

Re-enchanting Victorians with Mt Piper's butterflies 13 May 2021

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1. Background

The Butterfly Community No. 1 is a threatened flora and fauna community listed in the State of Victoria Flora and Fauna Guarantee Act 1988. The community is characterised by the unique co-occurrence of two rare Lycaenidae butterflies: the large ant-blue *Acrodipsas brisbanensis cyrilus* (Figure 1a) and the small ant-blue *Acrodipsas myrmecophila* (Figure 1b). These species are also listed as threatened in the Flora and Fauna Guarantee Act 1988 and listed as Endangered and Critically Endangered respectively on the 'Advisory list of threatened invertebrate fauna in Victoria 2009'.

The Mount Piper Nature Conservation Reserve (Broadford, Victoria) is the only known location of this community in Australia. As much as 41 butterfly species have been recorded at Mt Piper and the reserve also supports the golden sun-moth *Synemon plana*, a threatened diurnal moth listed under the Australian Government Environment Protection and Biodiversity Conservation Act 1999.

The overarching aim of this study is to raise awareness of the ecological and conservation significance of Mt Piper's Butterfly Community No. 1. We are driven by the conviction that re-enchanting Victorians with Mt Piper's butterflies is a key step to protect the biodiversity values of Mt Piper – not only its butterflies and moth species but also the intricate ecological interactions they form with host plants and mutualistic ants – and guarantee that the strategies and conservation measures that have been put in place to protect the Butterfly Community No. 1. continue to be effectively implemented into the future. We begin by providing an updated baseline list of the butterfly species recorded at Mt Piper around the time the Butterfly Community No. 1 was established in 1991 (New 2011). We then summarise post-2010 records, including those derived from recent surveys conducted by the authors in collaboration with members of Mt Piper's local community. Next, we provide guidelines for the establishment of a community science monitoring program for Mt Piper's butterflies and discuss outcomes from a pilot workshop that introduced this program to a first cohort of local community members. We finish by proposing specific pathways to confirm the occurrence of the large ant-blue and small ant-blue at Mt Piper, including suggestions for surveying these species at other locations across Victoria where these butterflies may be present.

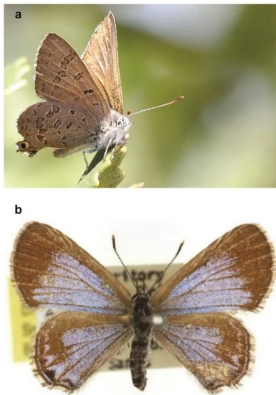


Figure 1. The Butterfly Community No. 1 is characterised by the unique co-occurrence of two rare Lycaenidae butterflies: (a) the large ant-blue *Acrodipsas brisbanensis cyrilus* and (b) the small ant-blue *Acrodipsas myrmecophila*. Photos by Matt Endacott (a) and CSIRO (b).

2. Mt Piper's butterflies

Our synthesis indicates that 41 butterfly species had been recorded at Mt Piper either before or a few years after the establishment of the Butterfly Community No. 1 (Table 1). These species span all butterfly families known to occur in Victoria, namely skippers (Hesperiidae), blues (Lycaenidae), nymphs (Nymphalidae), swallowtails (Papilionidae), and whites (Pieridae). All but one species – the cabbage white *Pieris rapae* (Figure 2f) – are locally indigenous to Victoria. Five species are listed under the State of Victoria Flora and Fauna Guarantee Act: the large ant-blue *Acrodipsas brisbanensis cyrilus* (Figure 1a), the small ant-blue *Acrodipsas myrmecophila* (Figure 1b), the white-spot skipper *Trapezites luteus luteus*, the Icilius blue *Jalmenus icilius*, and the Southern purple azure *Ogyris genoveva*.



Figure 2. Representatives of the nine butterfly species that have been recorded at Mt Piper since 2010: (a) the grass blue *Zizina otis*; (b) the common brown *Heteronympha merope*; (c) the yellow admiral *Vanessa itea*; (d) the Australian painted lady *Vanessa kershawi*; (e) the wood white *Delias aganippe*; and (f) the cabbage white *Pieris rapae*. The other three species were the large ant-blue, the small ant-blue, and the Olane azure *Ogyris olane*. All photos from Mount Piper Nature Conservation Reserve. Photos by Kerry de Gabrielle (c,e) and Luis Mata (a,b,d,f).

Our findings further indicate that only nine butterfly species have been recorded at Mt Piper since 2010. These species include (1) both the large and small ant-blues, which were recorded in 2010 by Dr Ken Walker – Senior Curator of Entomology at Museums Victoria –; and (2) the Olane azure *Ogyris olane*, the grass blue *Zizina otis* (Figure 2a), the common brown *Heteronympha merope* (Figure 2b), the yellow admiral *Vanessa itea* (Figure 2c), the Australian painted lady *Vanessa kershawi* (Figure 2d), the wood white *Delias aganippe* (Figure 2e), and the cabbage white *Pieris rapae* (Figure 2f), which were recorded in November 2020 and March 2021 during surveys organised as part of the present work.

3. Community science monitoring program for Mt Piper's butterflies

We believe that raising awareness of the ecological and conservation significance of Mt Piper's butterflies will hinge in making their beauty, diversity, life histories, and associations with lichens, plants, and other insects tangible to people, particularly members of the local Mt Piper community. We therefore propose a community science monitoring program for Mt Piper's butterflies based on the following guidelines:

Use of iNaturalist for data collection

iNaturalist (www.inaturalist.org) is a global social network of naturalists aimed at recording and sharing biodiversity observations. It is arguably the most popular biodiversity community science platform in the world. As of today, approximately 63 million observations have been contributed by over 1.5 million users. Australia is the top contributing nation in the southern hemisphere and amongst the top four contributing nations globally (Mesaglio and Callaghan 2021).

For this study we created a dedicated iNaturalist project entitled Mt Piper Butterfly Community No. 1 (www.inaturalist.org/projects/mt-piper-butterfly-community-no-1). All butterfly records collected during the November 2020 and March 2021 surveys have been submitted to this group. The project currently comprises 21 observations and documents the occurrence of all nine butterfly species that have been recorded in Mt Piper since 2010.

Importantly, these and future observations contributed to the Mt Piper iNaturalist project will be up taken by the Atlas of Living Australia and those achieving 'Research Grade' level – according to the platform's 'Community Taxon' approach – will also flow into the Global Biodiversity Information Facility.

Seasonal workshops

We suggest that a series of four or more seasonal workshops could be conducted across the year to bring the local community together with the purpose of sparking, renewing, or stimulating further interest in the ecological and conservation importance of Mt Piper's Butterfly Community No. 1, and to provide pathways and tools for the community to be actively involved in monitoring Mt Piper's butterflies on an ongoing basis. We propose that these workshops should be structured around the following four parts: (1) Background, in which a summary of Mt Piper's ecological and conservation significance is presented to participants, as well as a brief introduction to its butterfly community, including its FFG Act and EPBC listed species; (2) Species Identification, in which participants are trained to identify common and easily identifiable butterfly species that are known to occur at Mt Piper; (3) Survey Protocol, in which the survey protocol and guidelines (described in next section) are clearly outlined to participants; and (4) Testing ID Skills, in which participants are offered a visual questionnaire of nine butterfly photos to reinforce their butterfly identification skills.

Survey protocol

Our proposed survey protocol has been inspired by the Pollinator Observatories approach described by Mata and colleagues (2020). During a given survey session, for example, while walking to and back from Mt. Piper's summit, participating community surveyors would repeat the following steps as many times as possible during the time they have allocated to conduct the survey session: (1) locate a plant species or patch to be surveyed; (2) have the iNaturalist app ready to use, that is, the 'Observe' and 'Camera' icons have been clicked, enabling the device's photo app to be ready to capture images; and (3) conduct a timed survey subscribing to the following time by plant volume guidelines: $< 1 \text{ m}^3 = 3 \text{ min}$ | $1 \text{ m}^3 = 5 \text{ min}$ | $2 \text{ m}^3 = 10 \text{ min}$ | $> 3 \text{ m}^3 =$

15 min. We suggest that participants curate their observations (i.e. add taxa IDs, comments, and annotations) only after they have completed the full survey session.

4. Pilot workshop

We conducted a pilot workshop on March 28, 2021 at the Broadford Community Hall (Broadford, Shire of Mitchell, Victoria). The workshop was attended by 29 participants. While most participants were members of the local community – including members of BEAM Mitchell Environment Group and Friends of Mt Piper, and local landowners – the workshop was also attended by representatives of state (e.g. Parks Victoria) and local (e.g. Hume City Council) government. Most interestingly, a few participants came from areas outside of Mitchell (e.g. Frankston).

The workshop began with a one-hour presentation entitled ‘Re-enchanting Victorians with Mt Piper’s butterflies’, which was structured around the parts described above. First, we stated the main objective of our project; that is, to raise awareness of the ecological and conservation significance of Mt Piper’s Butterfly Community No. 1. In this background section, we also (1) briefly introduced the 41 species that have been recorded at Mt Piper prior to 2010, (2) provided an overview of the five butterfly families that these belong to, (3) discussed the conservation significance of the large ant-blue and small ant-blue, and (4) presented the species that were recorded in the November 2010 surveys. Next, we conducted a training session aimed at developing participants’ skills in identifying the most common and easily identifiable butterfly species known to occur at Mt Piper. These included the Dingy swallowtail *Papilio anactus* (Figure 3), the Australian painted lady *Vanessa kershawi* (Figure 2d), the Yellow admiral *Vanessa itea* (Figure 2c), the Meadow argus *Junonia villida*, the female of the Common brown *Heteronympha merope* (Figure 2b), the Lesser wanderer *Danaus petilia*, the Cabbage white *Pieris rapae* (Figure 2f), blues (family *Lycaneidae*; Figure 1), and skippers (family *Hesperiidae*). Each species was

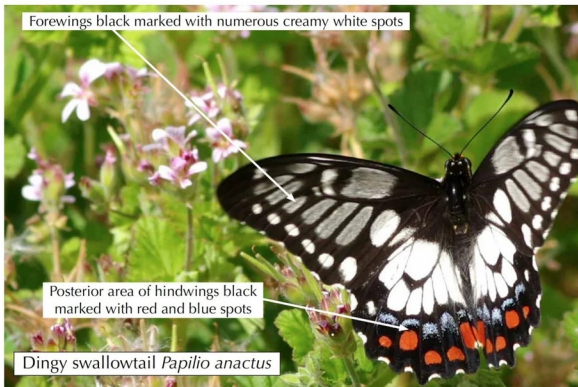


Figure 3. Example of the pilot workshop’s identification training slides, in which we used visual cues to emphasise particular butterfly morphological traits. This particular slide was the one for the dingy swallowtail *Papilio anactus*. Photo by Luis Mata.

represented on a separate slide, in which we used visual cues to emphasise particular morphological traits (e.g. the colouration and location of wing spots; Figure 3). We then described the survey protocol, including a brief introduction on how to make observations with iNaturalist. We further provided participants with the three following general guidelines: (1) "Avoid disturbing the targeted plant(s) while getting ready to conduct the survey"; (2) "Try your best to be quite and mindful while conducting the timed surveys as this will greatly increase your chances of spotting butterflies"; and (3) "Try to take photos from multiple angles of each observed butterfly species before sharing". Lastly, we showed nine unlabelled photos and prompted participants to suggest potential family, genus, or species identification. This testing component included issues with butterfly identification – and options to address them – that were not fully covered in the preceding training session. For example, what to do when a butterfly has its wings folded and one can only see the wings' underside (solution: wait for it to unfold its wings and show the wings' topside).

After the presentation we reconvened at the base of Mt Piper for a one-hour survey session. One group conducted surveys along the south-east side of the mountain, while a second group conducted surveys while walking to and back from the mountain's summit. This latter group also conducted a general survey while resting at the summit. Overall, these surveys yielded 14 iNaturalist observations of five butterfly species: the Olane azure *Ogyris olane*, the grass blue *Zizina otis* (Figure 2a), the common brown *Heteronympha merope* (Figure 2b), the yellow admiral *Vanessa itea* (Figure 2c), and the wood white *Delias aganippe* (Figure 2e). The observations were contributed by eight observers, including both co-authors.

5. Future surveys for the large ant-blue and small ant-blue

We argue that confirming the occurrence of the large ant-blue and small ant-blue at Mt Piper – and, in the case of the large ant-blue, at other locations across Victoria – would be critical to guarantee the ongoing protection of these unique, threatened Lycaenidae butterflies. The distribution of the large ant-blue is restricted to Victoria and limited to Mt Piper and a few other hill-topping sites across the state (Britton et al. 1995, New 2011). Very little is known about the ecology and life history of the large ant-blue, with the species apparent myrmecophagy inferred by a single oviposition record on a nest of the *Papyrius* sp. *nitidus* group complex (Britton et al. 1995). These same authors report the sighting of hill-topping male large ant-blues between December and March around the highest gum trees on Mt Piper summit. The distribution of the small ant-blue in Victoria is restricted to Mt Piper, with the only other two historically documented populations (Ringwood and Ocean Grove) now extinct (New 2011). The small ant-blue is a myrmecophagous species, with larvae developing within the ant nests of coconuts ants in the *Papyrius* sp. *nitidus* group complex (New and Britton 1997). New and Britton (1997) provide an account of the *Papyrius* sp. *nitidus* group complex's ecology and life history, including how the ants (1) occur predominantly in open forest; (2) forage for the honeydew secreted by hemipteran bugs on gum trees and wattles; (3) build their nest in the ground but also in dead wood on and near the surface, usually in close proximity to honeydew sources. The authors also provide insightful information about the life history of the small ant-blue and its close symbiotic association with the *Papyrius* sp. *nitidus* group complex. The small ant-blue is a bivoltine species: adults of the spring generation fly from November to December and those of the summer generation from February to early April. Female butterflies oviposit during these two periods, laying between 14 to 40 eggs in loose groups, mainly on the trunks of gum tree and wattle saplings. Shortly after they hatch the first instar caterpillars enter or are taken into the ants' nest. Caterpillars are found inside the ants' nest all year around and pupation typically occurs from February to March and from October to December.

Based on current ecological understanding of the large ant-blue and small ant-blue, and the *Papyrius* sp. *nitidus* group complex, we suggest the following three approaches to confirm the occurrence of these species at Mt Piper. While we focus our attention on Mt Piper, our suggested approaches may also be applied to investigate the occurrence of the large ant-blue at other hill-topping sites across Victoria where this butterfly may likely also be present.

Table 1. The 41 butterfly species that have been recorded at Mount Piper Nature Conservation Reserve.

Species	Common name	Family	Baseline records	Records since 2010
<i>Dispar compacta</i>	Barred skipper	Hesperiidae	1993	
<i>Hesperilla donnyisa</i>	Varied sedge-skipper	Hesperiidae	1998	
<i>Ocybadistes walkeri</i>	Green grass-dart	Hesperiidae	1993	
<i>Signeta fiammeata</i>	Bright shield-skipper	Hesperiidae	1993	
<i>Taractrocera papyria</i>	White-banded grass-dart	Hesperiidae	1993	
<i>Trapezites luteus luteus</i> *	White-spot skipper	Hesperiidae	1993	
<i>Trapezites phigalia</i>	Heath ochre	Hesperiidae	1998	
<i>Trapezites phigalioides</i>	Montane ochre	Hesperiidae	1993	
<i>Acrodipsas brisbanensis cyrilus</i> *	Large ant-blue	Lycaenidae	1991	2013
<i>Acrodipsas myrmecophila</i> *	Small ant-blue	Lycaenidae	1992	2013
<i>Candalides hyacinthinus</i>	Varied dusky-blue	Lycaenidae	1993	
<i>Hypochrysops delicia</i>	Blue jewel	Lycaenidae	1993	
<i>Jalmenus evagoras</i>	Imperial hairstreak	Lycaenidae	1993	
<i>Jalmenus icilius</i> *	Icilius blue	Lycaenidae	1993	
<i>Lampides boeticus</i>	Pea blue	Lycaenidae	1993	
<i>Lucia limbaria</i>	Small cooper	Lycaenidae	1993	
<i>Nacaduba biocellata</i>	Two-spotted line-blue	Lycaenidae	1993	
<i>Neolucia agricola</i>	Fringed blue	Lycaenidae	1993	
<i>Ogyris abrota</i>	Dark purple azure	Lycaenidae	1993	
<i>Ogyris genoveva</i> *	Southern purple azure	Lycaenidae	1993	
<i>Ogyris olane</i>	Olane azure	Lycaenidae	1993	2021
<i>Theclinesstes miskini</i>	Wattle blue	Lycaenidae	1993	
<i>Theclinesstes serpentatus</i>	Chequered blue	Lycaenidae	1993	
<i>Zizina otis</i>	Grass blue	Lycaenidae	1993	2020-2021
<i>Acraea andromacha</i>	Glasswing	Nymphalidae	1993	
<i>Charaxes sempronius</i>	Tailed emperor	Nymphalidae	1998	
<i>Danaus petilia</i>	Lesser wanderer	Nymphalidae	1993	
<i>Geitoneura klugii</i>	Klug's xenica	Nymphalidae	1993	
<i>Heteronympha merope</i>	Common brown	Nymphalidae	1993	2020-2021
<i>Heteronympha penelope</i>	Shouldered brown	Nymphalidae	1998	
<i>Junonia villida</i>	Meadow argus	Nymphalidae	1993	
<i>Vanessa itea</i>	Yellow admiral	Nymphalidae	1993	2021
<i>Vanessa kershawi</i>	Australian painted lady	Nymphalidae	1993	2020-2021
<i>Papilio anactus</i>	Dingy swallowtail	Papilionidae	1993	
<i>Papilio demoleus</i>	Chequered swallowtail	Papilionidae	1993	
<i>Appias paulina</i>	Yellow albatross	Pieridae	1993	
<i>Belenois java</i>	Caper white	Pieridae	1993	
<i>Delias aganippe</i>	Wood white	Pieridae	1993	2021
<i>Delias harpalyce</i>	Imperial white	Pieridae	1993	
<i>Eurema smilax</i>	Small grass-yellow	Pieridae	1993	
<i>Pieris rapae</i> **	Cabbage white	Pieridae	1993	2020

Notes: * Listed in the FFG Act; ** Nonnative species. Sources: New (2011), Atlas of Living Australia, and this study.

Direct observation

Conduct periodic direct observation surveys for adult large ant-blues and small ant-blues during the times they are known to hill-top at Mt Piper (November to April). These could be conducted by (i) trained entomologist/lepidopterologists, who may confidently identify any potential sightings on the wing, (ii) community scientists, as long as they are capable to photographically document any potential sightings, and posteriorly share photographic records through the Mt Piper Butterfly Community No. 1 iNaturalist group, or (iii) a combination of both.

Ant trap nests

Establish a network of wooden ant trap nests across Mt Piper open forested areas. As described by New and Britton (1997), these trap nests may be rapidly colonised by *Papryrus* sp. *nitidus* group complex and, subsequently, by the small ant-blue. Importantly, the traps may provide surrogate habitat for the ant. Trap nests would need to be first carefully examined externally and then opened for examination with minimal disturbance. The period of opening should not exceed five minutes and only in good weather conditions. Detailed instructions on how to build, deploy, and survey the trap nests are provided in Britton (1997) and New (2011).

Bait traps

Deploy a series of funnel bait traps at Mt Piper summit. This alternative was first proposed by New and Britton (1997), who suggest that the particular anal gland scents secreted by the *Papryrus* sp. *nitidus* group complex may be used as bait to attract adult small ant-blues. This approach could be used synergistically with the direct observation approach proposed above.

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