

Nomination of Mount Canobolas
State Conservation Area
as an
Area of Outstanding Biodiversity Value



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EXECUTIVE SUMMARY

This submission justifies the nomination of the Mount Canobolas State Conservation Area (SCA) as an Area of Outstanding Biodiversity Value (AOBV) under the *NSW Biodiversity Conservation Act 2016* (BC Act).

Mt Canobolas SCA occupies an area of 1672 ha and is located approximately 15 km south west of Orange in the Central West of New South Wales (NSW) (see Map p.6). Mt Canobolas is part of an extinct compound shield volcanic complex of international geological significance that formed over a period of about one million years in the mid to late Miocene epoch 13 to 11 million years ago. It is a prominent ‘landlocked island’ protruding up to half a kilometre above the surrounding plateau of the western Central Tablelands (CT).

This submission provides current knowledge of the unique biodiversity occurring within the Mt Canobolas SCA together with supporting background information on the geographical isolation and geological distinctiveness of Mt Canobolas, along with an overview of climate, soils and history of the park.

The available data on biodiversity overwhelmingly indicates that Mt Canobolas SCA merits recognition as an AOBV. How it meets or exceeds the AOBV criteria set out in the BC Act is summarised below against each of the criteria.

1. State, National and Global Significance

Mt Canobolas is an inselberg supporting relict montane and sub-alpine flora, moss and lichen communities that include many endemic species, and that are compositionally distinct from those in all other high altitude areas of NSW and Australia. Despite a paucity of scientific investigation, Mt Canobolas is known to support within a remarkably small area an array of vascular plants, lichens, insects, a Velvet Worm and a planarian that occur nowhere else in Australia or globally. The number of species recognised as unique to Mt Canobolas is expected to grow considerably with further research. There can be no doubt that Mt Canobolas is a hotspot of endemism within NSW and Australia, of global significance.

2. Significant Contribution to the Persistence of Threatened Species and Ecological Communities

With a known biota in excess of 800 species, the SCA has a rich and unique biodiversity including three threatened ecological communities and 12 threatened species listed under State and/or Commonwealth conservation Acts. One of the threatened ecological communities, the Endangered Mt Canobolas *Xanthoparmelia* Lichen Community is endemic to Mt Canobolas volcanic complex and depends on the SCA for its survival. The threatened species comprise two plants, four

mammals and six birds. One of the threatened plant species, *Prostanthera gilesii* (Giles' Mintbush), is listed as Critically Endangered, occurs only in the SCA and is dependent on the SCA for survival in the wild. The other, *Eucalyptus canobolensis* (Silver-leaf Candlebark), is listed as Vulnerable under the BC Act and Endangered under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The only viable populations of this species occur in the SCA. Another seven species endemic to the SCA would undoubtedly meet the criteria for listing as threatened under the BC Act if they were to be nominated. Accordingly, Mt Canobolas SCA supports a high concentration of unique and threatened biodiversity, such that it merits recognition as an AOBV.

3. Significant Contribution to the Persistence of Irreplaceable Biological Distinctiveness

The biodiversity of the Mt Canobolas SCA is demonstrably distinctive and irreplaceable. Despite limited scientific research, it is clear that the SCA has high levels of endemism, even though few taxonomic groups have been subject to in-depth study. By definition endemic species occur nowhere else and consequently are irreplaceable.

So far, nine taxa comprising four plants, two of which are undescribed, three lichens, a Velvet Worm and an unnamed planarian are recognised as endemic to Mt Canobolas. Further plant species occurring on the mountain are currently under investigation and considered likely to be new endemic species.

The distinctiveness extends to the ecological communities in the SCA, which typically differ in vegetation composition from analogous communities in high altitude areas along the Great Dividing Range (GDR) to the east. The ecological communities on Mt Canobolas are characterised by the presence of *E. canobolensis* (Silver-leaf Candlebark) as a canopy dominant and the absence of other species that typically occur in similar montane or sub-alpine communities on the eastern tablelands, such as *E. radiata* (Narrow-leaved Peppermint) and *E. robertsonii* (Robertson's Peppermint), perhaps reflecting the relictual nature of the SCA vegetation, its more inland location and consequent climatic differences.

The rock plate *Xanthoparmelia* lichen community, which is unique, listed as Endangered (BC Act) and endemic to Mt Canobolas, is also irreplaceable.

4. Significant Contribution to the Persistence of Ecological Processes or Ecological Integrity

Mt Canobolas vegetation has high ecological integrity and resilience. The SCA has recovered to climax condition from a long history of light grazing, and from past wildfires.

The vegetation on Mt Canobolas provides an excellent example of vegetation community adaptation to ecological drivers at the landscape and geographical scales. The montane and sub-alpine communities of Mt Canobolas are at the western extremity of these vegetation types on the NSW CT. The vegetation has responded in several ways to significant differences in climate between Mt Canobolas and the Great Divide to the east. These include the changes in community composition mentioned above, but also climate-driven changes whereby the Tablelands Basalt Endangered Ecological Community occurs at higher altitudes on Mt Canobolas than it does on the eastern tablelands, likely due to climatic differences arising from the more inland location. Mt Canobolas provides extensive opportunities for gaining an understanding of landscape and geographical scale ecological drivers on vegetation communities and biodiversity in general.

5. Significant Contribution to Outstanding Ecological Value for Education or Scientific Research

The importance of Mt Canobolas as a centre of endemism is becoming increasingly evident to the scientific community. Research on various cryptogams, vascular plant taxa and invertebrates in the SCA is being, or has been, undertaken by the Department of Biological Sciences, Macquarie University (bryophytes), Royal Botanic Gardens and Domain Trust, Sydney (*Prostanthera gilesii*), Botany School at the University of New England, Armidale (various flowering plants), Research School of Chemistry, Australian National University (lichens), David Jones (Associate of the Centre for Australian National Biodiversity Research, Canberra) (orchids), National Museum of Victoria (insects), Australian National Insect Collection, Canberra (beetles), The Australian Museum Sydney (insects) and the Biosecurity Collections Unit of NSW DPI in Orange (moths). The SCA provides abundant opportunities for further taxonomic research.

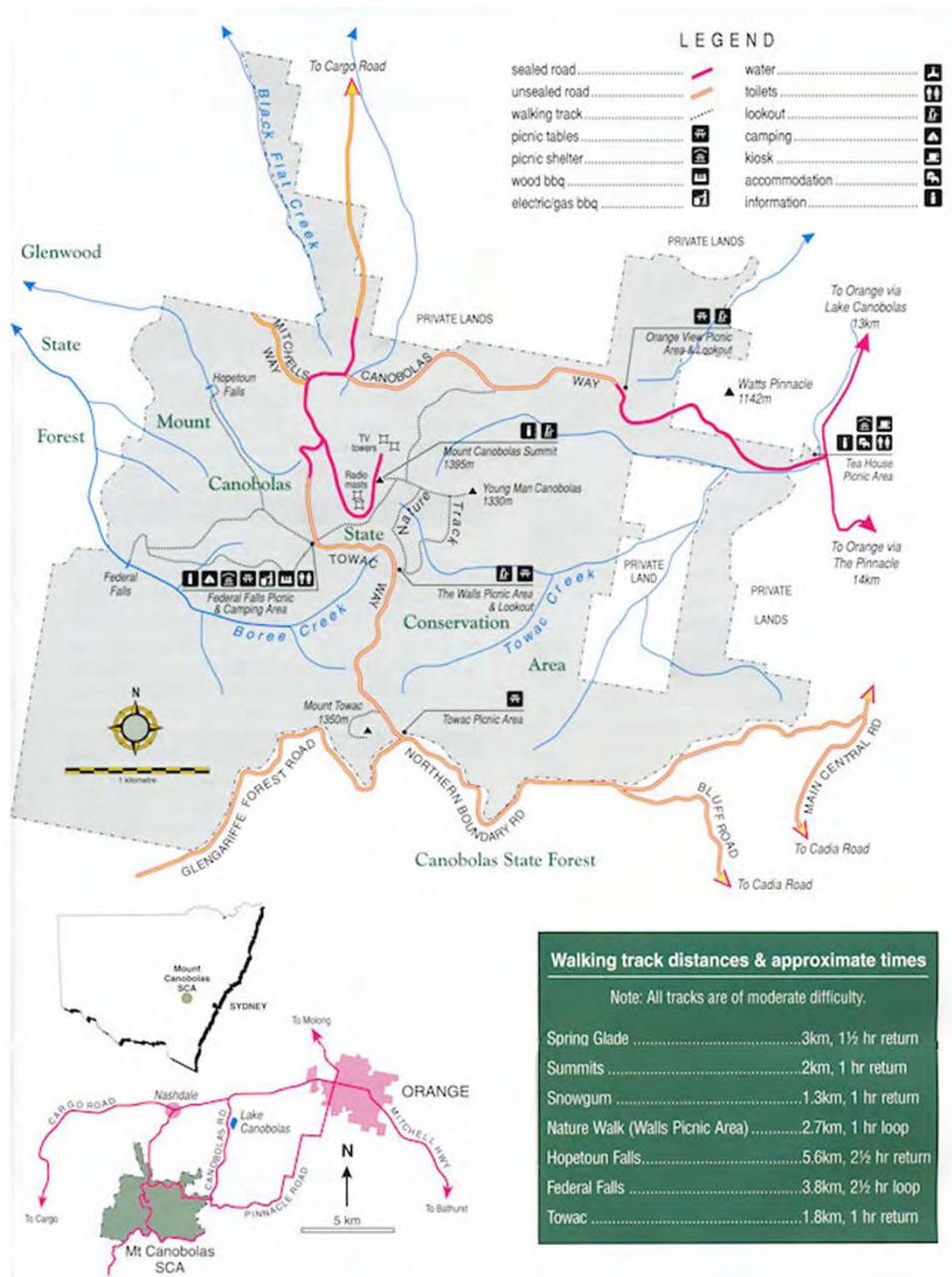
The less vagile plant and animal communities on Mt Canobolas have evolved over millions of years in relative isolation. This has resulted in recognisably distinct assemblages that differ from communities in similar environments elsewhere. Accordingly, the biodiversity of Mt Canobolas provides examples of the ecological and evolutionary responses of an entire landlocked island biota to isolation, longitudinal displacement and climatic gradients, providing many fertile avenues for research and education.

6. The declaration of an area may relate to, but is not limited to, protecting threatened species or ecological communities, connectivity, climate refuges and migratory species

Because of the large altitudinal range (900 to 1400 m) within the SCA and the connecting vegetated ridges to the surrounding lower lands, Mt Canobolas has high importance as a potential climate refuge. As temperatures warm, native vegetation communities characteristic of the lower altitudes surrounding the mountain and their biota may follow their favoured climatic conditions upwards

within the volcanic complex. Given there is no other similar high altitude land system within the western CT, Mt Canobolas assumes critical importance for the survival of the distinctive biodiversity of the volcanic complex in a warming world.

It is concluded that the Mount Canobolas State Conservation Area meets the criteria for Areas of Outstanding Biodiversity Value.



Map of Mount Canobolas State Conservation Area showing roads, streams, walking tracks and regional geographic location in relation to Orange NSW (NPWS 2010).

1. Introduction

The Mount Canobolas State Conservation Area (the SCA) is approximately 15 km south west of Orange in the Central West of New South Wales (NSW). As part of the State's Conservation Estate it reserves land in order to protect and conserve significant ecosystems, landforms, biodiversity and places of cultural significance. State Conservation Areas differ from other areas in the State's Conservation Estate, such as National Parks and Nature Reserves, in that mineral and petroleum exploration and mining may be permitted. SCAs also provide opportunities for sustainable visitation, public enjoyment and research.

An Area of Outstanding Biodiversity Value (AOBV) is a special area that contains irreplaceable biodiversity values that are important to the whole of NSW, Australia or globally. The NSW *Biodiversity Conservation Act 2016* (BC Act) provides legal protections for AOBVs, recognising these areas will represent the most valuable sites for biodiversity conservation across NSW.

The purpose of this submission is to document the rich and unique biodiversity of the SCA and to show how it meets the eligibility criteria for declaration as an AOBV. The principal aim is to compile evidence of the SCA's highly distinctive biodiversity, encompassing at least nine endemic species, three endangered ecological communities, and twelve threatened plant and animal species listed under the BC Act and/or the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), to demonstrate the SCA's State, national and global significance.

2. Background

The SCA covers an area of 1,672 ha and lies at the north western margin of the South Eastern Highlands Bioregion in the Interim Biogeographic Regionalisation for Australia (IBRA) sub-region of Orange (NPWS 2003a). The whole of the SCA is situated on an extinct volcano, provincially known as The Mount Canobolas Volcanic Complex, and its mountainous terrain ranges in altitude from approximately 900 m to 1,397 m at the summit with a number of peaks, steep valleys and waterfalls (NPWS 2003b). It is surrounded by highlands having variable relief of up to 1,000 m altitude of the extensive Central Tablelands (CT) plateau but dips away to the west into the Central Western Slopes (CWS). The boundary between the CT and CWS is an undulating series of erosional step-down scarps.

Mt Canobolas is part of an extinct compound shield volcanic complex that formed over a period of about one million years in the mid to late Miocene epoch 13 to 11 million years ago (Branagan and Packham 2000). It is a prominent 'landlocked island' protruding up to half a kilometre above the surrounding plateau of the western CT. A long period of uplifting along Eastern Australia ended with the Miocene volcanism. An extended erosional phase followed that is lowering the landscape,

reducing and fragmenting prior alpine and sub-alpine areas with resultant isolation of pockets on high peaks, such as Mt Canobolas. This is also being exacerbated by the Australian Continental Plate's slow drift northwards into the tropics.

When white settlers arrived in the Orange district, sub-alpine woodlands on fertile basaltic soils derived from Mt Canobolas occupied up to 580 km² of undulating plateau above 800 m altitude from Orange almost to Blayney (Kovac *et al.* 1990). Most of that area has been cleared for agrarian purposes. The SCA is the only conservation reserve on soils derived from the Canobolas volcano and represents less than three percent of the original basaltic woodland vegetation. Consequently, the SCA is a small remnant within a highly modified landscape of intensive silviculture, horticulture and extensive agricultural grazing pursuits.

Within the SCA, ecosystems have largely survived intact having been subjected to minimal clearing, light grazing and intermittent controlled burning. Wildfires, the most recent being February 2018, have been infrequent due to the sub-alpine environment (NPWS 2003b).

Situated on the western boundary of the CT, the area is separated from coastal drainage by the Great Divide, approximately 85 km to the east. The western CT can be regarded as a western trending spur of the Great Dividing Range (GDR). The so called Canobolas Divide is a north-west trending range and passes through the centre of the SCA, forming the watershed and dividing the inland drainage of the northern Macquarie-Darling River system from the southern Lachlan River system (Chan 2003). Most drainage within the SCA is by first and second order streams. The myriad of different constructional landforms that have evolved from the turbulent geological past has given rise to polymorphic drainage patterns and microclimates within the SCA. The high altitudes dictate a climate of the mountain's own making and the geology provides a geodiversity not found elsewhere in the bioregion (Branagan and Packham 2000). The SCA contains a significant remnant of vegetation with montane and sub-alpine affinities; the only such area within the Central West of the State. A combination of geographical isolation, high altitude, distinctive geology, soils and climate have led to the evolution of ecosystems that are unique to the SCA.

Additional regional background information is provided on the geology, soils, fire history and climate of Mt Canobolas in Appendix 1. Precis of the cultural heritage, European history and geoheritage are also provided in Appendix 1.

3. Bioheritage

Biodiversity on Mt Canobolas started with a clean slate about 11 million years ago after the landscape settled following protracted volcanism (Appendix 1). This scene would have been common throughout the highlands of south eastern Australia during the Miocene epoch. The assemblage of cool climate adapted species now present on the mountain has thus been in the

making for millions of years. It is a distinct and irreplaceable assemblage still largely under-appreciated through the paucity of scientific study. The SCA is a haven for endemic, rare, regionally significant species, a number of threatened ecological communities and threatened plant and animal species. Threatened communities and species are discussed below in Sections 4 and 5.

More than 800 biological species have been recorded for the SCA (Table 1). This biodiversity is expressed across some 267 families and more than double that number of genera, 557, reflecting high niche and habitat specialisation in some groups. Considering only one commissioned scientific study of biota on the mountain has been undertaken (of the vegetation and flora), the number of 800 arises mainly from casual and opportunistic records and some collecting forays. The total number of taxa is thus a conservative estimate which will undoubtedly grow with further systematic study.

3.1 Bryophytes

An initial scrutiny of bryophytes on Mt Canobolas identified 75 species, including 60 moss species, 13 liverwort species and two hornwort species (Downing *et al.* 2002) (Appendix 2). Areas of exposed rock on the upper flanks of the mountain in seepage areas are particularly species rich. One assemblage included an unusual combination of alpine, arid zone and rainforest species, although overall clear ecological patterns could not be discerned. The authors gave an example of a most unusual combination of two opposed species growing together: *Encalypta vulgaris*, a calcicole (i.e. a species found only on calcareous substrates) and *Campylopus introflexus*, a calcifuge (i.e. a species never found growing on calcareous substrates). Around the summit some rare alpine species, previously known only from Yarrangobilly Caves, occurred together with species from the arid zones to the west.

3.2 Vascular plants

Vascular plants constitute the largest component of the currently known native biota within the SCA (Appendix 3). Some 12 ferns, 104 monocotyledons and 176 dicotyledons are present (Table 1) (Hunter 2002). The diversity spans some 70 families and over 200 genera. Among these are at least four endemic species and two threatened species (Sections 5 and 6). A further 100 or so plant species can be considered as being regionally significant because of their rarity or because they are at their geographical range limits (Section 7). The sub-alpine forests and woodlands support 11 Eucalypt species as canopy dominants and a broad array of understory shrubs, forbs and grasses, in seven recognisable communities (Section 8). A rich and eclectic suite of terrestrial orchids occurs within the SCA, adding to the biodiversity conservation value of the area.

Table 1. Summary of known biodiversity within the Mt Canobolas State Conservation Area.

Biodiversity	Families	Genera	Native species	Exotic species	Endemic species	Regionally significant species	EEC ¹	TS ²
Ecological communities							2	
Bryophytes	26	43	75			9		
Gymnosperms	2	2	1	1				
Ferns and Allies	6	11	12			4		
Monocotyledons	10	55	104	7	2	29		
Dicotyledons	53	138	176	56	2 +	67		2
Fungi	22	38	93	1	3 +	51	1	
Mammals	19	26	25	7		2		4
Birds	34	63	82	2				6
Amphibians	2	3	4					
Reptiles	3	13	18					
Fish	1	1	1					
Molluscs	6	8	8			4		
Insects	81	154	~200 +		?			
Velvet worms	1	1	1		1	1		
Flat worms	1	1	1		1	1		
TOTAL	267	557	801	73	9+	168	3	12

¹ Endangered Ecological Communities listed under the *Biodiversity Conservation Act 2016*.

² Threatened Species listed under the *Biodiversity Conservation Act 2016 and/or Commonwealth Environment Protection and Biodiversity Conservation Act 1999*.

3.3 Fungi

No published account of fungi exists for Mt Canobolas, but extensive lichen records are known from field work within the SCA by JA Elix of the Australian National University and his colleagues. The substantial rock platforms and outcrops of Mt Canobolas support a diverse range of around 73 species of lichens (ALA 2018) (Appendix 4). One particular assemblage of lichens, involving an endemic species, is listed as an Endangered Ecological Community (Scientific Committee 2008) (Section 4.1); the only lichen community in Australia with such legal recognition. More than 50 species are regionally significant as they are at their geographical range limits. Two new species found on the summit are further endemics (McCarty and Elix 2014). As for the Bryophyte communities within the SCA, lichens are most conspicuous in areas of bare rock or soil. These landscapes are especially vulnerable from pressures of foot traffic around some of the most popular lookout points.

3.4 Vertebrates

Despite a lack of systematic survey at least 25 native mammals have been recorded for the SCA from opportunistic observations (ALA 2018) (Appendix 5), four of which are threatened species (Section 5). Some 82 native bird species also have been recorded for the SCA (Appendix 5) with six

of these listed as threatened (Section 5). One fish, four amphibians and 18 reptiles are among the native biota of the SCA (Table 1). Knowledge of frogs and snakes within the SCA is particularly data deficient.

3.5 Invertebrates

Over 210 species of invertebrates (Table 1), have been recorded for the SCA (ALA and other database sources, 2018) (Appendix 6), despite a lack of systematic survey and published accounts. The diverse lizard and bird fauna attests to an abundant invertebrate food resource within the reserve. A single rare species of Velvet Worm is endemic to Mt Canobolas and regarded as belonging to an ancient lineage (Fletcher 2017). Likewise, an unnamed fluorescent yellow Planarian Worm is thought to be endemic to the mountain (M Fletcher *pers. comm.* 2018). A cricket, several moths and leafhoppers represent unnamed taxa and two named species, *Monomorium crinitum* and *Johnrehnia canoblaensis* have their type localities on Mt Canobolas. Four mollusc species are rare and regionally significant.

4. Threatened Ecological Communities

Three threatened ecological communities occur in the SCA.

4.1 Xanthoparmelia Lichen Community

A lichen community of at least nine species of foliose lichens has been recognised as endemic to the SCA, and gazetted as the:

- *Mt Canobolas Xanthoparmelia Lichen Community.*

The assemblage consists of *Cladia fuliginosa*, *Xanthoparmelia canobolasensis*, *X. digitiformis*, *X. metaclystoides*, *X. metastrigosa*, *X. multipartita*, *X. neorimalis* and *X. sulcifera*. It occurs on rock faces and soils unique to the Mt Canobolas volcanic complex. *Xanthoparmelia metastrigosa* is endemic to Mt Canobolas and *X. canobolasensis* is known only from Mt Canobolas and one locality in Tasmania while *X. sulcifera* and *C. fuliginosa* are each known from a limited number of other localities within NSW.

Because of various identified threats to the assemblage, including from development, tourism visitation, rock collecting and infrastructural works it has been gazetted as an Endangered Ecological Community (EEC) under the BC Act (Scientific Committee 2001).

4.2 Tableland Basalt Forest Community

The Tableland Basalt Forest Community is a tall montane forest community dominated by *Eucalyptus dalrympleana* (Mountain Gum) and *E. pauciflora* (Snow Gum) (Scientific Committee 2008), and gazetted as the:

- *Tableland Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregions Endangered Ecological Community.*

It is known to occur between 600 and 900 m altitude on the eastern parts of the CT. On Mt Canobolas, Tableland Basalt Forests occur extensively in the lower valleys and into the heads of valleys in deep basaltic soils above 900 m altitude, hence represent a high altitude variant of the EEC on the western CT.

4.3 Tablelands Snow Gum Woodland Community

The Tablelands Snow Gum Woodland Community generally occurs on frost-prone valley floors and on lower slopes principally across the Central and Southern Tablelands but is now highly fragmented and few high quality remnants remain (Scientific Committee 2011). It was gazetted as:

- *Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland in the South Eastern Highlands, Sydney Basin, South East Corner and NSW South Western Slopes Bioregions Endangered Ecological Community.*

This EEC occurs in the SCA along the reaches of Towac Creek where *Eucalyptus pauciflora* (Snow Gum) occurs with scattered *E. stellulata* (Black Sallee) and *E. viminalis* (Ribbon Gum) trees.

Within the SCA *Eucalyptus rubida* (Candlebark) is replaced by the threatened *E. canobolensis* (Silver-leaf Candlebark) in this EEC. The EEC is likely to have been present over a larger area on the cleared in-holding portion of the Towac Valley (see Map p. 6).

5. Threatened Species

Twelve threatened species have been recorded within the SCA including two locally endemic plant species, four mammals and six birds (Table 2).

5.1 Plants

- The endemic shrub *Prostanthera gilesii* [formerly *P. sp. C*] (Giles' Mintbush) is only known from two small colonies and has been listed as Critically Endangered under the BC Act (Scientific Committee 2017).
- The tree *Eucalyptus canobolensis* [syn. *E. rubida* subsp. *canobolensis*] (Silver-leaf Candlebark) occurs throughout the SCA and is endemic to the Mt Canobolas precinct. Its stronghold is above 1,000 m altitude in the SCA but occurs sporadically down to ± 900 m altitude on the slopes surrounding the mountain. With a propensity to form hollows, the species provides valuable nesting and roosting habitat as well as copious manna exudate as a food source for arboreal mammals and birds. It is listed as Vulnerable under the BC Act and Endangered under the EPBC Act (Department of the Environment, Water, Heritage and the Arts 2008).

5.2 Mammals

- *Petaurus australis* (Yellow-bellied Glider) is an arboreal glider found along the east coast to the western slopes of the GDR. With a preference for tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils, the SCA provides an ideal habitat. *E. canobolensis* undoubtedly offers a valuable roosting habitat together with a food source from copious manna secretions. It is listed as Vulnerable under the BC Act (OEH 2017a).
- *Petauroides volans* (Greater Glider) ranges throughout eastern Australia, occurring from north Queensland through to central Victoria, from sea level to 1200 m altitude. This Glider favours forests with a diversity of eucalypt species, providing food sources across seasons. It is a common glider in the SCA owing to an abundance of tree hollows and food provided by the diverse suite of eucalypts. It is listed as Vulnerable under the EPBC Act (Threatened Species Scientific Committee 2016).
- *Miniopterus schreibersii* infrasp. *oceanensis* (Eastern Bent-wing Bat) is primarily a cave dwelling mammal found mainly in coastal districts of eastern Australia. This unusual species for the SCA is known to frequent other high altitude forest areas, making use of rock habitats and hunts insects, particularly moths in the montane environments. It is listed as Vulnerable under the BC Act (OEH 2017b).
- *Saccolaimus flaviventris* (Yellow-bellied Sheathtail Bat) is a wide-ranging insectivorous mammal that forages above forest and grassland canopies in northern and eastern Australia and is suspected of being migratory. It is listed as Vulnerable under the BC Act (OEH 2017c).

5.3 Birds

- *Artamus cyanopterus* (Dusky Woodswallow) is widespread in eastern, southern and southwestern Australia and is widespread in NSW from the coast to inland, including the western slopes of the GDR and farther west. It occurs in a wide range of habitats but is considered to be a woodland dependent bird breeding mostly along the slopes and feeding mainly on invertebrates. It is listed as Vulnerable under the BC Act (Scientific Committee 2016).
- *Daphoenositta chrysoptera* (Varied Sittella) is a small songbird. Although widespread in NSW it has undergone a decline due to the clearing of forest and woodland habitats. It feeds on arthropods in rough or decorticated bark, dead branches, standing dead trees and small branches and twigs in eucalypt canopies. As a sedentary species it is likely to be a permanent resident of the SCA. It is listed as Vulnerable under the BC Act (Scientific Committee 2010a).

Table 2. Threatened plant and animal species within the Mt Canobolas State Conservation Area. V denotes Vulnerable listing, E Endangered and CE Critically Endangered.

	Family Name	Scientific Name	Common Name	Conservation Status		Remarks
				BC Act ¹	EPBC Act ²	
Plants	Lamiaceae	<i>Prostanthera gilesii</i>	Giles' Mintbush	CE		Endemic to the SCA. Only two small disjunct colonies known.
	Myrtaceae	<i>Eucalyptus canobolensis</i>	Silver-leaf Candlebark	V	E	Endemic to the SCA. Common throughout SCA.
Mammals	Emballonuridae	<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheathtail Bat	V		Recorded 2004-11-17
	Miniopteridae	<i>Miniopterus schreibersii</i> infrasp. <i>oceanensis</i>	Eastern Bent-wing Bat	V		Recorded 2004-11-17
	Petauridae	<i>Petaurus australis</i>	Yellow-bellied Glider	V		No recent sighting records.
	Petauridae	<i>Petauroides volans</i>	Greater Glider		V	Common in the SCA with 15 records, 1997 to 2009.
Birds	Accipitridae	<i>Hieraaetus morphnoides</i>	Little Eagle	V		One record; 2009-03-21. Regularly observed in adjacent Towac Valley.
	Artamidae	<i>Artamus cyanopterus cyanopterus</i>	Dusky Woodswallow	V		Recorded 2001-3-16
	Neosittidae	<i>Daphoenositta chrysoptera</i>	Varied Sittella	V		Two records; 1997-09-27, 2014-06-09
	Petroicidae	<i>Petroica boodang</i>	Scarlet Robin	V		Two records; 1999-08-21, 2017-03-17
	Petroicidae	<i>Petroica phoenicea</i>	Flame Robin	V		33 records; 1997-2017
	Psittacidae	<i>Neophema pulchella</i>	Turquoise Parrot	V		Recorded 1978

¹ Threatened Species listed under the *Biodiversity Conservation Act 2016*.

² Threatened Species listed under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999*.

- *Hieraaetus morphnoides* (Little Eagle) is a medium sized bird of prey that has undergone declines in population principally due to clearing, habitat degradation and loss of prey species. It is listed as Vulnerable under the BC Act (Scientific Committee 2010b).
- *Neophema pulchella* (Turquoise Parrot) is a distinctively coloured Parrot that ranges throughout most of eastern NSW. Living mainly around the edges of woodlands it feeds mostly on the ground, foraging for seed, and nests in hollows of stumps and trees. It is listed as Vulnerable under the BC Act (OEH 2017d).
- *Petroica boodang* (Scarlet Robin) is a small Australian Robin that occurs throughout south eastern Australia. Predominantly a woodland bird it breeds in higher terrain areas such as the SCA before dispersing onto the slopes and near plains in NSW. The degradation and loss of primary habitat, especially those that contain abundant logs and fallen timber underlies its listing as Vulnerable under the BC Act (OEH 2017e).
- *Petroica phoenicea* (Flame Robin) is a small Australian Robin that occurs throughout south eastern Australia. Predominantly a woodland bird it breeds in higher terrain areas such as the SCA before dispersing over winter onto the slopes and near plains in NSW. The degradation and loss of primary habitat, especially those that contain abundant logs and fallen timber underlies its listing as Vulnerable under the BC Act (OEH 2017f).

6. Endemic Species

At least nine species are considered to be endemic to the Canobolas volcanic complex. These include four plant species, *Prostanthera gilesii* (Conn and Wilson 2015), *Eucalyptus canobolensis* (Hunter 1998), *Bulbine petraea* [ms] (J Bruhl *pers. comm.* 2018) and *Prasophyllum* sp. aff. *odoratum* [ms] (D Jones *pers. comm.* 2018). Three lichens, *Gyalideopsis halocarpa*, *Sarcogyne sekikaica* (McCarty and Elix 2014) and *Xanthoparmelia metastrigosa* are endemic to the SCA (Scientific Committee 2001) as is *Cephalofovea pavimento*, the Mt Canobolas Velvet Worm (Fletcher 2017) and an unnamed Planarian Worm (M Fletcher *pers. comm.* 2018). Other taxa, including shrubs in the genera *Asterolasia* and *Phebalium*, still under study, are likely also to be endemics (I Telford and J Bruhl *pers. comm.* 2018), along with several unnamed insects (M Fletcher *pers. comm.* 2018).

Two of the endemic plants *E. canobolensis* and *P. gilesii* are listed as threatened (Table 2) (Section 5) and one endemic lichen is part of the Endangered Mt Canobolas *Xanthoparmelia* Lichen Community (Section 4). It is highly likely that the remaining non-listed endemic species would also qualify for threatened status if they were to be nominated.

The presence of multiple endemic species in diverse groups of flora and fauna in the SCA reflects the geographic isolation of Mt Canobolas as a landlocked island of high altitude habitats that provides an ideal environment for species evolution. After the Late Miocene when the Mt Canobolas volcanic complex had ceased activity the land surface of the eastern highlands would have been much higher with alpine and sub-alpine vegetation considerably more widespread and interconnected than it is today. A long period of erosional activity has lowered the land surfaces resulting in the contraction and fragmentation of sub-alpine habitats which ultimately led to the stranding of remnant communities and populations on Mt Canobolas. The isolation of Mt Canobolas has been in place for long enough to allow the evolution of multiple new life forms, a process known as evolution by vicariance, essentially by the splitting of populations into isolated fragments that subsequently evolve independently. Consequently, it is likely that many of the endemic species with close relatives elsewhere have evolved into new species on Mt Canobolas by vicariance.

Alternatively, Mt Canobolas has acted as a refugium for formerly widespread species that have become extinct elsewhere. For these species Mt Canobolas is likely to be their last refuge on the planet. The velvet worm and the planarian may fit into this category.

In either event, the presence of these endemic species in the SCA is scientifically important and provides fascinating opportunities for research.

7. Regionally Significant Species

In addition to the threatened and endemic species discussed above, the biota of the SCA is noteworthy for the many regionally significant species that are rare or at the limits of their natural geographic ranges. Range edges are characterized by increased genetic isolation, genetic differentiation, and variability in individual and population performance (Sexton *et al.* 2009) so are important to the State for conservation. One hundred and sixty eight species, around 21%, of the known biota, are at their range limit on or in close proximity to the mountain. The majority of these are among the fungi and vascular plants, however for most of the invertebrate taxa, there isn't sufficient information to determine their status in this context. A small number of species, four plants and two fungi are northern species which occur at their southernmost range limits around or on the mountain. A larger number, 16 fungi and 21 plant species are clearly species with their distributional strongholds in southern regions, being at their northernmost range limit on or near the mountain. Many of these species have strong alpine affinities. The greatest number, 25 fungi and 75 plant species are at their westernmost distribution within the Central West of NSW. These are comprised of many coastal and Blue Mountains species.

Terrestrial orchids are another subset of plants with regional significance within the SCA. At least 35 species are known to occur, making the mountain important for conservation of these species which are declining elsewhere through loss of habitat. A fire ephemeral *Prasophyllum* sp. aff. *odoratum* only seen after a summer fire in 1982 is endemic and other orchid species are at their geographic range limits (Appendix 3).

8. Vegetation Communities

This section summarises the vegetation communities present in the SCA after Hunter (2002) and discusses their significance in relation to similar high altitude vegetation types on the Great Divide to the east.

Hunter (2002) defined seven vegetation communities in the SCA:

8.1 Snow Gum-Mountain Gum Grassy Woodland and Tall Open Forest occupies some 52% of the SCA above 900 m altitude. The community is characterised by predominantly *Eucalyptus pauciflora*, *E. dalrympleana* subsp. *dalrympleana*, *E. canobolensis* in association with *E. dives*, *E. macroryncha*, *E. viminalis* and *Acacia dealbata*. It has a well-developed layer of low and tall shrubs and a dense ground layer of 80 to 100% cover of climbers and trailers, herbs and grasses. Hunter (*op cit.*) recognised sub-assemblages within this community but could not separate them using his data. Conservation of this community within the SCA is important as it represents a relatively undisturbed example and is at the north western limit of its distribution. Elsewhere on the CT, Benson and Keith (1990) indicate that the understorey of many remnants of similar assemblages are heavily disturbed, particularly by grazing, highlighting the importance of conservation of this community in the SCA.

This community closely fits the Tableland Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregions EEC. This EEC occurs between 600 and 900 m altitude on the Great Divide. On Mt Canobolas, Tableland Basalt Forest occurs in the lower valleys and into the heads of valleys in deep basaltic soils above 900 m altitude. Accordingly, the Mt Canobolas occurrence represents a high altitude variant of the EEC, which has likely moved to higher altitudes owing to the more inland location and consequent climatic differences from its habitats to the east.

Tableland Basalt Forest on the eastern tablelands and GDR encompasses at least three recognised assemblages similar to that on Mt Canobolas. These are Plant Community Types (PCT) 952, 953 and 1197 (BioNet 2018). All three are dominated by *Eucalyptus dalrympleana*, *E. pauciflora* and *E. dives* with associated eucalypts that don't occur on or

near Mt Canobolas, including principally *E. radiata* and *E. robertsonii*. By contrast, the related assemblages on Mt Canobolas have *E. canobolensis* as a dominant, a species that is absent in the east. It is likely that future vegetation community analysis will recognise the Mt Canobolas assemblage as a distinct and threatened PCT.

8.2 Stringybark–Peppermint Shrubby Open Forests and Woodlands covers around 26% of the SCA in areas above 1000 m altitude. The community is characterised by predominantly *Eucalyptus macrorhyncha* and *E. dives*, in association with *E. canobolensis*, *E. pauciflora*, *E. dalrympleana* subsp. *dalrympleana*, *Acacia dealbata*, *A. melanoxylon* and *Exocarpos cupressiformis*. As with the above it also has a well-developed shrub layer and ground cover of herbs and grasses. Hunter (*op. cit.*) states the occurrence within the SCA is significant due to the unusual assortment of associated species and the community being at its north western geographic limit of occurrence.

Hunter's observation that this community, which principally occurs on upper slopes and ridgetops within the SCA, has an unusual assemblage of tree species is correct. There are no PCTs in the BioNet Vegetation Classification database (2018) that closely match it. Most recognised PCTs dominated by *E. macrorhyncha* and *E. dives* occur in drier environments than on Mt Canobolas as reflected in their understorey shrubs and grasses. The closest PCT in BioNet (2018) is PCT 305, which also includes *E. bridgesiana*, *E. rubida* and *E. stellulata*. *E. bridgesiana* occurs sparingly in this community on Mt Canobolas, *E. stellulata* is absent and *E. rubida* is replaced on Mt Canobolas by *E. canobolensis*. This assemblage in the SCA is also likely to merit recognition as a PCT in its own right.

8.3 Grasslands and Grassy Open Woodlands occupy some 15% of the SCA area above 1200 m altitude. Trees are a minor component of the community, with *Eucalyptus pauciflora*, *E. canobolensis*, *E. dalrympleana* subsp. *dalrympleana*, *Acacia dealbata* and *A. melanoxylon* occurring in low densities. The shrub layer is of low stature and sparse or absent whereas the ground layer of twiners, herbs and grass is well developed. Hunter (*op. cit.*) states it is likely that this community is poorly conserved across its range and that the occurrence within the SCA is highly significant for conservation.

This assemblage is most similar to PCT 1197 in the BioNet Vegetation Classification (2018), where it is regarded as part of the Tablelands Basalt Forest EEC.

8.4 Outcrop Heaths and Shrublands and Outcrop Low Open Woodlands are two closely similar communities found on skeletal soils on rock outcrops. Together they occupy some 6% of the SCA, occurring as highly disjunct and small patches throughout. The main

difference between the two is that the first of these communities lacks trees and the shrubs are scattered and depauperate and occur in association with bryophytes and scattered herbs and grasses. These rock outcrops contain the endangered Mt Canobolas *Xanthoparmelia* lichen community. The second community may have scattered trees of *Eucalyptus canobolensis*, *E. bridgesiana* and *Acacia dealbata*. Hunter (*op. cit.*) considers these communities to be restricted to the SCA and close surrounds, being unique to the mountain, and should be considered vulnerable to inappropriate fire regimes and visitor pressure.

The high altitude basalt rock platform heathlands of Mt Canobolas are unique. No floristically similar heathlands are recognised as PCTs in the BioNet Vegetation Classification (2018). The endemic Mt Canobolas assemblages are likely to warrant recognition as a distinct and threatened PCT.

8.5 Waterfall Low Open Woodlands occur at the Federal and Hopeton Falls locations, occupying less than 1% of the SCA. Primarily an open shrubland community occurring with occasional stunted trees of *Eucalyptus goniocalyx*, *E. canobolensis* and *Acacia melanoxylon* in shallow soils around the margins and often with taller *Eucalyptus viminalis* around the base of the falls.

This community is of very limited extent and it is doubtful that it deserves recognition as an entity distinct from the surrounding vegetation.

8.6 Disturbed Creek-lines occur in the north eastern lower reaches of the SCA, occupying about 1% of its area. They are characterised by tall open stands of *Eucalyptus viminalis*, *E. stellulata*, *E. pauciflora*, *E. dalrympleana* subsp. *dalrympleana* and *Acacia melanoxylon* with a scattered to dense shrub layer, ferns and herbs. The community has suffered considerable disturbance but is highly significant as it conforms to the *Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland in the South Eastern Highlands, Sydney Basin, South East Corner and NSW South Western Slopes Bioregions* EEC.

This assemblage is most similar to PCTs 1100 and 1101 that are dominated by *E. viminalis*, *E. pauciflora*, *E. radiata* and *E. stellulata* (BioNet 2018). *E. radiata* is missing from Mt Canobolas.

9. Assessing Mt Canobolas State Conservation Area as an Area of Outstanding Biodiversity Value

Criterion 1. Importance of Mount Canobolas SCA at a State, National and Global Scale:

Mount Canobolas is a prominent volcanic inselberg with distinct and independently evolving biodiversity. It is an iconic natural remnant area located within the heavily cleared landscapes of Central Western NSW. The SCA protects the only reserved remnant of sub-alpine habitats which represent the last three percent of the original basaltic woodland vegetation on the volcanic plateau surrounding the mountain. The physiography of the Mt Canobolas remnant shield volcano, its altitude, geology, soils, isolation from other high altitude areas and influence on the local weather have united to produce a biota specific to the mountain giving it State and national status.

The Mt Canobolas relict montane and sub-alpine flora, bryophyte and lichen communities are compositionally distinct from those in all other high altitude areas of NSW and Australia. Despite a paucity of scientific investigation, Mt Canobolas is known to support within a remarkably small area an array of endemic vascular plants, lichens, a Velvet Worm and a planarian that occur nowhere else (Section 6). The number of species recognised as unique to Mt Canobolas is expected to grow significantly with further research. There can be no doubt that Mt Canobolas is a hotspot of endemism within NSW and Australia, of global significance.

Criterion 2. Mount Canobolas SCA makes a significant contribution to the persistence of at least one of the following:

(i) Multiple species or at least one threatened species or ecological community:

Three endangered ecological communities occur within the SCA (Section 4).

The Mt Canobolas *Xanthoparmelia* lichen community is unique and endemic to the Canobolas volcanic complex. That is, its survival is entirely dependent on the continuance of its habitats within the SCA and immediate surrounds.

In addition, areas of *Tableland Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregions Endangered Ecological Community* and of *Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland in the South Eastern Highlands, Sydney Basin, South East Corner and NSW South Western Slopes Bioregions Endangered Ecological Community* have been identified.

There are records of twelve threatened plant and animal species occurring within the SCA (Section 5). Two plant, four mammal and six bird species are listed as threatened under the BC Act and/or EPBC Act. In particular, the SCA is the only place on Earth supporting natural populations of the Critically Endangered *Prostanthera gilesii* (Giles' Mintbush) and the only area where large viable

populations remain of the Vulnerable/Endangered *Eucalyptus canobolensis* (Silver-leaf Candlebark).

(ii) Irreplaceable biological distinctiveness:

At least nine species are endemic to the Canobolas volcanic complex, i.e. they do not occur naturally anywhere else. Crucially, they are conserved only in this conservation area, state-wide, nationally or globally (Section 6).

Known endemics include four plant species, *Prostanthera gilesii*, *Eucalyptus canobolensis*, *Bulbine petraea* [ms] and *Prasophyllum* sp. aff. *odoratum* [ms]. At least three lichens, *Gyalideopsis halocarpa*, *Sarcogyne sekikaica* and *Xanthoparmelia metastrigosa* are endemic to the SCA, as is *Cephalofvea pavimenta*, the Mt Canobolas Velvet Worm and an unnamed Planarian Worm. A lichen, *Xanthoparmelia canobolasensis* and two species of insects, *Johnrehnia canoblaensis* and *Monomorium crinitum* have been described based on specimens from Mt Canobolas which is therefore the type locality for these species (Section 6). The unnamed yellow Planarian Worm has not been recorded anywhere else and is dependent for its survival on the dense leaf litter found on Mt Canobolas. Two shrub taxa, an *Asterolasia* and a *Phebalium*, currently under study, are considered likely to be further new endemic species (Section 6). Additional plants considered by the authors to be taxonomic anomalies, including a *Craspedia* and a *Veronica* species, are possibly also undescribed endemic species.

The level of species endemism within plant and animal groups in the SCA is high and worthy of enhanced recognition and protection. While many localised endemic species are highly protected in Australia, most notably the celebrated *Wollemia nobilis* (Wollemi Pine), others remain unrecognised. Some, such as *E. canobolensis* set the SCA apart giving it a distinctive visual character whilst other more diminutive forms, such as the three endemic lichens, go unheralded; an exception being Giles' Mintbush, which has been widely cultivated.

Mt Canobolas hosts unique sub-alpine rock plate communities with a combination of bryophyte, lichen and plant species not recorded elsewhere in NSW, Australia or globally. All of the endemic species on Mt Canobolas are completely dependent on the habitat there for their survival in the wild.

Furthermore, there is a vast and under-explored reservoir of genetic diversity residing on and around the SCA, particularly among the flora with around 100 vascular plants and some 50 fungal species that are rare or at the limits of their natural geographic ranges. These regionally significant species have affinities with lineages from the north, the southern alpine areas and the coastal and Blue Mountains areas to the east. Many of these species at the edges of their ranges have become

stranded outlying populations disconnected in geological time from occurrences elsewhere. It is this disconnection that has set them on a distinct evolutionary pathway resulting in the evolution of new species over millennia, a process that is continuing. Establishing an AOBV across the SCA would further enhance the protection of this unique biodiversity resource as a living gene bank, in perpetuity.

(iii) Ecological processes or ecological integrity:

The vegetation communities on Mt Canobolas are the result of ecological and evolutionary processes operating over millions of years. They have evolved in relative isolation to become recognisably distinct from similar communities elsewhere. Accordingly, the vegetation communities of Mt Canobolas provide examples of the ecological responses of vegetation assemblages to isolation, longitudinal displacement and climatic gradients.

Importantly, the vegetation of the SCA is in remarkably good condition and retains its ecological integrity. Other than for a history of light grazing and periodic wildfire perturbation, the most recent being in February 2018, the vegetation has the resilience of functioning climax ecosystems. Being surrounded by forestry and agricultural lands the SCA is, however, somewhat prone to invasion by exotic plant and animal pests, like many other areas in the State's conservation estate. Mitigation of these incursions will require ongoing resources and committed management to protect the extant biodiversity and the integrity of the unique ecosystems.

One indicator of continuing ecological integrity is the number of terrestrial orchids found in the SCA. Upwards of 35 species have been recorded. Orchids are particularly sensitive to disturbance from overgrazing and nutrient influxes, hence the diversity is indicative of high resilience within the SCA ecosystems.

(iv) Outstanding ecological value for education or scientific research:

The importance of Mt Canobolas as a centre of endemism is becoming increasingly evident to the scientific community. Research on various cryptogams and vascular plant taxa in the SCA is being, or has been, undertaken by the Department of Biological Sciences, Macquarie University (bryophytes), Royal Botanic Gardens and Domain Trust, Sydney (*Prostanthera gilesii*), Botany School at the University of New England, Armidale (various flowering plants), Research School of Chemistry, Australian National University (lichens) and David Jones (Associate of the Centre for Australian National Biodiversity Research, Canberra) (orchids). Collecting forays by the National Museum of Victoria (insects), Australian National Insect Collection, Canberra (beetles), The Australian Museum, Sydney (insects) and the Biosecurity Collections Unit of NSW DPI in Orange (moths) have enhanced the scientific knowledge of invertebrates.

The SCA provides abundant opportunities for taxonomic research owing to its island nature which fosters evolution by vicariance, and its likely role as a refuge for formerly widespread species that are now stranded on the mountain.

As indicated above, the less vagile plant and animal communities on Mt Canobolas have evolved over millions of years in relative isolation. This has resulted in recognisably distinct assemblages that differ from communities in similar environments elsewhere. Accordingly, the biodiversity of Mt Canobolas provides an excellent example of the ecological and evolutionary responses of an entire landlocked island biota to isolation, longitudinal displacement and climatic gradients, providing many fertile avenues for research and education.

Mount Canobolas has been used regularly in the past as a field laboratory for education in fire ecology and management in sub-alpine environments, by the late Roger Good of the Australian National University. Following the recent fire the SCA again provides further opportunities for research and education into fire response and recovery, particularly of the threatened and endemic flora and fauna.

Criterion 3. The declaration of an area may relate to, but is not limited to, protecting threatened species or ecological communities, connectivity, climate refuges and migratory species:

The rich and irreplaceable biodiversity of Mt Canobolas, including twelve threatened species, three endangered ecological communities, at least nine endemic species, which occur nowhere else in the world, and near 170 regionally significant plant and animal species has been summarised above.

Mt Canobolas functions as both a refugium for declining species and an evolutionary nursery for new species, driven by its isolation from other high altitude areas on the GDR. Consequently, low connectivity has likely been a principal driver influencing the diversity of the less vagile elements of the biota. It is the reason why the unique creatures like the yellow planarian worm, the Mt Canobolas Velvet Worm and other endemics are restricted to the mountain. Conversely, connectivity at a landscape level assumes importance for the recorded migratory birds and mammals such as bats and gliders utilising the food and nesting resources provided by the SCA. Natural remnants form a south west corridor through Edenboro Reserve [Crown Land] and parts of Canobolas State Forest around Lees Mountain and Lapstone Hill. These link with a long tongue of remnant woodlands through Black Rock Ridge [Cadia Valley Operations Bio-offset] and nearby Colombine Mountain [Private Land]. To the west there are native remnants on Black Mountain, Paling Yards Reserve [Crown Land] and these link with Barton Nature Reserve. Further along the western slopes are Conimbla National Park (NP), Nangar NP and the extensive Goobang NP

extending from Bumberry to the northern Harvey Range. These lower altitude remnants are tentacles leading to Mt Canobolas which clearly hosts migratory species of mammals such as micro bats and birds such as the threatened robin species. Within a 50 km radius to the north and east are the Mullion Range SCA, Girralang Nature Reserve (NR), Freemantle NR, Hill End Historic Site (HS) and Winburndale NR whilst Copperhanna NR lies to the south. A small remnant known as The Pinnacle lies nearby to the east of the SCA.

Because of the large altitudinal range (900 to 1400 m) within the SCA and the connecting vegetated ridges to the surrounding lower lands, Mt Canobolas has high importance as a potential climate refuge. As temperatures warm, native vegetation communities characteristic of the lower altitudes surrounding the mountain, and their biota, may follow their favoured climatic conditions upwards within the volcanic complex. Given there is no other similar high altitude land system within the western Central Tablelands, Mt Canobolas assumes critical importance for the survival of the distinctive biodiversity of the volcanic complex in a warming world.

10. Conclusion

Mount Canobolas State Conservation Area more than adequately meets all of the criteria for Areas of Outstanding Biodiversity Value. This SCA is a scientifically important area containing unique components of genetic diversity and irreplaceable biodiversity of high conservation value to NSW, Australia and globally. The SCA has global significance as it hosts at least nine endemic species that occur nowhere else in the world. It also supports an Endangered lichen community and a rock plate heath ecological community that are nationally restricted to Mt Canobolas. Two other vegetation communities are compositionally distinct from analogous vegetation elsewhere and are of State significance. The ecosystems have high ecological integrity and resilience, and are generally in an undisturbed condition. The SCA also supports multiple threatened species and ecological communities and is important for their survival. It is also concluded that the SCA represents a natural laboratory for taxonomic, ecological and evolutionary studies of a landlocked island biota and provides fertile opportunities for education and scientific research.

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Nomination of Mount Canobolas State Conservation Area as an Area of Outstanding Biodiversity Value.

Appendices

Additional background, environmental and heritage information is appended along with species lists of the main components of biodiversity known for the SCA. Comments on data accuracy, points of interest about species and threatened communities and species are provided within the lists. Species marked with * denote introduced. The ALA data may be of variable accuracy.

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Appendix 1

Regional, environmental and historical overviews of Mt Canobolas SCA

1.1 Regional geographic setting

Mount Canobolas State Conservation Area (SCA) has several distinct geographical attributes. Starting life as part of a volcanic complex, the mountain now comprises several connected cone-shaped peaks rising above the surrounding Central Tablelands (CT) plateau. It is also the dominant feature in the landscape visible from up to 50 km in all directions.

Owing to the deep fertile soils and gentle terrain, almost all the CT plateau land has been cleared for horticulture, cropping and grazing, and more recently pine plantation forestry, especially around Mt. Canobolas itself. No substantial remnants of the original basaltic woodlands remain, except on the steep slopes and ridges of the mountain, mostly within the SCA. The SCA comprising 1672 ha is the only conserved remnant of sub-alpine woodlands on fertile basaltic soils, apart from the much smaller Coolamatong Forest Preserve in Canobolas State Forest of 63 ha.

The SCA is a landlocked island of remnant vegetation surrounded along most of the western and southern boundaries by Glenwood and Canobolas State Forests, both being largely commercial softwood plantation forests. The northern and eastern boundaries are mostly shared with private holdings involved with softwood plantation forestry, intensive horticulture or grazing activities. Punctuating the ‘island’ is the summit area where several communication towers and associated infrastructure are situated. Within the valley in the eastern sector is a private in-holding, previously cleared for horticulture but now re-cleared grazing land (see Map p.6).

1.2 European History

On 23rd May 1815, Assistant Government Surveyor George Evans named the mountain Jamison’s Table Mountain. However, by 1835/6 the name Mt Canobolas appeared on survey maps.

On 6th April 1835, then Surveyor-General for the Colony of NSW, Major Thomas Mitchell, climbed the mountain *en route* to exploring the Darling River. He reputedly was the first European to do so and is thought to have produced a rudimentary geological map of the area.

RH Cambage, a surveyor with the Department of Lands and Mines, apparently made the first collection of plants from Mt Canobolas in 1899, followed by JH Maiden and JL Boorman, collecting for the National Herbarium of NSW in 1908. Cambage was the first to produce a general scanty description of the roadside vegetation around Orange (Cambage 1902).

In 1953 reports appeared in the media indicating planning was underway for a television transmitting station on Mt Canobolas, where Country Broadcasting Services had held a lease on the

peak since 1938. It wasn't until February 1962 that the first test broadcast of commercial television was transmitted.

In November 1954 it was announced that an aircraft navigational aid was to be erected on top of Mt Canobolas, with a distance measuring beacon to be housed in a communications station and an access road constructed.

The area which in later years became a Park, was a 'Water Reserve' for travelling stock and temporary grazing, including grazing leases, from 1876 to 1958. In 1944 the area was 'Reserved from Sale' for Public Recreation and the first Trustees appointed. On March 22nd 1946 the Mt Canobolas Reserve was proclaimed a Bird and Animal Sanctuary and on 2nd February 1959 granted Public Recreation Reserve status, listed as Reserve 81412, comprising 1,663 ha.

The Reserve was subsequently managed by a group of Trustees, as a private trust under the control of the Department of Lands. On 8 June 1992, the Department of Lands, in line with administrative changes, classified the Reserve as a "Major Park". The Canobolas Regional Parklands Trust, comprising ex-officio members from Government departments and Local Government, together with citizen Trustees, had become custodians, by 1994, of more than 40 parcels of land, comprising roughly 7000 ha. After years of lobbying, finally in December 1997, the original Mt Canobolas Park was gazetted as Mount Canobolas State Recreation Area, comprising 1,672 ha of unique montane and sub-alpine landscape. Adoption into the States Conservation Estate thus came about because of the area's high natural and cultural heritage values.

At the end of 2002, amendments to the *National Parks and Wildlife Act 1974* changed all State Recreation Areas to State Conservation Areas, and draft plans of management incorporated new objectives which also came into effect that same year.

1.3 Geology

Geology is inert so does not constitute biodiversity. In the case of the SCA however, the geodiversity is intrinsically linked to the biodiversity value of the area.

The SCA lies in the north eastern sector of the ancient Lachlan Fold Belt, specifically in its eastern sub-province. The belt, which had its origin along the margins of Gondwana, in a subductional setting, is composed mainly of deformed deep-marine sedimentary rocks and mafic volcanic rocks. Throughout the province step-wise deformation and metamorphism involved folding, rifting, intrusion, faulting and uplifting which occurred during major tectonic events from the Silurian to Early Carboniferous epochs (Foster and Gray 2000). The resulting palaeoplain underwent extensive erosion during a tectonically quiescent period, providing the sediments of the Sydney Basin.

Subsequent rifting associated with the opening of the Tasman Sea and warping from its separation with the Great Divide together with Tertiary volcanism drastically changed drainage patterns east and west of the new divide. At the same time the Murray Darling Basin began to subside to the west. Three episodes of volcanism during the Tertiary period affected the warped, partly tilted and eroded palaeoplain; the most recent of these being the Canobolas Province.

Basement rocks of the Canobolas district are thus comprised of deep oceanic Palaeozoic volcanics and sediments of Gondwanan origin (Scott 2003). Mt Canobolas rises around 500 m above these basement rocks, being the prominent geomorphological feature seen today. The mountain is largely the result of Tertiary volcanism associated with the The Mount Canobolas Volcanic Complex (Sections 1.8, 1.9), upon which the SCA is centred. During the Tertiary period the Australian continental plate, as it drifted northward, passed over hotspots of lava pools in the earth's mantle creating a chain of volcanoes, resulting in a succession of volcanic formations along the eastern highlands of Australia. Mt Canobolas is the southern and westernmost of the volcanic remnants prominently visible in NSW. The eroded cone seen today is the remnant of a compound shield volcano. Extensive and violent eruptive episodes occurred over about ± 1 million years in the Middle to early/Late Miocene, between 13 to 11 million years before present. Lava and pyroclastic material from that era mostly cover the pre-Tertiary highly weathered palaeoplain landscapes within about a 50 km radius of the SCA. The Canobolas volcanic complex initially produced large outpourings of basic lava. Subsequent eruptions of felsic domes and copious amounts of pyroclastic material preceded the extrusion of more mafic trachyte kindred lavas which mantle the area (Middlemost 1981). There are also large quantities of agglomerate and tuff associated with the various lava flows. Subsequent alluvium deposits sometimes overlay lava flows in infilled drainage lines and elsewhere aeolian deposits have formed on rises, covering lava flows.

1.4 Climate

The altitude of the mountain and its height above the surrounding plateau results in highly orographic rainfall patterns. There are no meteorological records for Mt Canobolas, the nearest being Canobolas State Forest (CSF) at Four Mile Creek some 7 km SSE at 989 m altitude. Comparison of temperature data for it and Orange Post Office (OPO) (863 m altitude) (Bureau of Meteorology 2018) are presented in Figure 1a and rainfall in Figure 1b.

Minimum temperatures range from zero in July to about 13 °C in February at both OPO and CSF. In contrast there is about a 2 to 3 °C differential in mean maximum temperatures with CSF being consistently cooler (range 8 to 26 °C) than OPO (range 11 to 28 °C) throughout the year (Figure 1a). This reflects the effects of altitudinal difference of 125 m between the locations. Rainfall likewise shows an altitudinal trend with consistently higher mean monthly recordings for CSF, other than for

June. The long term annual average rainfall for OPO is 875 mm compared with 1100 mm for CSF, some 20% more due to elevation. Being almost 1400 m altitude at the SCA summit, annual precipitation is likely to exceed CSF by at least another 20% to around 1300 mm annually. Rainfall is near evenly distributed throughout the year in the district, other than for slightly drier autumn months and wetter winter.

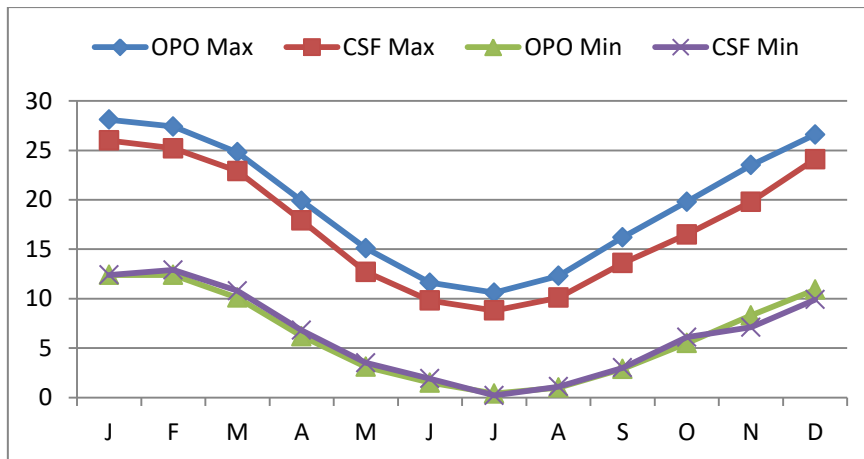


Figure 1a. Mean monthly minimum and maximum temperatures (°C) for Orange Post Office and Canobolas State Forest.

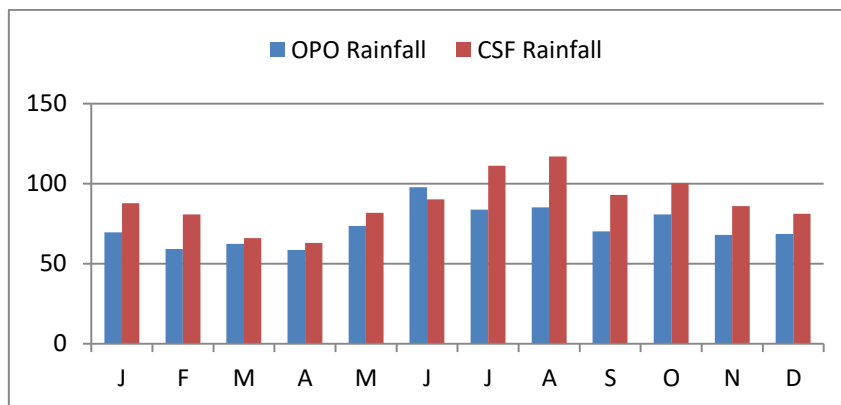


Figure 1b. Mean monthly rainfall (mm) for Orange Post Office and Canobolas State Forest.

Adiabatic influences drive temperatures lower at higher altitudes, hence Mt Canobolas is also likely to experience much cooler temperatures than surrounding areas. Coupled with occasional winter snowfalls, the climate is thus broadly classified as being cool temperate to sub-alpine. On sheltered southerly facing slopes snow can persist for a few weeks and coupled with the wind chill these factors result in sub-alpine temperatures in exposed areas during winter. Temperatures and weather over other seasons can be erratic, changeable and unpredictable due to the local influences of altitude and topography on weather systems. The effectiveness of the higher rainfall is amplified

because of increased cloud cover, fog and cooler temperatures across the mountain which reduces evapotranspiration. Soil moisture retention is further enhanced by the deep clay soils on the slopes and valleys. In addition, mountainous ridges of between 1200 and 1300 m altitude flank the SCA along its southern borders, effectively modifying the climate of the remaining SCA areas from southerly climatic patterns. An internal valley with a narrow outlet is protected by other high ridges on all sides from weather extremes, creating additional climatic microcosms.

1.5 Soils

The regolith landscape of the SCA broadly falls within the ‘Canobolas’, ‘Mt Canobolas’ and ‘Towac’ soil landscapes described by Kovac *et al.* (1990).

The principal soil of the Mt Canobolas landscape is the brownish/black sandy loam alpine humus with weak structure, found in pockets on the summit areas above 1,100 m altitude with slopes of 10 to 15%. Alpine humus soils are friable, well drained with high permeability and water holding capacity and moderate fertility.

On the rolling slopes surrounding the mountain, soils of the Canobolas landscape predominate. The landscape is characterised with relief of 80 to 250 m with rocky outcrops and radial drainage patterns off the summit, having slope runs of up to 1.5 km long and of 30 to 50% inclines. Some shallower drainage depressions occur. Soils range from skeletal sands and loams with some red earths and krasnozems. Elsewhere on the lower slopes of the SCA yellow podzolic/sodic soils of the Towac landscape occur, mostly in drainage lines and depressions.

1.6 Fire History

NPWS (2003b) states wild fire frequency in the SCA is poorly recorded, however it is believed to be quite low. The floristic composition of the SCA suggests that the vegetation has evolved largely in the absence of regular intense fire, probably because of the SCA’s altitude and relatively high rainfall. Further research is needed into fire events, to gain an understanding of fire history.

Available fire records show that a major fire in 1967 affected 415 ha in the northern section of the SCA. This fire originated on a private property inholding within the SCA and was at the end of a period of seasonal drought. One major wildfire affected 414 ha in the western part of the SCA in 1982 and another major fire to the south of the SCA in 1985 was controlled near the southern boundary after burning 83 ha of SCA. Both these latter fires originated some kilometres outside the SCA and entered the SCA under extreme weather conditions during years of below average rainfall. In February 2018 a bushfire ignited outside the SCA boundary and burned some 1160 hectares (70%) of the conservation area.

Information from local land holders indicates that the mountain was subjected to annual low intensity burning by previous occupiers to maintain fresh feed for their stock during the 1940's and 1950's. In recent times the main occurrence of fire in the SCA has been due to the dumping and burning of stolen cars. None of these has developed into a serious fire because of prompt action by local fire fighters and the relatively moist conditions usually found on the mountain.

1.7 Cultural heritage

The scenic grandeur of Mt Canobolas must have impressed the indigenous people as its Wiradjuri name clearly relates to the mountain's visual profile. Canobolas comes from 'coona' meaning shoulder and 'booloo' meaning two, which the Wiradjuri pronounced Ghannabulla, no doubt referring to the two prominent peaks now known as Old Man Canobolas and Young Man Canobolas (Greenwood undated).

As a major Wiradjuri place, Mt Canobolas was an important occupation site used for the sourcing and sharing of food, medicines and tools, and for corroborees and ceremonies particularly relating to men's business. To the Wiradjuri people Ghannabulla is a place of spiritual connection through worship of Baiame (the Creator God and Sky Father) and through the dreaming story of Ghannabulla as one of three feuding brothers (Greenwood undated). Such dreaming stories are known by some people with a strong traditional connection to Orange, but they are not in the public domain.

Initiation ceremonies (burbung) were once held on Mt Canobolas and scatters of stone tools and engravings can be found near the Old Man Canobolas peak (Orange Regional Museum undated). It is supposed that people camped on the mountain during these major ceremonies. Initiation ceremonies may have continued on the site as late as the 1930s and Mt Canobolas remains an important site of traditional knowledge and significance to the Wiradjuri people (NTSCORP 2012).

There is every likelihood that the Wiradjuri people would have had a hand in influencing the vegetation that evolved on the mountain by encouraging species of importance for food and medicine. On the colder tablelands, possum furs were fashioned into cloaks for use during the frigid winter months so Wiradjuri populations may have lived permanently on the mountain or nearby.

Because of its prominence, the mountain is of significance to the Wiradjuri people, past and present, and out of respect to traditional owners should be conserved appropriately.

1.8 Geoheritage

The geoheritage value of Mt Canobolas stems from its geological origins and prominence as a national example of 'shield' volcanism. The visual and aesthetic prominence of the mountain have long been noted and admired but its geoconservation value has been recently ignored. It is of

concern that scenic, cultural and geoheritage values of the Mt Canobolas landscape are not being fully appreciated or formally recognised, despite their high significance.

In 1983 “The Mount Canobolas Volcanic Complex”, Towac Way, Canobolas NSW, Australia (MCVC) was registered under the National Estate (Section 1.9). The Register of the National Estate was frozen in 2007 preventing the addition or removal of places. Seemingly the MCVC was not renominated for consideration in the interim period for protection under any other statutory list or local government heritage register, and the National Estate Register’s statutory basis has been removed/annulled.

The SCA is centralised upon the last-formed of the extinct cores of the MCVC.

Geomorphologically it is thus a relatively young constructional landform set in and spreading over a much older ancient landscape, so has global as well as regional and national significance. The distinctive landscape of the SCA is dominated by intrusions, plugs and domes, with Old Man Canobolas, Young Man Canobolas, Towac Pinnacle and Watt’s Pinnacle being among the more than 50 such provincial features. Middlemost (1981) emphasises that the relationships between the different volcanic rock units at the core is difficult to interpret because of subsidence over the millennia of volcanic activity. However, each of the volcanic vents ceased activity at different times, with the core at the summit of Mt Canobolas being the youngest (Branagan and Packham 2000). The shield which built from the earliest eruptions in the zone consists mainly of hawaiiite, considered to be a trachybasalt. Evolution of the magma chamber produced several different forms of lava over time, mostly of the trachyte kindred. Consequently, the volcanic remnants consist of vents, domes and plugs of individually different lava types and ages.

Given that the SCA is not categorically protected from disturbances such as mining exploration for example, it is warranted to submit that the geoheritage values of the volcanic remnant formations, of world standard, be formally recognised and better conserved from any threats. Their distinct geomorphic significance is not in doubt as a part of Australia’s geoheritage.

1.9. *Geoheritage* - The Register of the National Estate

Report Produced Mon Feb 12 22:32:20 2018

Mount Canobolas Volcanic Complex, Towac Way, Canobolas, NSW, Australia

Photographs



List	Register of the National Estate (Non-statutory archive)
Class	Natural
Legal Status	Registered (01/11/1983)
Place ID	852
Place File No	1/07/233/0007

Statement of Significance

The mount Canobolas volcanic complex dominates the skyline in the Orange region, and consists of a variety of igneous rock types readily accessible to student groups and geologists. Interpretative educational programs have already been initiated for the area, which is popular both with excursion groups and the general public.

(The Commission is in the process of developing and/or upgrading official statements for places listed prior to 1991. The above data was mainly provided by the nominator and has not yet been revised by the Commission.)

Official Values Not Available

Description

Mount Canobolas (1,396m) is an eroded volcanic complex of roughly conical shape with a base 15km in diameter the complex, of micaceous consists of a series of vents (represented by old man and young man Canobolas, and the Pinnacle) now plugged with porphyritic and material which intruded lava flows, tuffs and agglomerates. Basaltic and trachytic lavas widespread throughout the Orange district, probably were subsequently erupted from fissures in the side of the lava cones.

History Not Available

Condition and Integrity

The majority of the volcanic complex is adequately protected with the boundaries of the State Park and adjacent state forest. Conservation work and interpretative signposting of natural features is proceeding.

Location

About 1,700 ha, Towac Way and Glengariffe Forest Road, Canobolas, 10km south-west of Orange and comprising all that area within the external boundary of Mount Canobolas Park (1983 boundary).

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Appendix 2

Bryophytes recorded for the Mt Canobolas SCA – information extracted from Downing *et al.* (2002).

Bryophytes are comprised of mosses, liverworts and hornworts. They are often referred to as ‘lower plants’ and are regularly overlooked in biological surveys but form an important component of the vegetation.

An initial survey of bryophytes on Mt Canobolas identified 75 species, including 60 moss species, 13 liverwort species and two hornwort species (Downing *et al.* 2002). Although no endemic bryophyte species were recorded, the assemblage included an unusual combination of alpine, arid zone and rainforest species. Areas of exposed rock on the upper flanks of the mountain in seepage areas are particularly species rich. The geology of the area is complex and the presence of certain species at particular locations is probably determined by the chemical composition of the substrate rock, although clear patterns could not be discerned. The authors gave an example of a most unusual combination of two opposed species growing together: *Encalypta vulgaris*, a calcicole (i.e. a species found only on calcareous substrates) and *Campylopus introflexus*, a calcifuge (i.e. a species never found growing on calcareous substrates). Around the summit some rare alpine species previously known only from Yarrangobilly Caves in the Alps occurred together with species from the arid zones to the west. Elsewhere in the SCA in a cool moist and shady gully habitat a thallose epiphytic liverwort occurred; a species usually associated with rainforest gullies of the coast and coastal ranges.

Polytrichastrum alpinum, a rare species in NSW previously recorded only above 1500 metres in alpine areas of Kosciuszko National Park, was collected in the SCA at 1206 m alt. A number of uncommon species were recorded in the SCA, including the mosses *Bryoerythrophyllum jamesonii*, *Leptodontium paradoxum*, *Hymenostomum microstomum* var. *brachycarpa*, *Orthotrichum assimile*, *Tortula anderssonii*, *T. rubella* and *T. ruralis*, the liverwort *Riccia crozalsii* and the hornwort *Anthoceros* cf. *punctatus*.

Mosses and liverworts, as for the lichen communities within the SCA, are most conspicuous in areas of bare rock or soil, in particular the rocky areas and broad rock exposures in the heath/lichen communities. These landscapes are especially vulnerable from pressures of tourism foot traffic around some of the most popular lookout points.

Grassy woodlands are usually devoid of bryophytes. Not so in the SCA where a number of rare and uncommon species occurred on roadside banks, walking trail margins, fallen logs, on rough basal

bark of eucalypts and exposed rocks in the grassy woodlands which are the prominent vegetation communities within the SCA.

All of the above unusual bryophyte assemblages further emphasise the importance of the SCA as a refugium for biodiversity.

2.1 Mosses

Bartramiaceae

Bartramia hampeana, *B. ithyphylla*, *Breutelia affinis*, *Philonotis scabrifolia*, *P. tenuis*

Brachytheciaceae

Brachythecium rutabulum, *B. paradoxum*

Bryaceae

Bryum apiculatum, *B. argenteum*, *B. caespiticium*, *B. campylothecium*, *B. creberrimum*, *B. dichotomum*, *B. radiculosum*, *Rosulabryum billarderi*, *R. torquescens*

Dicranaceae

Campylopus australis, *C. introflexus*

Ditrichaceae

Ceratodon purpureus, *Ditrichum difficile*, *Eccremidium pulchellum*, *Pleuridium nervosum*

Encalyptaceae

Encalypta vulgaris

Fabroniaceae

Fabronia australis

Fissidentaceae

Fissidens asplenioides, *F. leptocladus*, *F. megalotis*, *F. pungens*, *F. taylorii*

Funariaceae

Entosthodon muhlenbergii, *E. subnudus* var. *gracilis*, *Funaria apophysata*

Grimmiaceae

Grimmia laevigata, *G. longirostris*, *G. pulvinata*, *G. trichophylla*, *Schistidium apocarpum*

Hedwigiaceae

Hedwigidium integrifolium

Hypnaceae

Hypnum cupressiforme

Orthotrichaceae

Orthotrichum assimile, *Zygodon intermedius*

Polytrichaceae

Polytrichastrum alpinum, *P. juniperinum*

Pottiaceae

Barbula calycina, *B. crinita*, *Bryoerythrophyllum jamesonii*, *Didymodon subtorquatus*,
Hymenostomum microstomum var. *brachycarpa*, *Leptodontium paradoxum*, *Tortula anderssonii*,
T. antarctica, *T. muralis*, *T. pagorum*, *T. papillosa*, *T. rubella*, *T. ruralis*, *Triquetrella papillata*

Racopilaceae

Racopilum cuspidigerum

Splachnaceae

Tayloria octoblepharum

Thuidiaceae

Thuidium sparsum

2.2 Liverworts

Aytoniaceae

Asterella drummondii

Cephaloziellaceae

Cephaloziella exiliflora, *C. arctica* subsp. *subantarctica*

Codoniaceae

Fossombronia sp.

Frullaniaceae

Frullania pentapleura, *F. probosciphora*, *F. wildii*

Geocalycaceae

Chiloscyphus fissistipus, *C. semiteres*

Metzgeriaceae

Metzgeria decipiens, *M. furcata*

Ricciaceae

Riccia crozalsii, *R. rorida*

2.3 Hornworts

Anthocerotaceae

Anthoceros cf. *punctatus*, *Phaeoceros laevis*

Appendix 3

Vascular plant species recorded within the Mt Canobolas SCA

- based on Hunter (2002), supplemented by Atlas of Living Australia records interpreted with local expertise and first-hand knowledge additions and comments.

3.1 *Gymnosperms*

One native naked seeded species *Callitris endlicheri* [Black Cypress Pine] is uncommon in the SCA, occurring only in an area known as Devils Hole. **Pinus radiata* [Monterey Pine] is a common wilding in the SCA having spread into the native remnants from surrounding State Forest and private commercial softwood plantation forests.

3.2 *Ferns and Allies*

Fourteen fern species in six families have been recorded in the SCA. Four of these species *Blechnum nudum*, *Lastreopsis acuminata*, *Pellaea nana* and *Polystichum proliferum* are at their westernmost geographic range within the Central Tablelands.

Hunter (*op. cit.*) records of *Pteris tremula* [Tender Brake] and *Rumohra adiantiformis* are not substantiated, however the former does occur elsewhere in the Orange district. There are no records of the latter in western watersheds.

Aspleniaceae

Asplenium flabellifolium [Butterfly or Necklace Fern], *Pleurosorus subglandulosus* [Blanket Fern]

Blechnaceae

Blechnum nudum [Fishbone Water Fern]

Dennstaedtiaceae

Histiopteris incisa [Bat's Wing Fern], *Pteridium esculentum* [Australian Bracken]

Dryopteridaceae

Lastreopsis acuminata [Creeping Shield Fern], *Polystichum proliferum* [Mother Shield Fern]

Ophioglossaceae

Ophioglossum lusitanicum [Adders Tongue]

Pteridaceae

Adiantum aethiopicum [Common Maidenhair], *Cheilanthes austrotenuifolia* [A Rock Fern], *C. distans* [Woolly Cloak Fern], *C. sieberi* subsp. *sieberi* [A Rock Fern], *Pellaea falcata* [Sickle Fern], *P. nana* [Dwarf Sickle Fern]

3.3 *Monocotyledons*

More than 100 grass, rush, lily, sedge and orchid species have been recorded within the SCA. The diversity is spread across 10 families and 55 genera. Twenty nine of the 104 monocotyledonous species have regional significance. *Lomandra confertifolia* subsp. *pallida* is a northern species at its southernmost geographic range. Conversely one grass, *Poa tenera* [with outliers at Olinda and Cox's Gap], and eight orchid species, *Arthrochilus huntianus*, *Caladenia congesta* [a doubtful

record for Mudgee], *C. dimorpha* [outliers at Cumnock, Mudgee and Barrington Tops], *C. phaeoclavia* [outliers at Clandulla and Moonbi Range], *Chiloglottis valida*, *Diuris pardina* [outliers just north of Orange, and Mudgee], *Pterostylis aestiva*, and *Thelymitra simulata* are southern species more or less at their northern range limits on or near the SCA.

A further 17 eastern species are at their westernmost range in the CT on the SCA. These include *Dianella caerulea* var. *caerulea*, *Lepidosperma gunnii*, the sedges *Carex breviculmis*, *C. gaudichaudiana*, *C. longibrachiata* and *Isolepis subtilissima*, two rushes *Luzula modesta* and *L. ovata* which have alpine affiliations, and seven orchids *Corybas hispidus*, *Dipodium punctatum* [also in Warrumbungles], *Gastrodia sesamoides*, *Genoplesium sagittiferum* [material in Conimbla NP has been reclassified], *Pterostylis coccinea*, *P. decurva* and *Spiranthes australis*.

Two monocots are endemic to the SCA. *Bulbine petraea* [ms] is an undescribed endemic species that occurs in rocky areas [J Bruhl *pers comm.* 2018]. The species has been separated from the *B. glauca* complex based primarily on seed morphology. *Prasophyllum* sp. aff. *odoratum* is likewise a new undescribed species [D Jones *pers comm.* 2018].

Antheriaceae

Arthropodium milleflorum [Pale Vanilla-lily], *A. minus*, *Thysanotus tuberosus* [Common Fringe-lily]

Asphodelaceae

Bulbine bulbosa [Native Leek], *B. petraea* [ms.]. *Bulbine petraea* is endemic to the SCA.

Colchicaceae

Burchardia umbellata [Milkmaids], *Wurmbea dioica* subsp. *dioica* [Early Nancy]

Cyperaceae

Carex appressa [Tall Sedge], *C. breviculmis* [Grassland Sedge], *C. gaudichaudiana*, *C. incomitata*, *C. inversa* [Knob Sedge], *C. longibrachiata* [Australian Sedge], *Cyperus flavidus* [Yellow Flat-sedge], *C. sanguinolentus*, *Eleocharis acuta*, *E. atricha*, *Isolepis australiensis*, *I. gaudichaudiana* [Benambra Club-Sedge], *I. hookeriana*, *I. subtilissima*, *Lipocarpha microcephala* [Button Rush], *Lepidosperma gunnii*, *L. laterale*, *Schoenus apogon* [Common Bog-rush]

Three species recorded by Hunter (*op. cit.*) are in doubt for the area *Fimbristylis dichotoma*, *Gahnia aspera* and *Oreobolus pumilio* subsp. *pumilio*.

Juncus

Juncus australis, *J. bufonius* [Toad Rush], *J. fockei*, *J. homalocaulis*, *J. remotiflorus*, *J. sarophorus* [Leafless Rush], *J. subsecundus*, *J. vaginatus*, *Luzula densiflora*, *L. flaccida*, *L. modesta*, *L. ovata* [Clustered Wood-rush]

Lomandraceae

Lomandra confertifolia subsp. *pallida*, *L. filiformis*, *L. longifolia*, *L. multiflora* subsp. *multiflora*

Orchidaceae

Arthrochilus huntianus [Elbow Orchid], *Caladenia congesta*, *C. cucullata*, *C. dimorpha*, *C. fitzgeraldii*, *C. gracilis* [Musky Caladenia], *C. phaeoclavia*, *Calochilus campestris*, *C. robertsonii*, *Chiloglottis trilabra*, *C. valida* [Alpine Bird-Orchid], *Corybas hispidus*, *Diuris*

pardina [Leopard Orchid], *D. sulphurea* [Tiger Orchid], *Dipodium punctatum*, *Eriochilus cucullatus*, *Gastrodia sesamoides*, *Genoplesium sagittiferum*, *Microtis parviflora*, *M. uniflora* [Common Onion Orchid], *Prasophyllum brevifolium*, *P. sp. aff. odoratum*, *Pterostylis aestiva*, *P. coccinea*, *P. decurva*, *P. laxa*, *P. nutans*, *P. rubescens*, *P. sp. B*, *P. tenuis*, *Spiranthes australis* [Ladies' Tresses], *Thelymitra brevifolia*, *T. carnea*, *T. ixioides*, *T. megcalyptra*, *T. pauciflora*, *T. peniculata*, *T. simulata*.

Diuris maculata and *D. semilunulata* recorded for the SCA are now considered to be a part of *D. pardina*. Other observations recorded for *Caladenia fuscata*, *C. tentaculata*, *Chiloglottis reflexa*, *C. pluricallata*, *Cryptostylis subulata*, *Dipodium roseum*, *D. variegatum*, *Diuris punctata*, *Pterostylis falcata*, *P. longifolia*, *P. pedunculata* and *P. striata* are unsubstantiated for the SCA and require verification.

Phormiaceae

Dianella caerulea var. *caerulea* [Blue Flax Lily, Blueberry Lily], *D. longifolia* var. *longifolia*, *D. revoluta* var. *revoluta* [Black-anther Flax Lily], *D. tasmanica* [Flax Lily], *Stypandra glauca* [Nodding Blue Lily]

Observations of *Dianella caerulea* var. *caerulea* and *D. tasmanica* are questionable – these are problematic taxa and could possibly be undescribed species.

Poaceae

**Aira cupaniana* [Silvery Grass], *Anthosachne scabra* [Wheatgrass], *Aristida ramosa* var. *scaberula*, *Austrostipa densiflora*, *A. scabra* [Speargrass], **Briza maxima* [Quaking Grass], **Bromus sterilis* [Sterile Brome], *Cymbopogon refractus* [Barbed Wire Grass], **Dactylis glomerata* [Cocksfoot], *Dichelachne micrantha* [Shorthair Plumegrass], *Digitaria brownii* [Cotton Panic Grass], *Echinopogon caespitosus* [Tufted Hedgehog Grass], *E. ovatus* [Forest Hedgehog Grass], *Eragrostis brownii* [Brown's Lovegrass], *Imperata cylindrica* [Blady Grass], *Microlaena stipoides* var. *stipoides* [Meadow Rice Grass], **Paspalum dilatatum* [Paspalum], **Poa annua* [Winter Grass], *P. labillardieri* var. *labillardieri* [Poa Tussock], *P. sieberiana* var. *cyanophylla* [Blue-leaf Tussock-grass], *P. sieberiana* var. *sieberiana* [Snow Grass], *P. tenera* [Slender Tussock Grass], *Rytidosperma erianthum* [A Wallaby Grass], *R. penicillata* [Slender Wallaby Grass], *R. pilosa* [Smooth-flower Wallaby Grass], *R. racemosa*, **Sorghum halepense* [Johnson Grass], *Themeda triandra* [Kangaroo Grass], *Tripogon loliiformis* [Fiveminute Grass]

Observations by Hunter (*op. cit.*) of *Digitaria breviglumis* and *Paspalidium constrictum* are unusual for the SCA so need to be verified.

Xanthoraceae

Xanthorrhoea glauca subsp. *angustifolia* [A Grasstree]

3.4 Dicotyledons

The so called broadleaf vascular plants are one of the largest and most important vegetation components of biota within the SCA as they encompass the trees, shrubs and many of the herbaceous elements. In all some 176 species in 53 families and 138 genera show a great diversity. Three super families, Asteraceae, Fabaceae and Myrtaceae account for slightly more than half of the dicot diversity.

There are two threatened species, both endemic to the MCV – *Eucalyptus canobolensis* and *Prostanthera gilesii*. It is likely that a species of *Asterolasia*, extremely rare within the SCA, and a *Phebalium* taxon will be recognised as new species endemic to the SCA [I Telford and J Bruhl *pers. comm.* 2018].

The dicots also represent an important living gene bank as 67 species [38%] are at their geographical range limits on or near Mt Canobolas. Two taxa, *Brachyscome dissectifolia* and *Wahlenbergia planiflora* subsp. *longipila* are northern species at their southernmost range limit on Mt Canobolas. *Asperula pusilla*, *Astrotricha ledifolia* [outliers at Olinda, Tamworth and Tenterfield], *Calotis scabiosifolia* var. *integrifolia*, *Cassinia aculeata* subsp. *aculeata* [outliers at Mt Airly and Point Lookout], *C. longifolia* [northern records probably *straminea*], *Hydrocotyle algida*, *Mirbelia oxylobioides* [outliers at Mt Kaputar], *Montia fontana* subsp. *chondrosperma* and *Ranunculus amphitrichus* [outliers at Moonan Brook, Walcha and Uralla] are southern species with their core population northern range limit within the CT on and around the SCA.

A considerable number of species of predominantly eastern distribution have their westernmost range in the CT on or around the SCA, including *Acacia melanoxylon*, *Acaena novae-zelandiae*, *Acrotriche serrulata*, *Billardiera scandens*, *Bossiaea buxifolia*, *Cardamine gunnii*, *Coprosma quadrifida*, *Desmodium gunnii*, *Eleocharis atricha*, *Eucalyptus dalrympleana* subsp. *dalrympleana*, *E. dives*, *E. pauciflora*, *E. stellulata*, *E. viminalis*, *Geranium homeanum*, *G. potentilloides* var. *potentilloides*, *Gratiola peruviana*, *Hovea heterophylla*, *Hydrocotyle peduncularis*, *Hypericum japonicum*, *Lagenophora stipitata*, *Leptospermum myrtifolium* [possible outlier at West Wyalong], *Leucopogon ericoides*, *L. fraseri* [outlier in Goobang NP], *Lilaeopsis polyantha*, *Monotoca scoparia* [outlier in Bumberry Range], *Neopaxia australasica*, *Olearia chrysophylla*, *O. erubescens*, *O. megalophylla*, *O. phlogopappa* subsp. *continentalis*, *Oreomyrrhis eriopoda*, *Oxalis chnoodes*, *Pimelea curviflora* var. *gracilis*, *P. latifolia* subsp. *hirsuta*, *P. ligustrina* subsp. *ligustrina*, *P. linifolia* subsp. *caesia*, *Polyscias sambucifolia* subsp. *decomposita*, *Pomaderris aspera*, *Pultenaea polifolia*, *P. subternata*, *Scleranthus biflorus*, *Senecio diaschides*, *S. linearifolius* var. *arachnoideus*, *S. minimus*, *S. prenanthoides*, *Stellaria flaccida*, *Veronica calycina*, *V. derwentiana* subsp. *subglauca*, *V. gracilis* and *Viola hederacea*.

Besides being at their natural range limits, a number of these species are extremely rare within the SCA and their colonies are quite disjunct, some by > 50 km, with no other colonies known within the Orange district, e.g. *Coprosma quadrifida*, *Lilaeopsis polyantha*, *Mirbelia oxylobioides*, *Olearia chrysophylla*, *O. megalophylla*, *O. phlogopappa* subsp. *continentalis*, *Pimelea latifolia* subsp. *hirsuta*, *P. linifolia* subsp. *caesia*, *Polyscias sambucifolia* subsp. *decomposita*, *Pomaderris aspera*, *Pultenaea polifolia* and *Veronica derwentiana* subsp. *subglauca*.

Adoxaceae

**Sambucus nigra* [Elderberry]

Apiaceae

Daucus glochidiatus form F [Native Carrot], *Hydrocotyle algida* [Pennywort], *H. laxiflora* [Stinking Pennywort], *H. sibthorpioides*, *Lilaeopsis polyantha*, *Oreomyrrhis eriopoda* [Australian Carraway]

Records of *Actinotus helianthi* and *Hydrocotyle pedicellosa* are unusual for the SCA and need to be verified.

Ameranthaceae

Alternanthera sp. A

Araliaceae

Astrotricha ledifolia, **Hedera helix* [English Ivy], *Polyscias sambucifolia* subsp. *decomposita* [Ferny Panax], **Tetrapanax papyrifer*

Occurrence of *Polyscias sambucifolia* subsp. *decomposita* in Towac Creek area is the only known record of the species for the Orange district.

Records of *Astrotricha linearis* for the SCA are considered to be a misidentification of *A. ledifolia*.

Asteraceae

**Bidens pilosa* [Cobblers Pegs], *Brachyscome dissectifolia* [Swamp Daisy], *B. ptychocarpa* [Tiny Daisy], *B. spathulata*, *Calotis scabiosifolia* var. *integrifolia*, *Cassinia aculeata* subsp. *aculeata* [Dolly Bush], *C. laevis* subsp. *rosmarinifolia* [Cough Bush], *C. longifolia* [Shining Cassinia], *C. sifton* [Sifton Bush], **Chondrilla juncea* [Skeleton Weed], *Chrysocephalum apiculatum* [Common Everlasting], *C. semipapposum* [Clustered Everlasting], **Cirsium vulgare* [Spear Thistle], **Conyza bonariensis* [Flaxleaf Fleabane], **C. sumatrensis* [Tall Fleabane], *Coronidium scorpioides* [Button Everlasting], *Craspedia variabilis* [Common Billy Buttons], **Crepis capillaris* [Smooth Hawksbeard], *Cymbonotus lawsonianus* [Bears-ear], *C. preissianus* [Austral Bear's Ear], *Euchiton japonicus* [Creeping Cudweed], *E. sphaericus* [Common Cudweed], **Hypochaeris radicata* [Flatweed], *Lagenophora stipitata* [Blue Bottle-daisy], *Microseris lanceolata* [Yam Daisy], *Olearia chrysophylla*, *O. erubescens* [Moth Daisy-bush], *O. megalophylla* [Large Daisy-bush], *O. phlogopappa* subsp. *continentalis* [Dusty Daisy-bush], *Senecio bathurstianus*, *S. diaschides*, *S. hispidulus* [Hill Fireweed], *S. linearifolius* var. *arachnoideus* [Fireweed Groundsel], *S. minimus*, *S. pinnatifolius* var. *lanceolatus*, *S. prenanthoides*, *S. quadridentatus* [Cotton Fireweed], *Sigesbeckia australiensis*, *S. orientalis* subsp. *orientalis* [Indian Weed], **Silybum marianum* [Variegated Thistle], **Sonchus oleraceus* [Common Sowthistle], **Taraxacum officinale* [Dandelion], *Vittadinia cuneata* var. *cuneata* [A Fuzzweed], *Xerochrysum bracteatum* [Golden Everlasting]

Recordings of *Cassinia uncata*, *Olearia stellulata* and *Senecio biserratus* cannot be substantiated for the SCA. Records of *Olearia chrysophylla* and *O. megalophylla* may be one and the same and require closer taxonomic scrutiny.

Boraginaceae

**Amsinckia calycina* [Yellow Gromwell], **A. intermedia* [Common Fiddleneck], **Anchusa arvensis* [Wild Bugloss], *Cynoglossum australe*, **Echium vulgare* [Vipers Bugloss], *Hackelia suaveolens*, *Myosotis australis* [Austral Forget-me-not], **M. discolor*

Brassicaceae

Cardamine gunnii [Spade-leaf Bittercress], *C. paucijuga*, **Hirschfeldia incana* [Buchan Weed]

Callitrichaceae

**Callitriche stagnalis* [Common Starwort]

Campanulaceae

Wahlenbergia communis, *W. luteola*, *W. planiflora* subsp. *longipila*, *W. stricta* subsp. *stricta*
[Tall Bluebell]

Records of *Wahlenbergia ceracea* is possible but unusual for the area and need to be verified.
The numerous recordings for *Wahlenbergia victoriensis* are considered to be misidentifications
of *Wahlenbergia planiflora* subsp. *longipila*.

Caprifoliaceae

**Lonicera japonica* [Japanese Honeysuckle]

Caryophyllaceae

**Cerastium balearicum* [Lesser Mouse-ear Chickweed], **C. glomeratum* [Mouse-ear
Chickweed], **Petrorhagia nanteuilii*, *Scleranthus biflorus* [Knawel], *Stellaria angustifolia*
[Swamp Starwort], *S. flaccida*, *S. pungens* [Prickly Starwort]

A record for *Stellaria multiflora* is not substantiated for the SCA.

Celastraceae

A recorded observation of *Denhamia silvestris* is not substantiated for the SCA.

Chenopodiaceae

Dysphania pumilio [Small Crumbweed]

Clusiaceae

Hypericum gramineum [Small St. John's Wort], *H. japonicum*, **H. perforatum* [St. John's Wort]

An observation record of **Hypericum androsaemum* is not substantiated for the SCA.

Convolvulaceae

Convolvulus erubescens, *Dichondra repens* [Kidney Weed]

Crassulaceae

Crassula sieberiana [Australian Stonecrop]

Observation records of *Crassula colorata* var. *acuminata* are not substantiated for the SCA.

Dilleniaceae

Hibbertia calycina [Lesser Guinea Flower], *H. obtusifolia* [Grey Guinea Flower], *H. riparia*
[Erect Guinea Flower]

Records for *Hibbertia incana*, *H. sericea* and *H. vestita* are not substantiated for the SCA.

Droseraceae

Drosera auriculata [A Sundew], *D. peltata* [Pygmy Sundew]

Epacridaceae

Acrotriche serrulata [Honey Pots], *Leucopogon attenuatus*, *L. ericoides*, *L. fraseri*, *L. virgatus*,
Melichrus urceolatus [Urn Heath], *Monotoca scoparia* [A Broom Heath]

Records of *Brachyloma daphnoides* subsp. *glabrum* and *Leucopogon fletcheri* subsp.
brachysepalus are very unusual for the area and need to be verified.

Fabaceae

Acacia brownii [Heath Wattle], *A. buxifolia* subsp. *buxifolia* [Box-leaf Wattle], *A. dealbata* subsp. *dealbata* [Silver Wattle], *A. gunnii* [Ploughshare Wattle], *A. lanigera* var. *lanigera* [Woolly Wattle], *A. melanoxylon* [Blackwood], *A. ulicifolia* [Prickly Moses], *A. verniciflua* [Varnish Wattle], *Bossiaea buxifolia*, **Cytisus scoparius* subsp. *scoparius* [Scotch Broom], *Daviesia latifolia* [Hop Bitter-pea], *D. leptophylla*, *Desmodium gunnii* [Slender Tick Trefoil], *D. varians* [Slender Tick Trefoil], *Dillwynia phyllicoides*, **Genista monspessulana* [Montpellier Broom], *Glycine clandestina*, *G. tabacina*, *Hardenbergia violacea* [Purple Coral Pea], *Hovea heterophylla*, *Indigofera adesmiifolia* [Tick Indigo], *I. australis* [Australian Indigo], *Lotus australis* [Australian Trefoil], **Medicago polymorpha* [Burr Medic], *Mirbelia oxylobioides* [Mountain Mirbelia], *Pultenaea polifolia* [Dusky Bush-pea], *P. setulosa* [Stony Bush-pea], *P. spinosa* [Spiny Bush-pea], *P. subternata*, **Trifolium arvense* [Haresfoot Clover], **T. dubium* [Yellow Suckling Clover], **T. repens* [White Clover], **Ulex europaeus* [Gorse], **Vicia villosa* subsp. *villosa* [Russian Vetch]

Records for *Acacia binervata*, *A. binervia*, *A. deanei* subsp. *paucijuga* [Green Wattle], *A. falciformis*, *A. irrorata* subsp. *irrorata*, *A. vestita*, *Bossiaea neo-anglica*, *B. scortechinii*, *Lespedeza juncea*, *Hovea linearis*, *Oxylobium ellipticum*, *Pultenaea aristata* and *P. lapidosa* are not substantiated for the SCA.

A part of the *Pultenaea setulosa* taxonomic complex that is restricted to Broad Sound in the Marlborough area in Queensland is listed as Threatened under the EPBC Act. The listing however does not apply to material occurring in the SCA under this taxon.

Gentianaceae

**Centaurium erythraea* [Common Centuary], **C. tenuiflorum*

Geraniaceae

Geranium homeanum, **G. molle* subsp. *molle* [Cranesbill Geranium], *G. potentilloides* var. *potentilloides*, *G. solanderi* var. *solanderi* [Native Geranium], *Pelargonium australe* [Native Storksbill]

Goodeniaceae

Goodenia hederacea subsp. *hederacea* [Ivy Goodenia, Forest Goodenia]

Goodenia rotundifolia is an unsubstantiated record.

Haloragaceae

Gonocarpus elatus, *Gonocarpus tetragynus* [Raspwort], *Haloragis heterophylla* [Rough Raspwort], *H. serra*

G. teucrioides is an unsubstantiated record.

Lamiaceae

Ajuga australis, *Mentha satureioides*, **Marrubium vulgare* [Horehound], *Prostanthera gilesii*, **Prunella vulgaris* [Self-heal], *Scutellaria humilis* [Dwarf Skullcap]

The record of *Mentha satureioides* is most likely a misidentification of *M. diemenica* [Slender Mint] which is common in the district.

Prostanthera gilesii is endemic to the SCA. It is known only from two small localised colonies and has been gazetted as Critically Endangered under the BC Act.

Lauraceae

Cassytha pubescens

Loranthaceae

Amyema miquelii, *A. pendula* subsp. *pendula*

Malaceae

**Cotoneaster glaucophyllus*, **Crataegus monogyna* [Hawthorn]

Myrtaceae

Calytrix tetragona [Common Fringe-myrtle], *Eucalyptus blakelyi* [Blakely's Red Gum], *E. bridgesiana* [Apple Box], *E. canobolensis*, *E. dalrympleana* subsp. *dalrympleana* [Mountain Gum], *E. dives* [Broad-leaved Peppermint], *E. goniocalyx* [Long-leaved Box, Bundy], *E. macrorhyncha* [Red Stringybark], *E. pauciflora* [Snow Gum], *E. polyanthemos* subsp. *polyanthemos* [Red Box], *E. stellulata* [Black Sally], *E. viminalis* [Manna Gum], *Kunzea parvifolia* [Violet Kunzea], *Leptospermum myrtifolium* [Myrtle Tea-tree]

Records for *Eucalyptus deanei*, *E. mannifera* subsp. *praecox*, *E. nobilis* [Ribbon Gum], *E. radiata* subsp. *radiata*, *E. rubida* subsp. *rubida*, *E. sieberi*, *Leptospermum brevipes*, *L. polygalifolium* subsp. *transmontanum* [Tantoon] require substantiation.

Records of *Eucalyptus perriniana* [Spinning Gum] and *E. pulverulenta* [Silver-leaved Mountain Gum] relate to occurrences that are considered to have been intentionally introduced. Both species have been widely cultivated and/or offered commercially in the district.

Eucalyptus saxicola has been synonymised with *Eucalyptus bridgesiana* and its conservation status rescinded.

Eucalyptus canobolensis is confined to the Mt Canobolas precinct. It is gazetted as Vulnerable under the BC Act and as Endangered under the EPBC Act.

Onagraceae

Epilobium billardierianum subsp. *cinereum* [A Willowherb]

Orobanchaceae

**Orobanche minor* [Broomrape]

Oxalidaceae

Oxalis chnoodes, *O. exilis*, *O. perennans*

Phyllanthaceae

Phyllanthus occidentalis [A Thyme-spurge], *Poranthera microphylla*

Pittosporaceae

Billardiera scandens [Hairy Apple Berry], *Rhytidosporum procumbens*

Plantaginaceae

Gratiola peruviana [Australian Brooklime], **Plantago lanceolata* [Lamb's Tongue], *P. varia*, **Veronica anagallis-aquatica* [Blue Water Speedwell], **V. arvensis* [Wall Speedwell], *V. calycina* [Hairy Speedwell], *V. derwentiana* subsp. *subglauca*, *V. gracilis* [Slender Speedwell]

Veronica derwentiana subsp. *subglauca* has anomalous features and may be an undescribed species. A record of *Plantago debilis* is not substantiated for the SCA.

Polygonaceae

**Acetosella vulgaris* [Sorrel], *Rumex brownii* [Swamp Dock]

Portulacaceae

Neopaxia australasica, *Montia fontana* subsp. *chondrosperma*

Proteaceae

Hakea decurrens subsp. *decurrens*, *Persoonia rigida*

Ranunculaceae

Ranunculus amphitrichus [Small River Buttercup], *R. inundatus* [River Buttercup], *R. lappaceus* [Common Buttercup], *R. pumilio* var. *pumilio* [Ferny Buttercup], *R. pumilio* var. *politus* [Ferny Buttercup]

Rhamnaceae

Cryptandra amara var. *amara* [Bitter Cryptandra], *Pomaderris aspera* [Hazel Pomaderris]

Material of the *C. amara* complex present on Mt Canobolas often has a prominent spininess and has been incorrectly identified as *C. spinescens* on occasions.

Occurrence of *Pomaderris aspera* in Towac Creek is the only known record of the species for the Orange district.

Rosaceae

Acaena novae-zelandiae [Bidgee-widgee], *A. ovina* [Sheeps Burr], *Aphanes australiana*, **Rosa rubiginosa* [Sweet Briar], **Prunus laurocerasus* [Cherry Laurel], **Rubus anglocandicans* [Blackberry], **R. ulmifolius* [Blackberry], *R. parvifolius* [Native Raspberry], **Sanguisorba minor* [Salad Burnet]

Rubiaceae

Asperula conferta [Common Woodruff], *A. pusilla*, *Coprosma quadrifida* [Prickly Currant Bush], **Galium aparine* [Cleavers], **G. divaricatum* [Slender Bedstraw], *G. gaudichaudii* [Rough Bedstraw], *G. leptogonium* [A Bedstraw], **G. murale* [Small Bedstraw], *Pomax umbellata*

Occurrence of *Coprosma quadrifida* in Towac Creek area is the only known record of the species for the Orange district.

The record of *Nertera granadensis* by Hunter (*op. cit.*) is a most unusual record for the area and needs to be substantiated.

Rutaceae

Asterolasia rupestris subsp. *rupestris*, *Phebalium squamulosum* complex

Both of these taxa are most unusual. The *Asterolasia* is uncommon to rare and highly localised to one small population. It has taxonomic issues. The *Phebalium* is slightly more abundant in the SCA and has been a source of much taxonomic confusion. The occurrences of both entities are confined to the SCA in the district and one or both may turn out to be new species endemic to the SCA.

The observation of *Correa reflexa* var. *reflexa* by Hunter (*op. cit.*) is a most unusual record for the SCA and needs to be substantiated.

Salicaceae

**Salix x fragilis* nothovar. *fragilis* [Crack Willow]

Santalaceae

Exocarpos cupressiformis [Native Cherry], *E. strictus* [Dwarf Cherry]

Sapindaceae

Dodonaea boroniifolia [Fern-leaf Hopbush], *D. viscosa* subsp. *angustissima* [Narrow-leaved Hopbush]

Scrophulariaceae

**Orobanche minor*, **Verbascum thapsus* subsp. *thapsus* [Great Mullein], **V. virgatum* [Twiggy Mullein]

Solanaceae

**Datura stramonium* [Common Thornapple]

Stackhousiaceae

Stackhousia monogyna [Creamy Candles]

A record of *Stackhousia viminea* is not substantiated for the SCA.

Stylidiaceae

Stylidium graminifolium [Grass Trigger Plant]

Thymelaeaceae

Pimelea curviflora var. *gracilis*, *P. latifolia* subsp. *hirsuta*, *P. ligustrina* subsp. *ligustrina* [Tall Rice Flower], *P. linifolia* subsp. *caesia*

A record for *Pimelea curviflora* var. *divergens* is interpreted as an old name for *P. curviflora* var. *gracilis*.

Urticaceae

Urtica incisa

Violaceae

Viola betonicifolia [Native Violet], *V. hederacea* [Ivy-leaved Violet]

Appendix 4

Fungi recorded within Mt Canobolas SCA

Opportunistic observations of Basidiomycota fungi have resulted in the recording of a gilled mushroom, *Cortinarius globuliformis*, an exotic rust **Phragmidium violaceum* [Violet Bramble Rust] and three species of truffle-like fungi, namely *Cystangium seminudum*, *C. sessile* and *C. shultziae*. The record of basidiomycetes is particularly depauperate for the SCA and dedicated study will undoubtedly identify many additional taxa.

A more extensive record of Ascomycota fungi, mainly lichens, shows a great diversity of over 90 species growing on logs, tree trunks, branches, soil and rocks in the SCA. These occur in some 20 families and 35 genera.

A lichen community of at least nine species of foliose lichens has been recognised in the SCA. Known as the Mt Canobolas *Xanthoparmelia* Lichen Community, the assemblage consists of *Cladia fuliginosa*, *Xanthoparmelia canobolasensis*, *X. digitiformis*, *X. metaclystoides*, *X. metastrigosa*, *X. multipartita*, *X. neorimalis* and *X. sulcifera*. It occurs on rock faces and soils unique to the Mt Canobolas volcanic complex. *Xanthoparmelia metastrigosa* is known only from Mt Canobolas, and *X. sulcifera* and *C. fuliginosa* are each known from only a limited number of localities in NSW. *Xanthoparmelia canobolasensis* occurs only on Mt Canobolas and one locality in Tasmania.

Because of various identified threats to the assemblage, including from development, tourism visitation, rock collecting and infrastructural works it has been gazetted as an Endangered Ecological Community under the BC Act (Scientific Committee 2001).

It is likely that microfauna and many species of invertebrates are associated with the lichens, but these have not been studied.

4.1 Ascomycota

Acarosporaceae

Acarospora fuscata, *A. nodulosa*, *A. schleicheri*, *Sarcogyne sekikaica*

Candelariaceae

Candelariella coralliz, *C. vitellina*

Cladoniaceae

Cladia aggregata, *C. corallaizon*, *C. fuliginosa*, *C. muelleri*, *Cladonia chlorophaea*, *C. corniculata*, *C. fimbriata*, *C. glebosa*, *C. sarmentosa*, *C. sulcata* var. *striata*

Collemataceae

Collema leucocarpum, *Lathagrium durietzii*

Gomphillaceae

Gyalideopsis halocarpa

Lecanoraceae

Lecanora bicincta, *L. farinacea*, *L. galactiniza*, *L. oreinoides*, *L. pseudistera*, *L. rupicola*,
Lecidella stigmatea, *Ramboldia petraeoides*, *R. sanguinolenta*, *Scoliciosporum umbrinum*

Lecideaceae

Lecidea atrobrunnea, *L. capensis*, *L. ochroleuca*

Lobariaceae

Pseudocyphellaria neglecta

Megasporaceae

Aspicilia contorta

Pannariaceae

Fuscopannaria subimmixta, *Psoroma hypnorum*

Parmeliaceae

Austroparmelina labrosa, *A. pruinata*, *A. pseudorelicina*, *Flavoparmelia haysomii*, *Hypogymnia billardierei*, *H. pulverata*, *H. subphysodes*, *Notoparmelia signifera*, *Parmotrema reticulatum*,
Punctelia borrieri, *Usnea inermis*, *Xanthoparmelia atrocarnodes*, *X. canobolasensis*, *X. congesta*, *X. dichotoma*, *X. digitiformis*, *X. elixii*, *X. flavescensireagens*, *X. furcata*, *X. loxodella*,
X. metaclystoides, *X. metamorphosa*, *X. metastrigosa*, *X. multipartita*, *X. mexicana*, *X. oleosa*, *X. neorimalis*, *X. pulla*, *X. scabrosa*, *X. semiviridis*, *X. substrigosa*, *X. sulcifera*, *X. willisii*

Pertusariaceae

Pertusaria lophocarpa

Physciaceae

Buellia homophylia, *B. ocellata*, *Physcia adscendens*, *P. austrocaesia*, *P. caesia*, *P. jackii*, *P. poncinsii*

Porpidiaceae

Paraporpidia leptocarpa

Rhizocarpaceae

Rhizocarpon distinctum, *R. geminatum*, *R. geographicum*, *R. reductum*

Stereocaulaceae

Stereocaulon corticatulum

Teloschistaceae

Caloplaca crenulatella, *C. rexfilsonii*, *C. rubelliana*

Thelotremataceae

Diploschistes scruposus, *D. sticticus*, *Ingvariella bispora*

Trapeliaceae

Placopsis perrugosa, *Rimularia insularis*

Tuberaceae

Labyrinthomyces varius

4.2 Basidiomycota**Cortinariaceae**

Cortinarius globuliformis

Phragmidiaceae

**Phragmidium violaceum*

Russulaceae

Cystangium seminudum, *C. sessile*, *C. shultziae*

Appendix 5

Vertebrates recorded within Mt Canobolas SCA

5.1 Mammals

The SCA hosts diverse wildlife of at least 25 native mammals. These include six species of gliders and possums namely, *Acrobates pygmaeus* [Feathertail Glider], *Petauroides volans* [Greater Glider], *Petaurus australis* [Yellow-Bellied Glider], *P. breviceps breviceps* [Sugar Glider], *Pseudocheirus peregrinus* [Common Ringtail Possum] and *Trichosurus vulpecula* [Australian Brushtail Possum].

Petaurus australis [Yellow-Bellied Glider] is listed as Vulnerable under the BC Act and *Petauroides volans* [Greater Glider] as Vulnerable under the EPBC Act.

Two species of marsupial mice, *Antechinus agilis* [Agile Antechinus], *A. stuartii* [Brown Antechinus], together with *Tachyglossus aculeatus* [Short-Beaked Echidna] and *Vombatus ursinus* [Bare-Nosed Wombat] also occur, along with four macropods, *Macropus giganteus* [Eastern Grey Kangaroo], *M. rufogriseus* [Red-necked Wallaby], *Osphranter robustus robustus* [Wallaroo] and *Wallabia bicolor* [Swamp Wallaby].

Indicative of the richness of the habitat of the SCA is the diversity of micro bats recorded on the mountain viz: *Austronomus australis* [White-Striped Freetail-Bat], *Chalinolobus gouldii* [Gould's Wattled Bat], *C. morio* [Chocolate Wattled Bat], *Miniopterus schreibersii oceanensis* [Eastern Bent-Wing Bat], *Mormopterus (Ozimops) ridei* [Ride's Free-Tailed Bat], *Nyctophilus geoffroyi geoffroyi*, *Saccolaimus flaviventris* [Yellow-Bellied Sheathtail-Bat], *Scotorepens orion* [Eastern Broad-Nosed Bat], *Vespadelus darlingtoni* [Large Forest Bat], *Vespadelus regulus* [Southern Forest Bat] and *V. vulturinus* [Little Forest Bat].

Miniopterus schreibersii oceanensis [Eastern Bent-Wing Bat] and *Saccolaimus flaviventris* [Yellow-Bellied Sheathtail-Bat] are listed as Vulnerable under the BC Act.

Some non-native mammals also have been recorded, namely **Capra hircus* [Goat], **Equus caballus* [Horse], **Mus musculus* [House Mouse], **Oryctolagus cuniculus* [Rabbit], **Rattus rattus* [Ship Rat], **Sus scrofa* [Pig] and **Vulpes vulpes* [Red Fox].

5.2 Avifauna

Bird fauna recorded within the Mt Canobolas SCA based on Atlas of Living Australia include 82 native and two non-native species, all from opportunistic observations. Mt Canobolas hosts a diversity of birds across at least 34 families and 63 genera. Many species are permanent residents

and others are migratory. Raptors such as the *Falco peregrinus* [Peregrine Falcon] uses cliff habitats around Federal Falls for nesting and hunting. The mountainous terrain attracts *Aquila audax* [Wedge-Tail Eagle] which is commonly observed hunting and soaring on thermals in the SCA. The endemic and threatened *Eucalyptus canobolensis* is extremely valuable for nesting of cockatoos and parrots, in particular, because of its propensity to form hollows.

Observations, based on single records, of *Acanthiza uropygialis* [Chestnut-Rumped Thornbill], *Acanthagenys rufogularis* [Spiny-Cheeked Honeyeater] and *Neophema pulchella* [Turquoise Parrot] are unusual for the area and require further verification.

Six of the bird species are listed as Vulnerable under the BC Act:

- *Artamus cyanopterus cyanopterus* [Dusky Woodswallow] a woodland dependent bird
- *Daphoenositta chrysoptera* [Varied Sittella] a small song-bird
- *Hieraaetus morphnoides* [Little Eagle] a medium-sized bird of prey
- *Neophema pulchella* [Turquoise Parrot] occurs around woodland edges
- *Petroica boodang* [Scarlet Robin] which is endemic to south-eastern Australia
- *Petroica phoenicea* [Flame Robin] which is endemic to south-eastern Australia

Anseriformes

Anatidae

Anas gracilis [Grey Teal], *A. superciliosa* [Pacific Black Duck], *Aythya australis* [White-eyed Duck], *Chenonetta jubata* [Australian Wood Duck]

Ciconiiformes

Ardeidae

Egretta novaehollandiae [White-faced Heron]

Threskiornithidae

Threskiornis spinicollis [Straw-necked Ibis]

Columbiformes

Columbidae

Phaps chalcoptera [Common Bronzewing]

Cuculiformes

Cuculidae

Cacomantis flabelliformis [Fan-Tailed Cuckoo], *Chrysococcyx basalis* [Horsfield's Bronze-Cuckoo], *C. lucidus* [Shining Bronze-Cuckoo], *Eudynamys orientalis* [Common Koel, Pacific Koel]

Strigidae

Ninox novaeseelandiae [Southern Boobook, Morepork]

Podargidae

Podargus strigoides [Tawny Frogmouth]

Coraciiformes

Coraciidae

Eurystomus orientalis [Dollarbird]

Halcyonidae

Dacelo novaeguineae [Laughing Kookaburra], *Todiramphus sanctus* [Sacred Kingfisher]

Falconiformes

Accipitridae

Accipiter fasciatus [Brown Goshawk], *A. cirrocephalus* [Collared Sparrowhawk], *Aquila audax* [Wedge-Tailed Eagle], *Hieraaetus morphnoides* [Little Eagle]

Falconidae

Falco cenchroides [Nankeen Kestrel], *F. peregrinus* [Peregrine Falcon]

Gruiformes

Rallidae

Fulica atra [Eurasian Coot], *Gallinula tenebrosa tenebrosa* [Dusky Moorhen]

Passeriformes

Acanthizidae

Acanthiza pusilla [Brown Thornbill], *A. reguloides* [Buff-Rumped Thornbill], *A. uropygialis* [Chestnut-Rumped Thornbill], *A. lineata* [Striated Thornbill], *A. nana* [Yellow Thornbill], *Gerygone fusca* [Western Gerygone], *G. olivacea* [White-Throated Gerygone], *Sericornis frontalis* [White-Browed Scrubwren]

Artamidae

Artamus cyanopterus [Dusky Woodswallow], *Cracticus nigrogularis* [Pied Butcherbird], *C. tibicen* [Australian Magpie], *Strepera versicolor* [Grey Currawong], *S. graculina* [Pied Currawong]

Campephagidae

Coracina novaehollandiae [Black-Faced Cuckoo-Shrike]

Climacteridae

Climacteris erythrops [Red-Browed Treecreeper], *Cormobates leucophaea* [White-Throated Treecreeper]

Corvidae

Corvus coronoides coronoides [Australian Raven], *C. mellori* [Little Raven]

Corcoracidae

Corcorax melanorhamphos [White-Winged Chough]

Dicaeidae

Dicaeum hirundinaceum [Mistletoebird]

Dicruridae

Grallina cyanoleuca [Magpie-Lark], *Myiagra cyanoleuca* [Satin Flycatcher], *M. rubecula* [Leaden Flycatcher], *M. inquieta* [Restless Flycatcher], *Rhipidura albiscapa alisteri* [Grey Fantail], *R. leucophrys* [Willie Wagtail], *R. rufifrons* [Rufous Fantail]

Estrildidae

Neochmia temporalis [Red-Browed Finch]

Maluridae

Malurus cyaneus [Superb Fairy-Wren]

Meliphagidae

Acanthagenys rufogularis [Spiny-Cheeked Honeyeater], *Acanthorhynchus tenuirostris* [Eastern Spinebill], *Anthochaera carunculata* [Red Wattlebird], *Caligavis chrysops* [Yellow-Faced Honeyeater], *Manorina melanocephala* [Noisy Miner], *Melithreptus lunatus* [White-Naped Honeyeater], *Nesoptilotis leucotis* [White-Eared Honeyeater], *Philemon corniculatus* [Noisy Friarbird]

Motacillidae

Anthus novaeseelandiae [Australian Pipit]

Neosittidae

Daphoenositta chrysoptera [Varied Sittella]

Oriolidae

Oriolus sagittatus [Olive-Backed Oriole]

Pachycephalidae

Colluricincla harmonica [Grey Shrike-Thrush], *Falcunculus frontatus frontatus* [Eastern Shrike-Tit], *Pachycephala rufiventris* [Rufous Whistler], *P. pectoralis* [Golden Whistler]

Pardalotinae

Pardalotus punctatus [Spotted Pardalote], *P. striatus* [Striated Pardalote]

Petroicidae

Eopsaltria australis [Eastern Yellow Robin], *Petroica boodang* [Scarlet Robin], *P. phoenicea* [Flame Robin], *P. rosea* [Rose Robin]

Sturnidae

**Sturnus vulgaris* [Common Starling]

Turdidae

**Turdus merula* [Common Blackbird]

Zosteropidae

Zosterops lateralis [Silvereye]

Psittaciformes**Cacatuidae**

Cacatua galerita [Sulphur-Crested Cockatoo], *Calyptorhynchus funereus* [Yellow-Tailed Black-Cockatoo], *Eolophus roseicapillus* [Galah]

Psittacidae

Alisterus scapularis [Australian King-Parrot], *Neophema pulchella* [Turquoise Parrot], *Platycercus elegans* [Crimson Rosella], *P. eximius* [Eastern Rosella]

5.3 Amphibians and Reptiles

Knowledge of the amphibian and reptilian fauna of the SCA is limited at present as no formal study has been undertaken. Current ALA data shows four amphibians *Crinia parinsignifera* [Eastern Sign-bearing Froglet], *C. signifera* [Common Froglet], *Litoria verreauxii* [Verreauxii Tree Frog] and *Uperoleia laevigata* [Smooth Toadlet] recorded for the area. There are two records for *Litoria verreauxii*, one stating the subspecies as *L. verreauxii* subsp. *verreauxii* the other doesn't state subspecies. *Litoria verreauxii* subsp. *alpina* is listed as Endangered under the BC Act and Vulnerable under the EPBC Act. Whilst not specifically recorded for the SCA it is possible that the subspecies could occur given its affinity with alpine and sub-alpine zones in south eastern Australia, and its preferred habitats of woodland, heath, grassland and herb fields which abound in the SCA. The amphibian record for the SCA is likely to be an under-estimate given that 10 species have been recorded in the Orange district (ALA 2018 and authors' *pers. obs.*).

Eighteen reptilian species have been recorded for the SCA. Curiously these records lack any observations of snakes, again indicative of the lack of intensive survey since seven snake species are recorded for inhabited areas in close proximity to the SCA, along with one tortoise species. An anecdotal report (J Paul *pers. comm.* 2018) of the White-lipped Snake for near The Walls Lookout is plausible for the area.

The 16 lizard species recorded in ALA for the Mt. Canobolas precinct are all widespread common species indicative of the incidental nature of the data. These species are a mixture of highland south-eastern species, coastal species and western inland species viz. *Amphibolurus muricatus* [Jacky Lizard], *Acritoscincus platynotus* [Red-throated Skink], *Ctenotus robustus* [Robust Ctenotus], *C. taeniolatus* [Copper-tailed Skink], *Egernia striolata* [Tree Skink], *Eulamprus quoyii* [Eastern Water-skink], *E. heatwolei* [Yellow-bellied Water Skink], *Hemiergus decresiensis* [Three-toed Earless Skink], *Lampropholis delicata* [Dark-flecked Garden Skink], *L. guichenoti* [Pale-flecked Garden Sunskink], *Liopholis whitii* [White's Skink], *Menetia greyii* [Common Dwarf Skink], *Pseudemoia entrecasteauxii* [Tussock Cool-skink], *Rankinia diemensis* [Mountain Dragon], *Saproscincus mustelinus* [Weasel Skink] and *Varanus gouldii* [Gould's Goanna].

As with the snakes, the lizard record is conservative. *Tiliqua scincoides* [Eastern Blue-tongue], *Egernia cunninghami* [Cunningham's Skink], *Egernia striolata* [Black Rock Skink] and *Tiliqua rugosa* [Shingle-back] are known to occur commonly in adjoining areas [Medd *pers. observ.*] and there could well be additional species in the SCA.

5.4 Fishes

One fish species has been recorded for the SCA, *Galaxias olidus* [Inland or Mountain Galaxia] in Towac/Molong Creek at the bridge crossing on Mt Canobolas Road, at the boundary of the SCA. Drainage systems originate within the SCA hence the streams are ephemeral, but this would not necessarily preclude other fish from occurring.

Appendix 6

Insect and other invertebrate fauna recorded within Mt Canobolas SCA

Almost 200 insect species are recorded for Mt Canobolas SCA based on records in the ALA from collections in Canberra (The Australian National Insect Collection), Sydney (The Australian Museum) and Melbourne (Museum Victoria) and from the insect collection in the Biosecurity Collections Unit of NSW DPI in Orange.

It is worth noting that, of these species, a cricket, several moths and leafhoppers represent unnamed taxa (listed with species numbers in the attachment) and two named species, *Monomorium crinitum* Heterick (Hymenoptera: Formicidae) and *Johnrehnia canoblaensis* Roth (Blattodea: Blatellidae) have their type localities on Mt Canobolas.

6.1 Insect Fauna (Class Insecta)

ORDER ODONATA [Dragonflies, Damselflies]

Family Lestidae: *Austrolestes leda*; Family Synthemiidae: *Eusynthemis tillyardi*

ORDER BLATTODEA [Cockroaches]

Family Blatellidae: *Johnrehnia canoblaensis*

ORDER ORTHOPTERA [Grasshoppers, locusts, crickets]

Family Acrididae - Short horn grasshoppers: *Praxibulus exculpturus*; Family Anostomatidae: *Penalva* sp.; Family Tettigoniidae [Long horn grasshoppers]: *Acripeza reticulata* [Mountain katydid], *Caedicia simplex* [Garden katydid]; Undetermined taxa in Family Gryllidae [Crickets]



Acripeza reticulata [Mountain katydid], female displaying on Mt Canobolas
(Image: H. Löcker, Orange Field Naturalist and Conservation Society Inc.)

ORDER THYSANOPTERA

Family Aeolothripidae: *Andrewarthaia kellyana*; *Desmothrips propinquus*; Family Phlaeothripidae: *Hoplandrothrips* sp., *Idolothrips spectrum*, *Kellyia hoodianus*; Family Thripidae: *Anaphothrips* sp., *Chirothrips* sp., **Pezothrips kellyanus* [Kelly's citrus thrips],

Pseudanaphothrips achaetus, *Tenothrips frici*, *Thrips australis* [Gum tree thrips], *Thrips imaginis* [Plague thrips], **Thrips tabaci* [Onion thrips]

ORDER HEMIPTERA [True bugs]

Family Aphrophoridae [Spittlebugs]: *Anyllis leiala*; Family Cicadellidae [Leafhoppers]: *Aneono* sp., *Anzygina attenuata* (undescribed species), *Anzygina zealandica* [The yellow leafhopper], *Arawa* sp., *Australopa brunensis*, *Austroagallia torrida* [The spotted leafhopper], *Austroagalloides* sp., *Balclutha* sp., *Diemoides* sp., *Empoascanara* sp.Z66 (undescribed species), *Euleimonios montanus*, *Horouta perparvus*, *Kahaono* sp., *Orosius argentatus* [The common brown leafhopper], *Pauroeurymela amplicincta* [a gumtree hopper], *Eurymeloides lineata*, [a gumtree hopper], *Rosopaella kirkaldyi*, *Stirellus fatigandus*, *Thamnophryne* sp.11 (undescribed species), *Trocna da dorsigera*, *Xestocephalus* sp., *Zygina evansi*, *Za* sp.04 (undescribed genus and species); Family Cicadidae [Cicadas]: *Yoyetta* sp.; Family Derbidae [Derbid planthoppers]: *Saccharodite chrysonoe*; Family Lygaeidae [Chinch bugs]: *Nysius vinitor* [Rutherglen bug]; Family Nabidae [Damsel bugs]: *Nabis (Tropiconabis) kinbergii*; Family Aleyrodidae [Whiteflies]: *Dumbletoniella eucalypti*; Family Eriococcidae: *Apiomorpha* sp.; Family Monophlebidae: *Nodulicoccus levis*; Family Psyllidae [Lerp insects, psyllids]: *Creiis lituratus*; Undetermined taxa in: Family Delphacidae [Grass planthoppers], Family Eurybrachidae [Gumtree planthoppers], Family Issidae [Issid planthoppers], Family Pentatomidae [Stink bugs], Family Reduviidae [Assassin bugs] and Family Tingidae [Lace bugs]

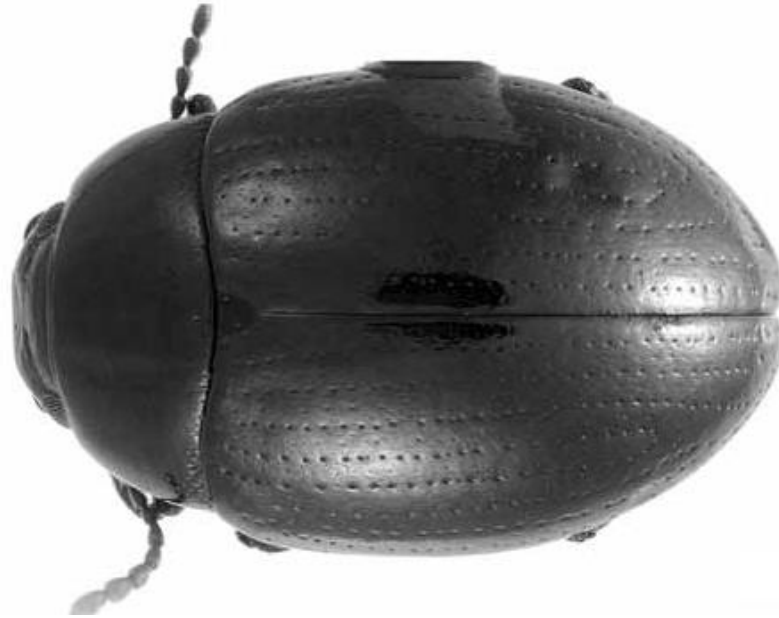


Undescribed species of *Arawa* (Hemiptera: Cicadellidae) photographed on Mt Canobolas
(Image: M.J. Fletcher, ASCU)

ORDER COLEOPTERA [Beetles]

Family Attelabidae [Attelabid weevils]: *Euops* sp.; Family Bothrideridae: *Deretaphrus* sp.; Family Cantharidae [Softwing beetles]: *Chauliognathus lugubris* [Garden soldier beetle]; Family Carabidae [ground beetles]: *Agonocheila cribripennis*, *Amblytelus pseudopelyx*, *Notagonum submetallicum* [Submetallic ground beetle]; Family Cerambycidae [Longicorn beetles], *Ancita* sp. and additional undetermined taxa; Family Chrysomelidae [Leaf eating beetles]: *Altica corrusca*, *Canobolas nobilis*; Family Cleridae: *Eunatalis porcata*, *Opilo congruus*, *Pylus fatuus*; Family Coccinellidae [Ladybird beetles]: *Coccinella transversalis* [Transverse ladybird]; Family Elateridae [Click beetles]: *Agrypnus caliginosus*, *Lingana illita*; Family Melyridae [Pollen beetles]: *Dicranolaius bellulus* [Red and blue beetle]; Family

Mycetophagidae: *Litargops intricatus*; Family Scarabaeidae [Scarab beetles]: *Heteronyx* sp., *Diphucephala azureipennis*; Family Tenebrionidae [Darkling beetles]: *Cillibus incisus*; Undetermined taxa in: Family Belidae [Belid weevils], Family Erotylidae, Family Lycidae, Family Mordellidae [Pintail beetles] and Family Phalacridae



Canobolas nobilis (Coleoptera: Chrysomelidae)

[Image: Reid, *et al.* 2009]

ORDER HYMENOPTERA [Wasps, bees, ants, sawflies]

Family Apidae [Hive bees]: *Amegilla* (*Notomegilla*) *chlorocyanea* [Blue banded bee], *Amegilla* (*Zonamegilla*) *asserta*, *Euryglossula chalcosoma*; Family Colletidae [Colletid bees]: *Hylaeus* (*Planihylaeus*) *quadriceps*, *Trichocolletes tenuiculus*, *Trichocolletes venustus*; Family Formicidae [Ants]: *Amblyopone australis*, *Dolichoderus doriae*, *Iridomyrmex bicknelli*, *Iridomyrmex splendens*, *Leptomymex erythrocephalus*, *Monomorium crinitum*, *Monomorium rubriceps*, *Monomorium sculpturatum*, *Monomorium tambourinense*, *Myrmecia forficata*, *Myrmecia fulvipes*, *Myrmecia pilosula*, *Myrmecia pulchra*, *Nylanderia rosae*, *Technomyrmex jocosus*; Family Pergidae: *Perga affinis* [Spitfire sawfly], *Pseudoperga guerinii*; Family Halictidae [Halictid bees]: *Homalictus* (*Homalictus*) *sphecodoides*, *Lasioglossum* (*Chilalictus*) *clelandi*, *Lasioglossum* (*Chilalictus*) *disclusum*, *Lasioglossum* (*Chilalictus*) *helichrysi*, *Lasioglossum* (*Chilalictus*) *orbatum*, *Lasioglossum* (*Chilalictus*) *vitripenne*, *Lasioglossum* (*Chilalictus*) *willsi*, *Lasioglossum* (*Parasphecodes*) *sulthicum*; Family Megachilidae [Megachilid bees]: *Megachile apicata*, *Megachile ordinaria*, *Megachile* (*Eutricharaea*) *sequior*; Family Tiphiidae [Flower wasps]: *Agriomyia* sp., *Neozeleboria monticola*, *Rhagigaster* sp.; Undetermined taxa in: Family Braconidae, Family Eulophidae, Family Pompilidae [Spider hunters] and Family Sphecidae [Mud dauber wasps]

ORDER DIPTERA [True flies]

Family Asilidae [Robber flies]: *Aplestobroma avidum*; Family Tephritidae [Fruit flies]: *Austrotephritis poenia*

ORDER TRICHOPTERA [Caddisflies]

Family Hydrobiosidae: *Ulmerochorema lentum*

ORDER LEPIDOPTERA [Moths, butterflies]

Family Anthelidae [Australian lappet moths]: *Chenuala heliaspis*; Family Cosmopterigidae: *Macrobathra* sp.; Family Crambidae: *Achyra affinalis*, *Diaphania indica*, *Hednota pedionoma*, *Hellula hydralis* [Cabbage centre grub], **Hellula undalis* [Cabbage webworm]; Family Erebidae: *Diatenes igneipicta*, *Eublemma rivula*, *Palaeosia bicosta*, *Praxis marmarinopa*, *Praxis porphyretica*, *Spilosoma curvata*, *Thallarcha lochaga*, *Thallarcha* sp.06 (undescribed species), *Tigrioides alterna*, *Utetheisa pulchelloides*; Family Gelechiidae: **Phthorimaea operculella* [Potato tuber moth]; Family Geometridae: *Amelora* sp.01 (undescribed species), *Austroterpna* sp., *Chlorocoma assimilis*, *Chlorocoma dichloraria*, *Corula geometroides*, *Crypsiphona oculataria*, *Dichromodes* sp.08 (undescribed species), *Gastrinodes argoplaca*, *Gastrophora henricaria*, *Heliomystis electrica*, *Hypobapta tachyhalotaria*, *Idiodes siculoides*, *Plesanemma fucata*, *Psilosticha attackta*, *Psilosticha pristis*, *Scioglyptis lyciaria*, *Scopula rubraria*; Family Hepialidae [Swift moths]: *Abantiades latipennis* [Pindi moth]; Family Lasiocampidae: *Porela* sp.03 (undescribed species); Family Limacodidae [Cup moths]: *Pseudanapaea transvestita*; Family Noctuidae: *Agrotis infusa* [Bogong moth], *Agrotis munda* [Brown cutworm], *Australothis rubrescens*, *Dasygaster* sp.02 (undescribed species), *Diarsia intermixta*, *Helicoverpa punctigera* [Native budworm], *Hypoperigea tonsa*, *Persectania ewingii* [Southern armyworm], *Proteuxoa restituta*, *Proteuxoa tibiata*; Family Nolidae: *Earias huegeliana* [Rough bollworm]; Family Notodontidae [Prominents]: *Sorama bicolor*, *Trichiocercis sparshalli*; Family Nymphalidae [Browns, Nymphs]: *Heteronympha merope merope* [Common brown butterfly]; Family Oecophoridae [Concealer moths]: *Agriophara* sp.12 (undescribed species), *Agriophara* sp.23 (undescribed species), *Coeranica isabella*, *Crossophora* sp 01 (undescribed species), *Euchaetis* sp.06 (undescribed species), *Philobota arabella*, *Philobota olympias*, *Tanyzancla argutella*; Family Pieridae [Whites, yellows]: **Pieris rapae* [Cabbage white butterfly]; Family Psychidae [Bagworms, case moths]: *Iphierga* sp.02 (undescribed species), *Lepidoscia* sp 06 (undescribed species); Family Pyralidae [Snout moths, grass moths]: *Gauna aegusalis*; Family Sphingidae [Hawk moths]: *Hippotion celerio* [Vine hawkmoth]; Family Tortricidae [Leafroller moths]: *Capua intractana*, *Dichelia cosmopis*, *Thrincochophora signigerana*; Undetermined taxa in: Family Carposinidae and Family Tineidae



Utetheisa pulchelloides (Lepidoptera: Erebidae)
(image: J. Tann, Wikipedia)

6.2 Arachnids (Class Arachnida)

Eight arachnid species are known to occur in the SCA. A survey of the mountain, particularly for spiders, would significantly increase the number of species recorded.

ORDER SCORPIONIDA [Scorpions]

Cercophonium squama (Forest scorpion), *Lychas marmoreus* (Little marbled scorpion)

ORDER OPILIONES [Harvestmen]

Equitius doriae, *Megalopsalis caeruleomontium*

ORDER ARANEIDA [Spiders]

Missulena occatoria [Red headed mouse spider]

ORDER ACARI [Mites, Ticks]

Family Eriophyidae [Eriophyid mites]: *Aceria* sp.; Family Phytoseiidae [Predatory mites]: *Galendromus occidentalis*, *Typhlodromus pyri*

Other invertebrate groups

6.3 Molluscs (Phylum Mollusca)

Eight species of snail have been observed within the SCA: *Austrorhytida capillacea* [Common Southern Carnivorous Snail], *Brevisentis atratus* [Black Jewel Glass-Snail], *Brevisentis jacksoniensis* [Green Amber Glass-Snail], **Cornus aspersum*, *Elsothera brazieri* [Sydney Basin Pinwheel Snail], *Galadistes molong* [Molong Woodland Snail], *Paralaoma caputspinulae* [Prickle Pinhead Snail] and *Scelidoropa sarahjaneae* [Wide-Ranging Pinwheel Snail]. Three of these species are endemic to NSW, *B. atratus*, *E. brazieri*, *G. molong* and *S. sarahjaneae* is endemic to NSW and NE Victoria.

6.4 Velvet worms (Phylum Onychophora)

New (1995) proposed that Onychophora, commonly known as Velvet worms or peripatus, appear to merit and need conservation both *per se* and as members of communities sensitive to change. Tait *et al.* (1990) reported that electrophoretic studies on Onychophora in eastern Australia revealed that each isolated population was quite distinct and had been isolated from other populations for millions of years. Reid *et al.* (1995) formalised the taxonomy of some of these populations including naming a species restricted to the Mt Canobolas SCA as *Cephalofovea pavimento* in the family Peripatopsidae. This species was recorded by the Orange Field Naturalist and Conservation Society at the Walls Picnic Area in 2001 (Fletcher 2017). The Mt Canobolas Velvet Worm, as with other Onychophora, lives inside rotting logs where it hunts for other small invertebrates. All Onychophora are considered rare and vulnerable (New 1995) and hence their presence is a good indicator of environmental quality.



Cephalofovea pavimenta [Mt Canobolas Velvet Worm]
(Image: M.J. Fletcher, Orange Field Naturalist and Conservation Society Inc.)

6.5 Flat Worms (Phylum Platyhelminthes)

The Mt Canobolas SCA features a fluorescent yellow planarian worm (Family Geoplanidae) which is apparently unnamed scientifically. The Mt Canobolas planarian worm can be seen on the walking trails after rain and walkers on the mountain often comment on its appearance (S Woodhall *pers. comm.* 2015). The species is predatory and normally lives in deep leaf litter to avoid desiccation.

Mt Canobolas Planarian Worm



(Image: H. Löcker, Orange Field Naturalist and Conservation Society Inc.)

6.6 Crustaceans (Class Crustacea)

The lack of permanent streams within the SCA accords with the absence of aquatic crustacean records. As for fish, however, the occurrence of crustaceans within the SCA should not be ruled out; five species are recorded for nearby areas.

Terrestrial crustaceans have also not been recognised within the SCA but Isopoda (slaters, pillbugs) and Amphipoda (landhoppers) are almost certainly present in the deep leaf litter of the gullies.