Where possible, we identified fungi using guidebooks (Fuhrer 2005; Young 2005) and lichens using keys (McCarthy & Malcolm 2004; Lumbsch *et al.* 2001) or by soliciting identifications from experts on iNaturalist.

**Arthropods**—We surveyed arthropods using various methods for different arthropod groups. During the sampling period, a group of students and researchers traversed the Mabi forest patch in the daytime for two three-hour sessions during two separate days to make general observations of invertebrates on plant foliage, tree trunks, and under rocks. To survey ground-dwelling arthropods we collected leaf litter and to survey dung beetles we employed baited pitfall traps. For both ground-dwelling arthropods and dung beetles, sampling was conducted along five 20 m linear transects established at the study site and spaced at least 20 m apart (Fig. 1A).



**Figure 2. Structural features of the survey site in the East Barron, near Yungaburra, Queensland, Australia.** (A) Aerial shot of the Mabi forest patch facing northeast with Lake Tinaroo in the background. A large deciduous fig tree (*Ficus henneana*), which was leafless at the time of photography is visible on the right of the photo; an image of the same tree taken from the understory is shown in (B). Structural features such as conspicuous plank buttresses and robust lianas typical of Mabi forests are shown in (C) and (D). Abundant large scoria rocks that cover the ground in most of the patch are shown in (E); these rocks provide substrate for smaller plant lifeforms such as ferns and bryophytes (F). Photos: Aerial photo by Kevin Explores (2025) (<https://www.facebook.com/kevinexplores/>, with permission); all others by David Tng.

All leaf litter in a 25 cm x 25 cm quadrat at 5 m, 10 m, 15 m and 20 m along the center line of each transect was collected and placed in a Berlese funnel (Macfadyen 1961) above a 70% ethanol mixture and allowed to sit for 60 hours, with a 28-watt lamp placed above the funnel. Leaf litter was shuffled every ~24 hours. After 60 hours, invertebrates which had fallen into the ethanol solution were collected and identified. Each funnel had a volume of ~1.5 L.

To survey dung beetles (Coleoptera: Scarabaeidae: Scarabaeinae), three sampling points were established along each transect at 0 m, 10 m and 20 m, totalling 15 sampling points. At each sampling point, we installed one standardised baited pitfall trap (Spector & Forsyth 1998) filled with 100 mL of water with a few drops of detergent added. Traps were baited alternately with a mix of Agile Wallaby (*Macropus agilis*), Red-legged Pademelon (*Thylogale stigmatica*) and Brushtail Possum (*Trichosurus vulpecula*) dung, rotting mushrooms, or carrion, to attract a wide range of native species, as several species in the study area show specialisation to either mammalian dung, mushroom or carrion bait (Hill 1996). Traps were placed at a minimum of 10m from the forest edge and were opened in the morning on 1<sup>st</sup> April 2025 and left in the field for three days. Beetles were identified to species level using voucher specimens, Mia A. Derhé's (M.D.) expert knowledge and specialised literature (Matthews 1972, 1974, 1976; Storey & Weir 1990).

Ants were identified to genus level using keys in AntWiki (2020); other species collected from the Berlese funnel and pitfall traps were sorted and photographed under a dissection microscope and posted on iNaturalist. Representative specimens of collected invertebrates were pinned or stored in containers with alcohol. Additional arthropod identifications were made using wildlife and field guides (Queensland Museum 2020; Zborowski & Storey 2024).

To record nocturnal flying invertebrates, we conducted three sessions of light-sheeting (Intachat & Woiwod 1999) at the edge of the forest between 1930 and 2130 hrs (Fig. 1A). Sampling involved a white projector sheet suspended from a rope between two trees with two 3,000-lumen LED portable work lights suspended above it. During each of the two hour sampling periods, two observers photographed all nocturnal invertebrate

species that landed on the white sheet. Moth specimens were identified to genus or species level using Richardson (2015) or by comparison with the image database on the Australian Lepidoptera website (Herbison-Evans & Crossley 2020). Other insect identifications were made using field guides (Whyte & Anderson 2017). For some invertebrate groups, limited taxonomic expertise means that entities referred to as species should be interpreted as morphologically distinct taxa.

*Birds*—Bird surveys were conducted in the morning between 0630 and 0830 hrs on three separate days in April 2025. During these surveys, one observer (J.L.) and a companion walked along six 20 m sampling transects, spending 20 minutes on each transect identifying birds by sight or sound (e.g. Loyn 1986). *Ad hoc* observations of nocturnal birds were recorded during nighttime surveys and opportunistic daytime bird sightings were also documented whenever researchers visited the site during the study.

*Mammals and other vertebrates*—to survey mammals we used five camera traps installed along five transects in the forest patch (Fig. 1A). Additional nocturnal mammal observations were made by an observer free-roaming throughout the forest patch on the same nights during which light-sheeting sessions were conducted. During the nocturnal walks, flashlights with red tinted film and handheld thermal sensors were used to search tree canopies for eye shine and movement. In addition, daytime vertebrate sightings were recorded on field sheets as opportunistic observations during surveys for other taxonomic groups. We have also included observations recorded by a camera trap deployed along the access road in 2021.

#### *Curating the survey data and other observations*

After entering all species data, including those submitted to iNaturalist, we searched our species list for threatened or endangered species. For reporting purposes and to facilitate cross-checking, we organised the data by major groups of organisms, namely plants, fungi, invertebrates, and vertebrates, and comment on observations of interest in this article.

During our preliminary online search for observations in the area, we found that the remnant patch (including the Mabi patch in the neighboring property across Thomas Road) has

many mammal, reptile and amphibian sightings and has been a local hotspot for birding, with numerous observations uploaded into eBird (Sullivan *et al.* 2009) and registered on the Atlas of Living Australia (Belbin *et al.* 2021). In addition, students and researchers from the School for Field Studies visited that remnant patch in March 2022 to conduct three days of pre-dawn bird surveys (0430 – 0630 hrs). For thoroughness, we collated these data and report on these complementary animal observations.

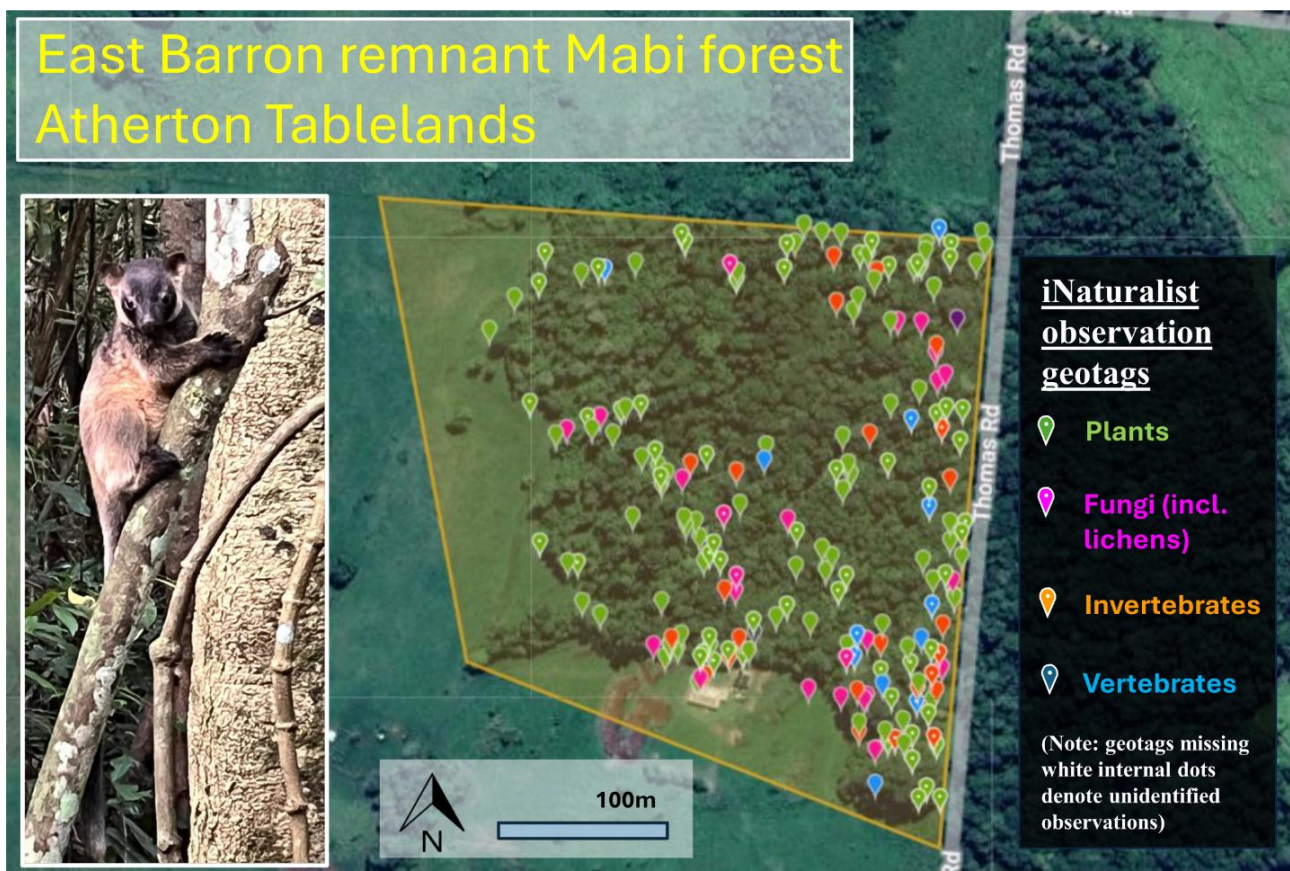
All biodiversity observations are tabulated in the Supplementary file, including those uploaded to iNaturalist which include the URLs to digitally curated observations (Tables S1-S5). The nomenclature for bryophytes in this paper follows Renner *et al.* (2024) for hornworts and liverworts, and Cairns *et al.* (2019) for mosses. Nomenclature for vascular plants, fungi, protozoa, and animals (except birds) follow that of iNaturalist; for bird nomenclature we followed BirdLife Australia (2022).

## Results

During the survey we recorded 811 observations on iNaturalist (Fig. 3) and compiled an additional list of mammal and bird observations comprising a total of 604 unique organisms (including all organisms regardless of identification status) (Table 1).

### Plant diversity

We documented a total of 167 vascular plant species and 33 non-vascular plant species (bryophytes). Among the vascular plants, trees were the most species-rich lifeform group (70 spp.), followed by vines (47), shrubs (25), herbs (15) and epiphytes (10). Some of the most frequently encountered trees were the Shiny Stinging Tree (*Dendrocnide photinophylla*), Black Bean (*Castanospermum australe*), Red Tulip Oak (*Argyrodendron peralatum*), Hairy Leaved Bollygum (*Neolitsea dealbata*), and *Wilkiea longipes*.



**Figure 3. Map of geotagged observations submitted by the research team and digitally curated in iNaturalist.** The inset on the left depicts an observation of the Lumholtz's Tree Kangaroo (*Dendrolagus lumhotzii*), the namesake mammal of Mabi forests. The URLs of digitally curated observations (with photographs on iNaturalist) are listed in Appendix Tables A1-A5. Inset photograph by Alice Cairns.

**Table 1. Breakdown of the number of unique taxa and families recorded across all major taxonomic groups at the Mabi forest remnant in East Barron, Queensland.** This table includes data from the Atlas of Living Australia and other sources.

Taxonomic groups	# Unique taxa	# Families distinguishable	# Genera distinguishable	# Species distinguishable	# only identified to genus level or higher
<b>PLANTS</b>	<b>200</b>	<b>84</b>	<b>167</b>	<b>190</b>	<b>10</b>
Non-vascular plants (bryophytes)	33	21	26	25	8
Pteridophytes	15	7	13	14	1
Angiosperms	152	56	128	151	1
<b>PROTISTS</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>
<b>PROTOZOA</b>	<b>4</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>1</b>
<b>FUNGI</b>	<b>66</b>	<b>22</b>	<b>29</b>	<b>21</b>	<b>45</b>
Macrofungi	44	18	24	19	25
Lichens	22	4	5	2	20
<b>INVERTEBRATES</b>	<b>192</b>	<b>65</b>	<b>118</b>	<b>100</b>	<b>92</b>
Gastropods (Gastropoda)	7	3	5	5	2
Arachnids (Arachnida)	7	6	5	3	4
Insects (Insecta):	174	55	108	92	82
Lepidoptera	78	20	61	58	20
Hymenoptera	18	4	9	3	15
Coleoptera	25	9	14	14	11
Dung beetles	9	1	5	9	0
Other Insect orders	53	21	24	17	36
Other invertebrates	4	1	0	0	4
<b>VERTEBRATES</b>	<b>141</b>	<b>67</b>	<b>116</b>	<b>141</b>	<b>0</b>
Amphibians	1	1	1	1	0
Reptiles	9	4	9	9	0
Birds	123	55	99	123	0
Mammals	8	7	7	8	0
<b>GRAND TOTAL</b>	<b>604</b>	<b>240</b>	<b>422</b>	<b>455</b>	<b>149</b>

Among the native groundcover species, the Dwarf Sickie Fern (*Pallaea nana*) and Wandering Jew (*Pollia crispata*) were the most common. Shrubs were conspicuous in the understorey, including Turkey Bush (*Eumachia frutescens*) and the Dwarf Phaleria (*Phaleria octandra*). Native vines encountered included the Millaa Millaa Vine (*Elaeagnus triflora*), cockspur thorn (*Maclura*

*cochinchinesis*), Northern Derris (*Derris* sp. Claudie River), and native pepper vines (*Piper* spp.). Various epiphytic ferns were also recorded such as the Bird's Nest Fern (*Asplenium australasicum*), Staghorn fern (*Platynerium superbum*) and rock felt fern (*Pyrrosia rupestre*). Four species of orchids including the Pencil Orchid (*Dendrobium teretifolia*) were observed.

Fourteen plant species recorded were of conservation significance (Table S1). These included various epiphytic ferns (e.g. *Antrophyum callifolium*, *Goniophlebium subauriculatum*, and *Crepidomanes* spp; Fig. 4A-C respectively). The Atherton Sauropus (*Breynia macranthus*) (Fig. 4D) and (F) *Phyllanthera grayi* (Apocynaceae), considered Vulnerable, were frequently observed throughout the patch, as was the Endangered Iron Malletwood (*Rhodamnia sessiliflora*, Myrtaceae). Notably, we also encountered specimens of the Critically Endangered vine *Gymnema stramineum* (Apocynaceae) (Fig. 4E).

Non-vascular plant species included 12 liverworts and 21 mosses, which were found primarily on rocks (Fig. 4G), at the base of tree trunks (Fig. 4H), on fallen branches and on rotting logs.

Fourteen species (9.2% of total) of the vascular plants are non-native or naturalised (Table S1), including shrubs such as Lantana (*Lantana camara*) and Cassia (e.g. *Senna* spp.) and prominent vines such as Turbina (*Turbina corymbosa*).

#### Protists, protozoans, and fungi

The Kingdom Protista was represented by two slime moulds from the genus *Acryria* (Fig. 5A) and the Kingdom Protozoa by one unidentified species of testate amoeba. The fruiting bodies of macrofungi were conspicuous during the sampling period, with a broad range of functional types including insect-infecting (entomopathogenic) fungi (Fig. 5B), wood-inhabiting saprophytes (Fig. 5C-D), ectomycorrhizal mushrooms (Fig. 5E), and a range of foliose (Fig. 5F), fruticose and crustose lichens (Table S2).

#### Invertebrate and vertebrate fauna

Among the fauna, invertebrates represented the second most species-rich set of observations (Table S3). Gastropods made up 3.7% of the recorded fauna (Fig. 6A). Spiders (3.7% of the fauna) were the primary type of arachnids documented; we recorded members of the families Araneidae (orb-weaving spiders), Theridiidae (tangle-web spiders) (Fig. 6B), Salticidae (jumping spiders), Sparassidae (hunter spiders) and a member of the superfamily Lycosoidea (wolf spiders). Butterflies and moths (Lepidoptera) were the invertebrate group with the highest percentage of unique taxa (23.4% of animal spp.), followed by other insects (15.9%), and beetles (Coleoptera: 7.5%).

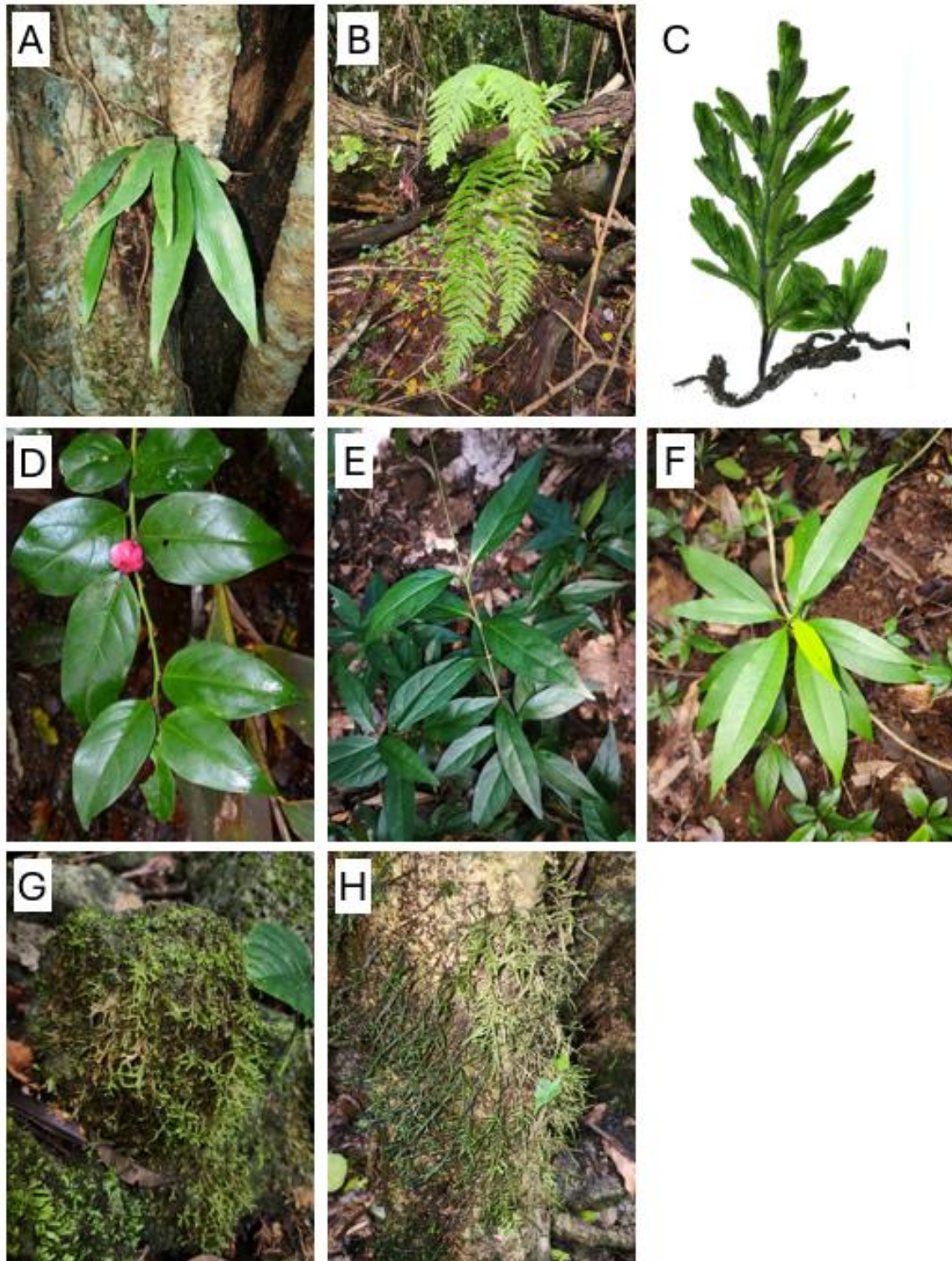
We found a relatively high diversity of dung beetles for the survey effort (15 traps over 3 days). We recorded a total of 145 dung beetles from nine species and five genera representing both rolling and tunnelling nesting strategies. The most abundant species recorded was *Onthophagus waminda* (n = 62; Fig. 6F), a diurnal, small-bodied, closed forest, tunnelling species endemic to the Wet Tropics. The dung beetles recorded represented a range of body sizes, endemism and diel activities. Out of the nine species recorded, four are endemic to the Wet Tropics (Matthews 1972, 1974; Table 2).

Most of the Lepidoptera observed were moths (73 spp.). Other insects recorded included members of the orders Trichoptera (caddisflies), Orthoptera (grasshoppers and crickets), and Phasmatodea (stick insects).

Among the reptiles, we observed the shed skin of one Brown Tree Snake (*Boiga irregularis*) and two lizards, the Yellow-Blotched Forest Skink (*Concinnia tigrina*) and the Boyd's Forest Dragon (*Lophosaurus boydii*). Additionally, the Atlas of Living Australia registered observations of the Yellow-faced Whip Snake (*Demansia psammophis*) and five other lizard species in the patch (Table S3). The naturalised Cane Toad (*Rhinella marina*) was the only amphibian species we sighted, no other amphibian species are registered in the Atlas of Living Australia.

Birds were the most species-rich vertebrate group, with 55 species recorded (31 families and 52 genera). However, the Atlas of Living Australia lists 1,271 observations belonging to 119 species (80 genera and 52 families, Table S4) for the patch, which includes all the species we observed during our survey. Using the classification scheme of avian habitat requirement by Kanowski *et al.* (2010), 30 (25%) of the documented bird species can be classified as rainforest species. One recorded species, the Masked Owl (*Tyto novaehollandiae*), is listed as Vulnerable in Queensland. The Common Myna (*Acridotheres tristis*) and Helmeted Guineafowl (*Numida meleagris*) were the only non-native birds recorded.

The next largest group of vertebrates recorded were mammals (8 species), which were mostly represented by marsupials (6 species). Among these, we recorded the Lumholtz's Tree Kangaroo (*Dendrolagus lumholtzi*) (Fig. 3) and the Green Ringtail Possum (*Pseudocheirops archeri*), both of



**Figure 4. A selection of vascular plant species of special conservation interest and non-vascular species observed during the survey at the Mabi forest patch in East Barron, Queensland.** These include ferns classified as being of Special Least Concern status such as the Ox-tongue Fern (*Antrophyum callifolium*, Pteridaceae) (A), the Caterpillar Fern (*Goniophlebium subauriculatum*, Polypodiaceae) (B) and the filmy fern (*Crepidomanes humile*, Hymenophyllaceae) (C); and threatened vascular plants including the Atherton Sauropus (*Breynea macrantha*, Phyllanthaceae) (D) [Vulnerable]; the vines *Gymnema stramineum* (Apocynaceae) [Critically Endangered] (E) and *Phyllanthera grayi* (Apocynaceae) [Vulnerable] (F); and bryophytes *Spruceanthus thozeanus* (Lejeuneaceae) (G) and *Calyptothecium urvilleanum* (Pterobryaceae) (H). Photos: David Tng.

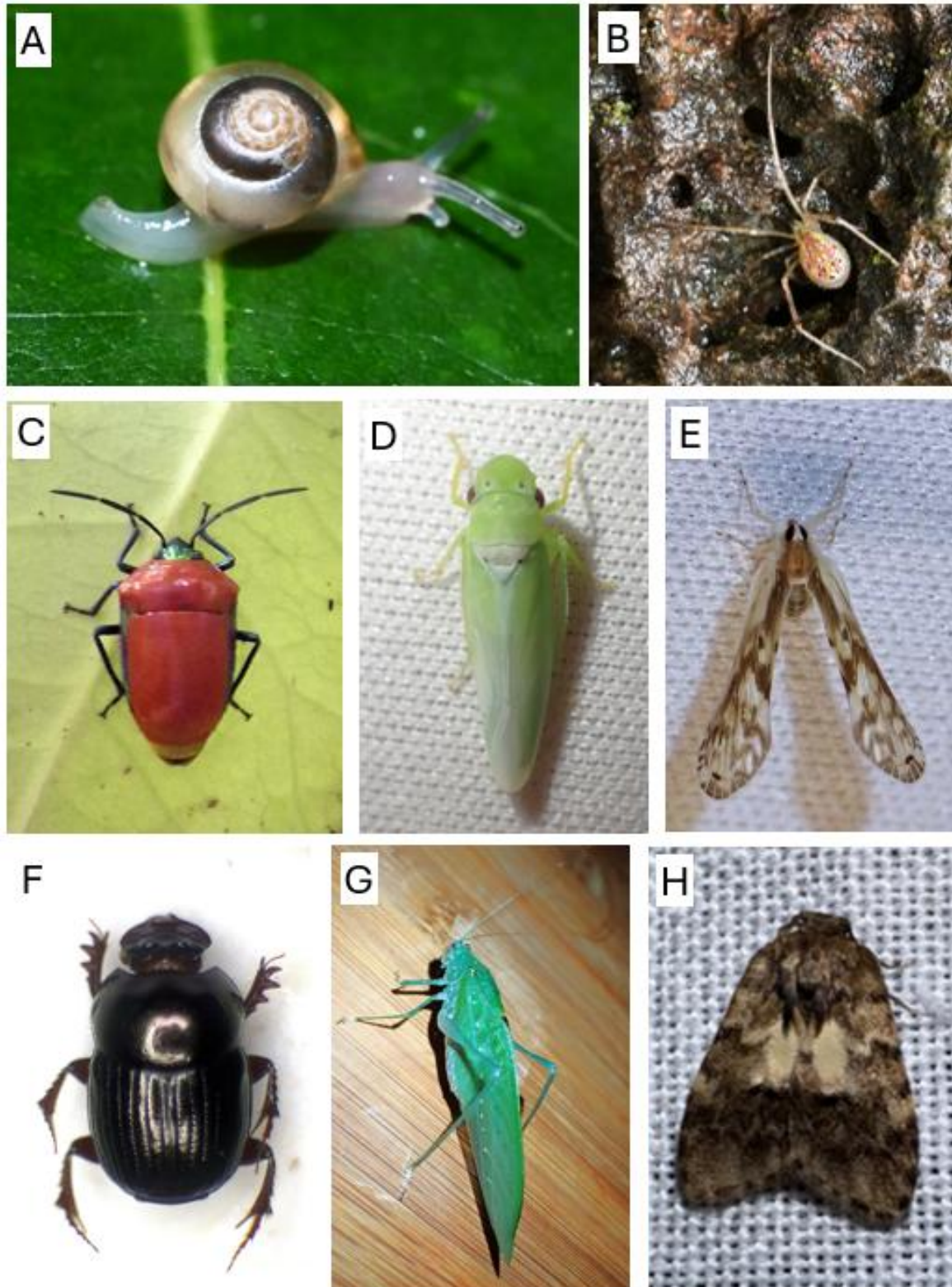


**Figure 5. Selection of protozoan and fungal species observed during the survey at the Mabi forest patch in East Barron, Queensland.** Multicellular protozoa such as White Carnival Candy Slime Mould (*Acryria cinerea*, Acryriaceae) (A), and various fungi including wood saprophytes such as Cramp Balls (*Annulohypoxylon* sp., Xylariaceae) (B), the insect-infecting *Ophiocordyceps dipterigena* (Ophiocordycipitaceae) (C), and *Phillipsia subpurpurea* (Sarcoscyphaceae) (D), an ectomycorrhizal toadstool fungus *Russula clelandii* (Russulaceae) (E) and a foliose lichen Blue Jellyskin (*Leptogium cyanescens*, Collemataceae) (F). Photos: A, B, C, F by David Tng; D and E by Dominika Zdziebko.

which are listed as Near Threatened in the Wet Tropics by the International Union for Conservation of Nature, the latter is also listed as Least Concern under the *Queensland Nature Conservation Act 1992*. Trail camera footage from 2021 also captured Dingoes (*Canis dingo*) and Feral Cats (*Felis catus*) (Table S5).

## Discussion

Despite an extensive history of recording flora and fauna in the domain of Mabi forest, published checklists for specific localities are rare. For example, although in 2006, R. Jensen and S. McKenna (unpublished data) conducted flora surveys of over



**Figure 6.** A selection of arthropods observed during the survey at the Mabi forest patch in East Barron, Queensland. These include: gastropods (A) Pampin's Beehive Snail (*Coneuplecta pampini*, Euconulidae); arachnids (B) Black-spotted Thwaitesia (*Thwaitesia nigronodosa*, Theridiidae); and various insects including (C) the jewel bug *Calliphara imperialis* (Scutelleridae), (D) a leafhopper *Conoquinula coeruleopennis* (Cicadellidae); (E) a planthopper from the subfamily Otiocerinae (Derbidae); (F) a dung beetle *Onthophagus waminda* (Scarabidae); (G) a katydid *Caedicia webberi* (Tettigoniidae); and (H) an unidentified moth *Scaphidriotis* sp. (Erebidae). Photos: A & B by David Tng; C, D, E & G by Camryn Zoeller, F by Mia Derhé.

**Table 2. Abundance of dung beetle species recorded at the Mabi forest patch, East Barron, Queensland.** Nesting strategies, habitat preference, diel activity, endemism and mean body size, along with the reference from which this information was determined is indicated. Diel activity was determined from observations conducted by M.D. and G. Monteith (pers comm), Queensland Museum.

Species	Abundance	Nesting strategy	Habitat preference	Diel activity	Endemism	Mean body size (mm)	Reference
<i>Onthophagus waminda</i>	62	Tunnellers	Closed forest	Diurnal	Wet Tropics	4	Matthews 1972
<i>Amphistomus complanatus</i>	41	Rollers	Closed forest	Nocturnal	Wet Tropics	6.75	Matthews 1974
<i>Boletoscapter cornutus</i>	19	Rollers	Closed forest	Nocturnal	North Queensland	7	Matthews 1974
<i>Onthophagus thoreyi</i>	12	Tunnellers	Open forest & pastures	Unknown	Queensland	9.5	Matthews 1972
<i>Monoplistes curvipes</i>	3	Rollers	Closed forest	Nocturnal	Wet Tropics	6	Matthews 1974
<i>Onthophagus rubicundulus</i>	3	Tunnellers	Closed forest	Diurnal	Eastern Australia	3.75	Matthews 1972
<i>Onthophagus yungaburra</i>	3	Tunnellers	Closed forest	Unknown	Wet Tropics	4.5	Matthews 1972
<i>Lepanus globulus</i>	1	Rollers	Closed forest	Unknown	Far North Queensland	4.4	Matthews 1974
<i>Onthophagus mulgravei</i>	1	Tunnellers	Closed forest	Nocturnal	Far North Queensland	5.5	Matthews 1972

40 Mabi patches, these data are not widely available. Our biodiversity survey of a remnant Mabi forest patch has contributed a substantial number of observations to iNaturalist (and by extension to the Atlas of Living Australia), which we hope will serve as a baseline for future Mabi forest surveys and to monitor biodiversity at the survey site.

A few limitations of the study need addressing. Firstly, even though the survey was thorough, due to the rocky substrate, and the density and type of understorey vegetation it was not feasible to traverse or sample the entire forest patch in a grid-like fashion; this limited the survey methodology and data collection. Secondly, while we attempted to survey broadly across plant and animal groups, plants, moths, dung beetles and birds were ultimately the most thoroughly surveyed as there was expertise among the research team in these groups. Thirdly, the field survey only accounted for observations in one wet season, and thus only captures a snapshot of the biodiversity present.

Finally, the surveyed Mabi forest patch should probably be considered as part of a larger patch (slightly >16 ha) together with the patch across the road, unfortunately we did not have consent to conduct any surveys at that patch.

Since plants were the most extensively surveyed group, most inferences can be made from these observations. The presence of many late successional species such as *Argyrodendron* spp. and large fig trees attest to the mature-phase status of the remnant patch, although Red Cedar (*Toona ciliata*) trees had previously been extracted from the site. The diverse mix of species and the presence of reproductively mature fleshy fruited trees such as *Ficus* (9 spp.), *Dendrocnide* spp., members of the laurel family (Lauraceae; 7 spp.), lychee family (Sapindaceae; 6 spp) and mahogany family (Meliaceae; 7 spp.) are a positive indicator that the forest patch includes food resources for rainforest animals, which coincides with the large number of bird species documented.

Although vascular plants are well documented throughout the region, the only records we found for the study site from the Australian Virtual Herbarium website (AVH 2025) included nine species, all of which were recorded during our survey. Interestingly, the Mabi forest patch across Thomas Road contains more substantial flora records, represented by collections made by CSIRO almost two decades ago. However, the number of vascular plant species recorded during our survey has surpassed those from across the road.

The presence of 14 vascular plant species of conservation significance highlights the importance of stewardship of Mabi forest patches under private property. In addition to the presence of species of conservation significance, there is high aesthetic value of some trees in the survey site. For example, there is a magnificent and enormous specimen of a strangling deciduous fig (*Ficus henneana*, Fig. 2A and Fig. 2B) which is arguably equivalent in stature and age to the iconic Cathedral Fig tree near the top of the Gillies Highway.

In terms of non-vascular plants, we did not find any previous records, therefore our survey has added a substantial number of gap-filling observations. Seven of the non-vascular plants collected could not be identified to species due to the lack of taxonomic expertise, however these observations still represent a step towards filling species occurrence gaps for bryophytes in the region. Some of these species, such as *Ectropothecium* sp., are poorly studied in the region (Cairns *et al.* 2019), and species distribution data for many bryophytes are still inadequate and their conservation statuses remain to be determined. Interestingly, we found less than half the number of bryophyte species in the current survey than at another remnant Mabi forest patch on Halloran's Hill (~ 5 km due west) (Tng *et al.* 2025); this could be due to differences in environmental factors (e.g. lower rockiness, greater slope and presence of creeks) at the Halloran's Hill patch.

There is considerable variation in the size and shape of Mabi forest patches and it is acknowledged that smaller patches are more susceptible to edge effects, namely weed invasion, climate extremes, and human impacts (DCCEEW 2023). The Department of Climate Change, Energy, the Environment and Water of the Australian Government published the Approved Conservation

Advice for Mabi Forest in 2023 (DCCEEW 2023), acknowledging that connected Mabi patches offer greater resilience to edge effects. The value of linkages between Mabi patches has long been recognised and collaborations between community-driven projects and non-profit organisations are common (for example, Terrain NRM and TREAT—Trees for the Evelyn and Atherton Tablelands; TKMG 2025). However, maintaining the integrity and health of pre-existing patches of remnant vegetation is also important as even small patches are valuable for conservation (Fischer & Lindenmayer 2002) as shown in this survey. And although large patches are required by many species to sustain viable populations, small remnants play an important role in conserving local biodiversity and in many landscapes, their conservation and restoration may represent the only practical management option (Fischer & Lindenmayer 2002).

As small rainforest patches are susceptible to edge effects and weed incursion (Waddell *et al.* 2020) the abundance of some non-native plant species in our study site is noteworthy and of concern. The non-native plants on the edges of the surveyed site included species such as *Asparagus setaceus* (Asparagaceae), *Cestrum nocturnum* (Solanaceae), Turbina (*Turbina corymbosa*, Convolvulaceae) and Climbing Nightshade (*Solanum seaforthianum*, Solanaceae). In particular, Turbina, a tropical South American vine, is recognised as an invasive plant on rainforest edges (Zich *et al.* 2020) where it smothers native trees and displaces native vines and shrubs (Department of Agriculture and Fisheries 2024). In our study site Turbina appeared to be abundant as established adults in some spots, and its seedlings were observed throughout the forest patch. The Barron Catchment Care 'Forest Resilience Project' has identified the entire Thomas Road Mabi forest as one of five remnant forest patches across the Atherton Tablelands (comprising 70 hectares) aiming to eradicate Turbina vine (personal comment B. Barnett 2025). However, it seems unlikely that seedlings of this species can be completely eradicated from the patch, thus we recommend that management actions should be targeted at the larger individuals that can easily be cut and poisoned. Such interventions may be beneficial for weed control and the long-term ecological integrity of the site.

While most biodiversity studies target vascular plants and to a lesser extent bryophytes, there has been a paucity of studies on fungi and lichens. It was fortuitous that we were able to conduct our survey during a wet period when fungal fruiting bodies were conspicuous and abundant. Although most of these records were only identified to high level taxonomic entities, these data on fungi occurrences are significant considering that we could only find one previous fungus record for the site (*Macroporus xanthopus*). The presence of a wide range of fungi functional groups such as entomopathogenic fungi, wood saprophytes and ectomycorrhizal species also attest to the ecosystem health of the site (Lodge & Cantrell 1995; Hyde *et al.* 2005). It would be worth conducting surveys over multiple years to explore temporal variations in the fungal community. Lichens were particularly conspicuous and would be possible to sample even in the dry season, however significant challenges due to lack of expertise in identifying these taxa need to be addressed.

Globally insects are the most species-rich group of organisms (Wiens 2023), thus it is not surprising that invertebrates were the second most diverse group recorded in our study. Despite our efforts to sample invertebrates broadly across different microhabitats (leaf litter and foliage), and behavioral patterns (nocturnal, diurnal, etc.), we acknowledge that our invertebrate records, represent just a snapshot of the diversity of this group at the site. For example, we found almost 70 species of moths over nine hours of light sheeting, and although this group of organisms was the most species rich of the invertebrates we surveyed, a much larger number of moth species might be recorded if continuous observations are made over a prolonged time (Orr & Kitching 2003). For example, Tng *et al.* (2021) noted over 1,000 distinct moth taxa over two years at a single spot at a forest edge at Dunbulla, just 13 km northeast of the study site.

Despite limited sampling effort, we recorded relatively high species numbers and functional richness of dung beetles at the study site. Given that closely related species or those with similar traits often respond similarly to environmental change (Turvey & Fritz 2011), examining species traits and the identity of functional groups present is critical. Traits such as diel activity, body size, and

nesting strategy influence dung beetles' sensitivity to habitat disturbance. For example, species that are nocturnal, small-bodied, and use rolling nesting strategies are particularly vulnerable to forest modification (Nichols *et al.* 2013). In our study, the second most abundant beetle species was a nocturnal tunneller restricted to closed forests in the Wet Tropics; this highlights the site's potential role as a refugium for sensitive and range-restricted functional groups and the importance of forest patches. Additionally, the presence of a broad array of functional groups across nesting strategies, body sizes, and activity periods suggests high functional richness at the site—an attribute known to enhance ecosystem resilience and stability (Derhé *et al.* 2016; Schmitt *et al.* 2020).

The lack of expertise was a limiting factor in identifying and surveying invertebrate species. Most of the invertebrates we collected, other than some moths and dung beetles, were identified to Order or Family levels. Other invertebrate groups, for example, butterflies, were likely under-sampled, given the difficulty of recording butterflies from the forest canopy and considering that the forest patch is home to many butterfly food plants (Sankowsky 2020). Other groups such as the Blattoidea (cockroaches) and Orthoptera (grasshoppers, katydids, and crickets) are known to be highly diverse in rainforests of the Wet Tropics region (Rentz 2014; Rentz & Su 2019) and are probably under-represented in our survey.

The bird fauna at the study site has been well surveyed, particularly when considering that there were over 1,200 observations listed in the Atlas of Living Australia, besides those from our current and 2022 field surveys. This relatively high number is impressive yet not surprising given the popularity of birding in the region, the accessibility of the site, and its proximity to Curtain Fig National Park (~ 195 ha of Mabi forest). The presence of many rainforest dependent bird species at the study site testifies to the significance of forest patches as good bird habitat and highlights their important role in conserving and protecting biodiversity (Fischer & Lindenmayer 2002; Freeman *et al.* 2009).

Long-term records of Lumholtz's Tree-kangaroo dating back to the early 1900s (personal communication A. Gillanders 2022), together with observations from this survey and recent records of Green Ringtail Possum, indicate that the East Barron forest patch—including the Mabi forest

east of Thomas Road—provides important habitat for these iconic species.

Revegetating a corridor between this patch and the Curtain Fig National Park could improve forest connectivity and aid movement of rainforest species between these rainforest patches (Bennett *et al.* 2022; Heise-Pavlov & Tng 2023).

While the Atlas of Living Australia provides a useful starting point for landowners interested in knowing the biodiversity on their properties, the gaps in occurrence data for most groups of organisms are substantial. We envision that our survey will provide additional baseline data for ecological monitoring of the site and will also stimulate interest in similar surveys of other Mabi forest patches (and other forest types). There is great scope for organising public and community-based activities such as BioBlitz events (e.g. Heiser *et al.* 2025) in the Atherton Tablelands and other areas in Wet Tropics to help filling knowledge gaps in species occurrence data.

## Acknowledgements

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## Supplementary file

A supplementary Excel file accompanies this paper on its web-page. It contains six worksheets:

- Figure S1: Proximity of the site to nearby features and forest patches;
- Table S1: Plants documented;
- Table S2: Protozoa and fungi documented;
- Table S3: Invertebrates documented;
- Table S4: Bird observations; and
- Table S5: Non-flying vertebrate observations.

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