

## Biodiversity and status of butterflies in the Ballarat Region, Victoria

Graeme J Ambrose<sup>1</sup>

### Abstract

The butterfly fauna of the Ballarat region is not well known, reflecting a lack of comprehensive surveys. This paper firstly characterises the Ballarat region and documents butterfly species found locally. Forty-five species from five families and 31 genera are now known for the region, including one introduced species. Management issues include habitat fragmentation and degradation. Some species are insufficiently known in the region to permit the development of management strategies. (*The Victorian Naturalist* 122 (1) 2005, 21-34).

### Introduction

The butterfly fauna of the Ballarat region is poorly documented. Before 1995, just 11 species had been recorded on the Victorian Butterfly Database for the grid squares that include Ballarat and environs: 143°45'00" E, 37°35'00" S and 143°55'00" E, 37°35'00" S. Surprisingly, the list excluded several abundant species. This paper records species found in the vicinity of Ballarat, with some notes on the broader region, extending as far as Ararat, Castlemaine and Lismore. It documents the status of each, their flight season and habitat use within the region. Database records are supplemented by records from transects made from 1991 to 1994, subsequent casual observations by the author, unpublished observations by naturalists, and literature records, including notes on regional species from the Ballarat *Courier*. Common and scientific names of butterflies follow the usage in Braby (2000).

### Characteristics of the Ballarat region

The Ballarat region is depicted in Fig. 1. Ballarat (population 86 000) lies 100 km west of Melbourne, Victoria, at altitudes of 400-500 m ASL. Ballarat is extensively urbanised, but has many areas of remnant vegetation within its outer suburbs. The urban/rural fringe of Ballarat is a dynamic environment that is strongly influenced by human activities. Prior to European settlement, the volcanic plains near Ballarat bore grasslands and grassy woodlands. These have been greatly diminished and fragmented by the combined impacts of grazing, cropping and urbanisation.

However, there are still substantial remnants of mixed-eucalypt open-forest on nutrient-poor Ordovician soils, as well as plantations of Monterey Pine *Pinus radiata* and eucalypts.

Grasslands on volcanic soils are dominated by Common Tussock-grass *Poa labillardieri* or Kangaroo Grass *Themeda triandra*. Grassy woodlands on volcanic soils have an overstorey of Manna Gum *Eucalyptus viminalis* and Messmate *E. obliqua*. Mts Warrenheip and Buninyong, volcanic peaks of about 740 m to the east and south-east of Ballarat, retain their original dominant vegetation (*E. viminalis*/*E. obliqua*/*P. labillardieri*).

Many open-forests in the region (Fig. 1) are still regenerating after widespread clearance and soil disturbance during the gold rush and/or subsequent logging. Mixed-eucalypt open-forests on Ordovician soils typically include Messmate, Scent-bark *E. aromaphloia*, Narrow-leaf Peppermint *E. radiata* and Blackwood *Acacia melanoxylon*, with a diverse understorey of shrubby legumes (including many peas, family Fabaceae), forbs such as Wattle Mat-rush *Lomandra filiformis* and Grey Tussock-grass *Poa sieberiana*. In damper gullies, Manna Gum, Swamp Gum *E. ovata* and Yarra Gum *E. yarraensis* commonly form the canopy. The understorey includes Sweet Bursaria *Bursaria spinosa*, Slender Tussock-grass *P. tenera*, Soft Tussock-grass *P. morrisii*, Weeping Grass *Microlaena stipoides* and various sedges.

### Butterfly fauna of the Ballarat region

Forty-five butterfly species from five families and 31 genera are now known,

<sup>1</sup>Environmental Management, School of Science and Engineering, University of Ballarat, Ballarat, Victoria 3353.

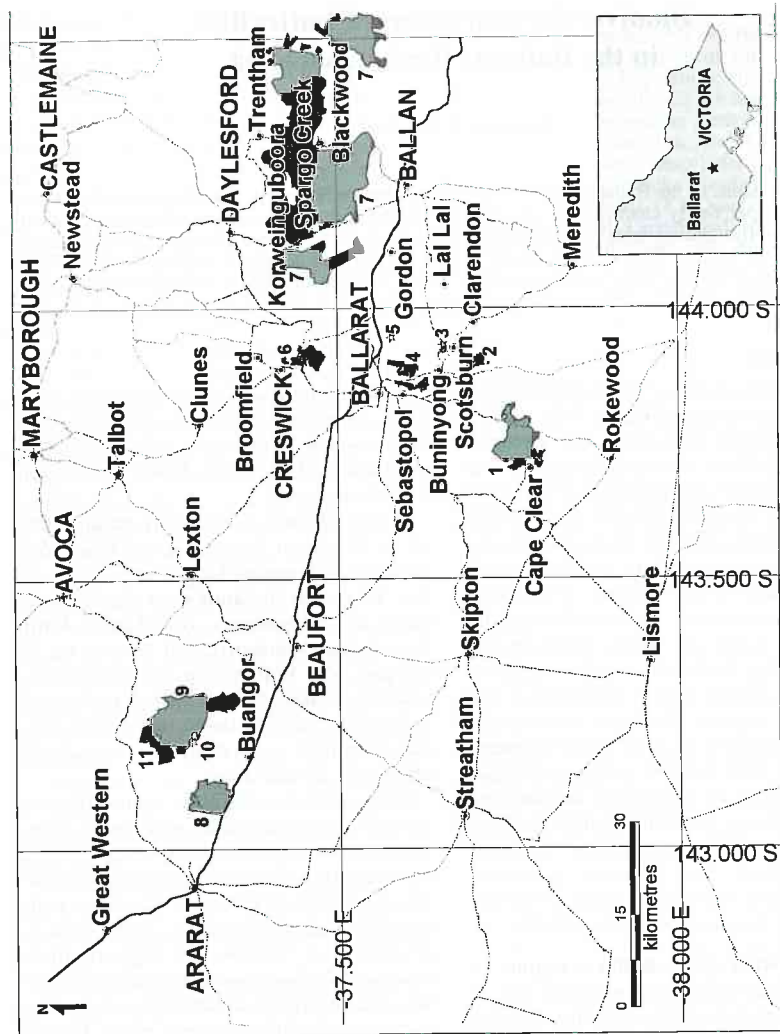


Fig. 1. The Ballarat Region, Victoria. Larger cities and towns are shown in capitals. Some Ballarat suburbs (Canadian, Delacombe, Mt. Clear, Mt. Helen, Mt. Pleasant and Wendouree) are not indicated. Key: 1 = Enfield State Park, 2 = Garibaldi State Forest, 3 = Mt Buninyong, 4 = Canadian bushland/plantations, 5 = Mt Warrenheip, 6 = Ballarat-Creswick Regional Park, 7 = Wombat State Forest, 8 = Langi Ghiran State Forest, 9 = Mt Cole State Forest, 10 = Mt Cole, 11 = Ben Nevis. Map: M O'Keefe.

including the introduced Cabbage White *Pieris rapae* (Table 1). The most diverse families in the region are Nymphalidae and Lycaenidae, with 13 species each. Twenty-five species forage for nectar in urban parks and gardens, including 14 species that also breed there, outside vegetation remnants. Five of these make significant use of exotic vegetation as larval food plants and nectar sources. Most butterfly species occupy either forest understorey or open situations, including grasslands, pasture and gardens. Few species are associated with tree canopies.

#### Potential occurrences in the region

It is acknowledged that the small number of knowledgeable observers in the region is unlikely to have recorded all local species. Indeed, it is hoped that the publication of this paper will stimulate interest in the region's butterflies and increase the number of informed and interested lepidopterists. Cryptic and high-flying species, and those noted in Table 1 as localised and uncommon, are likely to be under-recorded. Further populations of some species will probably be discovered in suitable sites, particularly if intact habitat and lar-

val foodplants are still widespread. This is likely to be the case with species dependent on *Oxalis* and *Gahnia*, for example. Species dependent on introduced *Citrus* and related genera are either uncommon for unknown reasons (e.g. Dainty Swallowtail *Papilio anactus*) or still in the process of extending into the area (e.g. Orchard Swallowtail *P. aegeus aegeus*). Citrus trees, with the exception of Lemons and Kumquats, are not widely grown near Ballarat because of the cold climate. Localised and uncommon species that hilltop (listed in Table 1) may be more effectively sought on the summits of prominent local hills and mountains. A number of species not recorded to date are likely to occur in the region. Some of these are known to hilltop. Table 2 lists some possible candidates.

The species listed in Table 2 may have escaped detection because they are localised and sedentary, rare, or fly high in the canopy. Others inhabit less well searched montane and damp, moist habitats that are more distant from Ballarat. Table 2 suggests that the most productive areas in which to search for further species in the region are hilltopping sites, damp montane forests and damp understoreys with *Gahnia* sedges. Promising localities to search for damp forest species include wetter parts of the Wombat State Forest (Trentham and Daylesford-Korweinguboora-Spargo Creek areas), Enfield State Forest and the Mt Cole/Ben Nevis region. The four lycaenids that require drier forests, woodlands and heathlands are all hilltopping species with associations between their larvae and ants. They may be most effectively detected on prominent hill summits near suitable plant communities that have relatively intact understoreys. Systematic searching during summer for the two possible vagrants (see Table 2) is unwarranted because of the low probability of encountering them.

#### Hilltopping

Hilltopping is a form of serial polygyny in which males attempt to attract females to their territory (lek) by displays. Butterflies assemble at prominent features on the landscape, the males seeking mates and courting. The hilltopping behaviour of species may differ according to available

vegetation and in the location on the hilltop, height above the ground, time of day and time of year. After mating, females disperse to suitable habitats containing larval foodplants, where they lay their eggs (Common and Waterhouse 1981).

Males of some species tend to set up perching territories on the summits. Perching hilltoppers are capable of rapid flight. They may dart up quickly to investigate passing insects and then court potential mates or pursue rivals (F Douglas 2004 pers. comm. 10 June). They include smaller understorey species such as skippers (ochres *Trapezites* spp., Bright Shield-skipper *Signeta flammeata*), as well as lycaenids (e.g. some azures *Ogyris* spp., Rayed Blue *Candalides heathi heathi*). Larger hilltopping species may be camouflaged at rest (e.g. *Vanessa* spp., Marbled Xenicas *Geitoneura klugii klugii* and browns *Heteronympha* spp.). Butterflies such as the Tailed Emperor *Polyura sempronius* and some *Geitoneura* species have perching sites but also intermittently patrol a larger area (F Douglas 2004 pers. comm. 10 June).

Males of broader-winged species, adapted for gliding, are able to patrol suitable areas searching for females in an energy-efficient manner. They may do so over longer periods during the day than the perchers. These include swallowtails *Papilio* spp., the Forest Brown *Argynnis cyrila* and the Imperial Jezebel *Delias harpalyce*. Cabbage Whites tend to be quite mobile, ascending and patrolling mountains, but are not considered hilltoppers (Wainer and Yen 2000).

Mt Buninyong and Mt Warrenheip are significant for hilltopping butterflies, particularly those that are uncommon or widely dispersed or localised, such as the ochres *Trapezites* spp. and swallowtails *Papilio* spp. Wasps, hoverflies, and probably other insects, may also hilltop at these sites. Large numbers of dragonflies hawk for these hilltopping insects in the canopy at the summits. Both mountains have been proclaimed as scenic reserves. The Land Conservation Council, Victoria (1981) recommended that their management should aim to protect the relatively undisturbed native vegetation. This should also assist in conserving the local insect communities.

**Table 1.** Flight seasons and status of butterflies in the Ballarat Region. Status: H = historic record (pre-1990) only, current status unknown; R = rare; UC = uncommon; MC = moderately common; C = common; VC = very common; loc = localised; v = vagrant with few recorded local sightings; F = visit to feed on nectar (urban areas); BF = breed and feed on nectar (urban areas); nb = not breeding; ✓ = species recorded as hilltopping; x = species not hilltopping; Pe = territorial perching; Pa = patrolling behaviour; nb = species not breeding in the Ballarat region; Flight seasons: \* = the flight season for the Ballarat region; # = flight season for Victoria recorded in Braby (2000); e = found early in the month; l = late in the month. Flight seasons are not provided for species in the Ballarat region for which insufficient information is available. Information for Ballarat flight seasons in Table 1 is summarised from field data collected by the author, Neil Hives, Fabian Douglas, David Crosby and Roger Thomas; also these references: Anderson and Spry (1893), Braby (2000), Thomas (1990a, 1990b, 1991, 1992a, 1992b, 1992c, 1993a, 1993b, 1993c, 1994, 1995, 1997a, 1997b, 1998).

Species in urban areas (Excludes species found in or near urban vegetation remnants)	Status	Breed/ Feed	Hill- top? Perch/ patrol?	J	A	S	O	N	D	J	F	M	A	M	J
Family Hesperidae (Skippers, Awls, Grass-darts)															
Heath Ochre	<i>Trapezites phigalia phigalia</i>	MC loc	F?	✓Pe			#	*#	*#	*#	#				
Montane Ochre	<i>Trapezites phigalioides phigalioides</i>	H loc		✓Pe			#	#	*#	*#	#				
Yellow Ochre	<i>Trapezites lutea lutea</i>	H loc		xPe			#	*#	*#	#	#	#			
Splendid Ochre	<i>Trapezites symmokus soma</i>	H loc		xPa/Pe					*	*#	*#	*#	*#		
Barred Skipper	<i>Dispar compacta</i>	MC	BF	✓Pa						*#	*#	*#	*#		
Bright Shield-skipper	<i>Signeta flammeata</i>	MC	F	✓Pe					#	*#	*#	*#	*#		
Varied Sedge-skipper	<i>Hesperilla donnysa patmos</i>	UC loc	F	xPe				*#	*#	*#	*#	*#	*#		
White-banded Grass-dart	<i>Taractrocera papyria papyria</i>	C	BF	x? Pe				#	*#	*#	*#	*#	*#	#	
Green Grass-dart	<i>Ocybadistes walkeri sothis</i>	R loc	BF	x			#	#	*#	*#	*#	*?#	*?#	*?#	#
Family Papilionidae (Swallowtails)															
Dainty Swallowtail	<i>Papilio anactus</i>	UC	BF	✓Pa				* 1	*#	*#	*#	*#	*#	#	#
Orchard Swallowtail	<i>Papilio aegaeus aegaeus</i>	UC	BF	x				#	#	#	#	#	#		
Chequered Swallowtail	<i>Papilio demoleus sthenelus</i>	UC	nb?	✓Pa, nb	#	#	#	* 1#	*#	*#	*#	*#	*#	#	#
Family Pieridae (Whites and Yellows)															
White Migrant	<i>Catopsilia pyranthe crokera</i>	R v	Fnb	x?, nb	#	*v#	#	#	#	#	#	#	#	#	#
Small Grass-yellow	<i>Eurema smilax</i>	R/UC	Fnb	x?, nb	#	#	#	*#	*#	#	#	#	#	#	#
Narrow-winged Pearl-white	<i>Elodina padusa</i>	H v	nb	N/A				#	#	#		*v#	*v		
Caper White	<i>Belenois java teutonia</i>	MC/VC	Fnb	N/A	#	#	#	*#	*#	*#	#	#	#	#	#
Imperial Jezebel	<i>Delias harpalyce</i>	UC/MC	BF	✓Pa	#	#	#	*#	*#	#	*?#	*?#	*?#	#	#
Spotted Jezebel	<i>Delias aganippe</i>	UC/MC	F	xPa	#	#	#	*#	*#	*#	*#	*#	*#	#	#
Cabbage White	<i>Pieris rapae</i>	VC	BF	xPa	#	* 1#	*#	*#	*#	*#	*#	*#	*#	* e#	#

Species and status in urban areas	Status	Breed/Feed	Hill-top? Perch/patrol?	Flight season of adults											
				J	A	S	O	N	D	J	F	M	A	M	J
Family Nymphalidae (Danais, Browns, Nymphs)															
Silver Xenica	<i>Oreixenica lathoniella herceus</i>	C loc		xPe					*	*	*#	*#	*#	*#	#
Forest Brown	<i>Argynnia cyrila</i>	UC/MC	F	✓Pa	#	#	*#	*#	*?#	#					
Ringed Xenica	<i>Geitoneura acantha</i>	UC loc		xPa				*	*#	*#	*#	*#	*#	*#	#
Marbled Xenica	<i>Geitoneura klugii klugii</i>	C loc		✓Pe					*#	*#	*#	*#	*#	*e?#	
Common Brown	<i>Heteronympha merope merope</i>	C	F	✓Pe			#	#	*1#	*#	*#	*#	*#	*#	*e#
Shouldered Brown	<i>Heteronympha penelope sterope</i>	C	F	✓Pe						*#	*#	*#	*#	*#	
Varied Sword-grass Brown	<i>Tisiphone abeona albifascia</i>	UC loc		✓Pa			#	#	* v#	*#	*#	*?#	*?#	#	
Tailed Emperor	<i>Polyura sempronius</i>	v		✓Pe			#	#	#	#	*v#	*v#	#	#	#
Meadow Argus	<i>Junonia villida calybe</i>	MC	BF	xPe			#	#	*#	*#	*#	*#	*#	*#	
Yellow Admiral	<i>Vanessa itea</i>	MC	BF	✓Pe	#	* 1#	*#	*#	*#	*#	*#	*#	*#	*#	#
Australian Painted Lady	<i>Vanessa kershawi</i>	C	BF	✓Pe/Pa			* 1#	*#	*#	*#	*#	*#	*#	*#	#
Lesser Wanderer	<i>Danaus chrysippus petilia</i>	R v	BF	x			#	#	*#	*#	*#	*#	*#	#	
Monarch	<i>Danaus plexippus plexippus</i>	R/UCv	BF	x	#	#	#	#	*#	*#	*#	*#	*#	*#	#
Family Lycaenidae (Blues, Azures, Hairstreaks, Coppers)															
Grassland Copper	<i>Lucia limbaria</i>	R/UC loc		x	#	#	#	#	#	#	#	#	#	#	#
Bright Copper	<i>Paralucia aurifer</i>	R loc		x			#	#	* 1#	*#	*#	*#	*e#		
Dark-purple Azure	<i>Ogyris abrota</i>	R loc		x			#	#	#	#	*#	#	#	#	
Satin Azure	<i>Ogyris amaryllis meridionalis</i>	H		x			#	#	*#	*#	#	#	#	#	
Imperial Hairstreak	<i>Jalmenus evagoras evagoras</i>	UC loc	F	x				#	*#	*#	*#	*#	*#	*e#	
Amethyst Hairstreak	<i>Jalmenus icilius</i>	H loc		x			#	#	*#	#	#	#	#	#	
Silky Hairstreak	<i>Pseudalmenus chlorinda zephyrus</i>	R loc		x	#	#	*#	*#	*#	*#	#				
Varied Dusky-blue	<i>Candalides hyacintha hyacintha</i>	H		✓Pe			#	#	#	#					
Rayed Blue	<i>Candalides heathi heathi</i>	R loc		x, nb?	#	#	#	#	#	#	#	#	#	#	
Two-spotted Line-blue	<i>Nacaduba biocellata biocellata</i>	UC/MC loc	F	x	#	#	#	*#	*#	*#	#	#	#	#	#
Saltbush Blue	<i>Theclinesstes serpentata</i>	H		x, nb	#	#	#	#	#	#	#	#	#	#	#
Long-tailed Pea-blue	<i>Lampides boeticus</i>	UC/MC	BF	x	#	#	*#	*#	*#	*#	*#	*#	*#	*#	#
Common Grass-blue	<i>Zizina labradus labradus</i>	VC	BF	x	#	#	*#	*#	*#	*#	*#	*#	*#	*e#	#



### Historic Records

Eight species are known only from historic records (Table 1) and their current status in the region is unclear. One of these, the Narrow-winged Pearl-white *Elodina padusa*, is a rare vagrant that does not breed in the region. Two other species have larval foodplants that are not plentiful in the region. The larvae of the Varied Dusky-blue *Candalides hyacintha hyacintha* feed on the hemiparasitic dodder-laurals *Cassytha* spp. (Lauraceae), which are uncommon close to Ballarat. The Saltbush Blue *Theclinestes serpentata* is facultatively myrmecophilous. Its larvae feed on various chenopods (Chenopodiaceae). (Few chenopods are abundant locally, except for an introduced annual, Fat Hen *Chenopodium album*). The other three species are ochres *Trapezites* spp., discussed under 'Use of Urban Areas'. The Amethyst Hairstreak *Jalmenus icilius* has been recorded once (December 1982) at Kalimna Park, Castlemaine, in association with Wire-leaf Mistletoe *Amyema preissii* (Loranthaceae) growing on wattles (DF Crosby 2004 pers. comm.). The Amethyst Hairstreak is possibly a rare resident of northern areas. Other historic records are discussed under 'Vagrants' and 'Management Issues'.

### Seasonal Changes in the Butterfly Community

Some early season butterflies (Yellow Admiral *Vanessa itea*, Australian Painted Lady *V. kershawi* and Cabbage White) arrive from late August, on days with northerly winds. These are later supplemented by locally emerging adults. Several other species are known only as uncommon vagrants or migrants. Most uncommon migrants, such as the Small Grass-yellow *Eurema smilax*, arrive in October and November in association with greater, but highly variable, numbers of the Caper White *Belenois java teutonia*. In some years during the mid-late 1980s there were sufficient Caper Whites appearing suddenly in spring to prompt media attention. Numbers of migrant species have been very low since the mid-1990s, possibly because a lengthy drought produced an extended series of poor breeding seasons in their area of origin. Prevailing winds

can also influence the number of migrants arriving in an area, but this possibility has not been investigated. Smaller numbers of migrants appear in late summer and autumn.

Butterfly abundance and diversity increase through spring and summer. Late summer-autumn butterflies include four skippers and two nymphalids (Shouldered Brown *Heteronympha penelope sterope* and Silver Xenica *Oreixenica lathoniella herceus*), which tend to breed in gullies, forest understoreys, clearings and forest margins. All but the last species venture outside forested areas to forage for nectar. Dense forests and pine plantations are occupied only during the warmest months, mostly by female Common Browns *Heteronympha merope merope*. Butterfly numbers and diversity eventually decline as nights become cooler in April.

### Influence of the Cool Climate

The Ballarat region has a cool climate because of its altitude and inland location. Nights and winters are colder than those of Melbourne because temperatures are not moderated by the ocean. As a result, many butterflies in the Ballarat region have shorter flight seasons than those in Melbourne or Victoria generally. Species such as the Imperial Hairstreak *Jalmenus evagoras evagoras* may have fewer generations per year than elsewhere because of the shorter warm season. Early season species either disperse into the region from warmer areas to the north or emerge later than lowland individuals. Few late-season species survive past April. Apparently no butterflies overwinter as adults: none is seen after the onset of cold weather and frosts in early May, even on occasional sunny winter days.

Adults of three species require cool, moist and sheltered conditions: Splendid Ochre *Trap-ezites symmommus soma*, Silver Xenica and Ringed Xenica *Geitoneura acantha* (Braby 2000). In the Ballarat region, they often dwell in sheltered gullies where their larval foodplants are less desiccated. Silver Xenicas are also found in the cooler and moister conditions of the summits of Mts Buninyong and Warrenheip. The Ringed Xenica is known from sheltered gullies (e.g. around the Union Jack Creek bridge, Buninyong) but

**Table 2.** Potential occurrences in the Ballarat Region. This table is compiled from suggestions supplied by Fabian Douglas. Notes on larval food plants, adult flight periods for Victoria, behaviour (e.g. hilltopping) and habitat preferences are based on Braby (2000). Distributions of plants in the Ballarat region follow Gullan (2002).

Species	Larval foodplant	Flight period (Vic.), likely status. Local occurrence of foodplants
Montane Sedge-skipper <i>Oreixiplamus perornata</i>	Saw-sedges <i>Gahnia</i> , including Red-fruited Saw-sedge <i>G. sieberiana</i> and Thatch Saw-sedge <i>G. radula</i> (Cyperaceae)	October – April. Possible resident. Populations are localised. <i>G. sieberiana</i> grows in state forests to the SW, S and E of Ballarat, including Canadian State Forest. <i>G. radula</i> is also widespread, particularly to the N, E and S of Ballarat, often in drier forests than those inhabited by <i>G. sieberiana</i> .
Spotted Sedge-skipper <i>Hesperilla ornata ornata</i>	Saw-sedges <i>Gahnia</i> and tassel-sedges <i>Carex</i> (Cyperaceae)	October – April. Possible resident. Populations are localised. A hill topping species that both perches and patrols in the afternoons. Both sedge genera are widespread in damp habitats.
Heath Sand-skipper <i>Antipodila (Hesperilla) chaostola chares</i>	Saw-sedges <i>Gahnia</i> (Cyperaceae)	October – December. Possible resident. Populations are rare and localised, often in moist heathlands or sparse eucalypt forest.
Lemon Migrant <i>Calopsilla pomona pomona</i>	Cassias <i>Senna</i> (Caesalpinaceae)	<i>G. radula</i> and <i>G. sieberiana</i> both grow in the region (as above). Summer. Possible vagrant. Tropical species, occasionally interrupting to scattered Victorian localities. Cassias are not local native plants. Both exotic and native cassias are cultivated occasionally.
Yellow Abatross <i>Appias paulina ega</i>	Yellow Tulip <i>Drypetes deplanchei</i> (Euphorbiaceae) and possibly Dog Caper <i>Capparis canescens</i> (Capparidaceae)	Summer. Possible vagrant. Occasionally disperses during summer to eastern and central Victoria. Neither foodplant occurs locally.
Striped Xenica <i>Oreixenica kershawi kershawi</i>	Grasses, including tussock-grasses <i>Poa</i> and Forest Wire-grass <i>Tetrarrhena juncea</i> (Poaceae)	December – April. Possible resident of montane forests. May occur in the Mt. Cole/BenNevis region. <i>Poa</i> spp. are widespread. <i>T. juncea</i> grows in wetter forest understoreys S and E of Ballarat and (NW) in the mountainous area noted.
Spotted Brown <i>Heteronympha paradelpha</i>	Soft grasses, e.g. Weeping Grass <i>Microalaena stipoides</i> , Slender Tussock-grass <i>Poa tenera</i> .	January – April. Possible resident. Known from Mt. Buangor and Macedon. Mountains and foothills. Found in shady moist forests. A patrolling species with an erratic flight close to the ground. Larval foodplants are common forest understorey species.
Solander's Brown <i>Heteronympha solandri</i>	Native grasses, including tussock-grasses <i>Poa</i> spp. (e.g. Common Tussock-grass <i>P. labillardieri</i> ), Forest Wire-grass <i>Tetrarrhena juncea</i>	December – April. Possible resident. Found in montane forests and woodlands, including Mt. Cole and Mt. Buangor, usually above 500–600 m. Inhabits cool moist habitats. Powerful erratic flight within a few metres of the ground. <i>Poa</i> spp. and <i>T. juncea</i> are common in suitable habitats.
Bright-eyed Brown <i>Heteronympha cordace cordace</i>	Tall Sedge <i>Carex appressa</i> (Cyperaceae)	November – March. Possible resident of wetlands or damp sites, e.g. swampy areas and near creeks. Recorded at Mt. Buangor (Braby 2000) and Mt. Cole (DF Crosby 2004 pers. comm.). Slow meandering flight close to the ground. Tall Sedge is widespread in suitable damp habitats in the region.

Species	Larval foodplant	Flight period (Vic.), likely status. Local occurrence of foodplants
Moonlight Jewel <i>Hypochoeris delicata</i> <i>delicata</i> (H. d. delos)	Wattles, especially Late Black Wattle <i>Acacia mearnsii</i> and Blackwood <i>A. melanoxylon</i> , but also Early Black Wattle <i>A. decurrens</i> and Silver Wattle <i>A. dealbata</i> (Mimosaceae)	November - March. Possible resident. A hillingtopping species that flies rapidly at tree top level in the afternoon, usually late. Localised breeding colonies. Found in drier eucalypt forests and woodlands on the slopes and foothills. The Moonlight Jewel has an obligate relationship with <i>Crematogaster</i> ants. <i>A. decurrens</i> is widely planted, while the other species listed are common native species in forests of the Ballarat area.
Fiery Jewel <i>Hypochoeris ignita</i> <i>ignita</i>	Many species of wattles, especially Golden Wattle <i>Acacia pycnantha</i> and Early Black Wattle <i>A. decurrens</i> (Mimosaceae), also Daphne Heath <i>Brachyloma</i> (Epacridaceae), hopbushes <i>Dodonaea</i> (Sapindaceae), pomaderris <i>Pomaderris</i> (Rhamnaceae), some eucalypts <i>Eucalyptus</i> (Myrtaceae).	December - early March. Possible resident. Sparse in temperate areas. The Fiery Jewel has an obligate association with <i>Papyrius</i> ants. Hilltopping species, usually seen early and mid-afternoon. A locally common species in drier eucalypt woodlands, open-woodlands and heathlands. Many of the foodplants occur locally. (Refer to Gullan 2002.)
Broad-margined Azure <i>Ogyris olane ocella</i>	Mistletoes, especially Drooping Mistletoe <i>Anyema pendula</i> and Box Mistletoe <i>A. miquelii</i> . (Loranthaceae)	September - May. Possible resident. Some larvae are attended by ants of several genera. A hillingtopping species, flying at treetop level from late morning to late afternoon. Found in drier eucalypt open-forests and woodlands. Both mistletoes occur in the region, the former being the more common.
Fringed Heath-blue <i>Neolucia agricola</i> <i>agricola</i>	Flower buds and flowers of some members of the pea family (Fabaceae), including <i>Aotus Aotus</i> , bossiaes <i>Bossiaea</i> , bitter-peas <i>Daviesia</i> , parrot-peas <i>Dilwynia</i> , Eutaxia <i>Eutaxia</i> and bush-peas <i>Pultenaea</i> .	September - February? Possible resident. A hillingtopping species that flies rapidly close to the ground. Larvae are sometimes attended by <i>Iridomyrmex</i> ants. Found in heathlands or the heathy understorey of woodlands. Shrubby and herbaceous species of Fabaceae are common understorey plants in local forests, in particular <i>Bossiaea</i> , <i>Daviesia</i> , <i>Dilwynia</i> and <i>Pultenaea</i> .

not from the mountains. Crosby (1998) described the Ringed Xenica as non-alpine at Mt Buffalo because it frequented shady damp areas around the base of the mountain but not higher altitudes. The three species emerge earlier than lowland adults, probably facilitated by Ballarat's cooler summer. There are insufficient local records of the Splendid Ochre to comment on its distribution near Ballarat. It is likely to be uncommon because its larval foodplant, Spiny-headed Mat-rush *Lomandra longifolia*, is not abundant close to Ballarat. A recent trend towards landscaping with this plant may provide more opportunities for this and other species. Splendid Ochres fly from December to April, Silver Xenicas from late December until April, while Ringed Xenicas fly from November to April.

#### Use of Urban Areas

Most of the common urban butterflies are not sedentary and feed on nectar from garden plants and weeds. Some lay eggs on weeds and cultivated plants, including grasses, legumes, plantains, nettles and daisies. In some cases, there is a correlation between watering and butterfly abundance: in the early 1990s, Common Grass-blues *Zizina labradus labradus* were more abundant in gardens with watered lawns than those left dry. Current restrictions preventing the watering of lawns in Ballarat have diminished the numbers of this species.

Long-flowering exotic plants with taproots, such as Smooth Catsear *Hypochoeris glabra* and Hairy Hawkbit *Leontodon saxatilis*, continue to produce nectar and attract butterflies through late summer and autumn when few native plants (apart from

Sweet Bursaria and Messmate) are flowering in habitat remnants. The two exotics mentioned often penetrate remnant understoreys.

Butterflies breeding in urban areas include amongst their larval foodplants introduced species that are cultivated or associated with disturbance. Grass-feeding larvae of the White-banded Grass-dart *Taractrocera papyria papyria* and Green Grass-dart *Ocybadistes walkeri sothis* include exotic grasses in their diet and appear to benefit from luxuriant grass in urban areas. Australian Painted Ladies are more common in gardens (especially cottage gardens) and pastures than in remnants with native daisies. Ongoing summer watering of nectar and foodplants, enabling them to remain turgid, may permit this and other multivoltine garden species to continue producing rapidly developing further generations over summer. The Meadow Argus *Junonia villida calybe* was found to be associated with disturbed sites and exotic plantains *Plantago* spp. rather than the native Varied Plantain *P. varia*. The larvae are also often found on centaury *Centaurea* spp. (Gentianaceae), common pink-flowered weeds represented by three species in the region. Centauries are able to grow in disturbed and bushland situations too dry for plantains. Yellow Admirals show a preference for laying eggs on exotic annual stinging nettles (Small Nettle *Urtica urens*) rather than on the perennial native Scrub Nettles *U. incisa*, as demonstrated by choice experiments (Harris 1993). The former is a weed of damp rich soils, including well-manured pastures, volcanic soils, stockyards at Delacombe and gardens in urban Ballarat, while the latter grows in riparian vegetation (e.g. below Lal Lal falls). The Lesser Wanderer *Danaus chrysippus petilia* and Monarch *D. plexippus plexippus* are able to breed in the region only because butterfly fanciers cultivate (frost-tender) Swan Plants *Asclepias* spp. in more protected locations to attract them.

Suburbs lacking remnants (e.g. Wendouree) tend to have less rich butterfly communities. However, even quite small vegetation remnants in urban areas contain rich butterfly communities, provided the understorey is largely intact. Dense shade

is inimical to understorey plants and is avoided by most butterflies except at the height of summer. Sunny glades in open-forest seem to promote species richness, as demonstrated by the experimental creation of a glade in the University of Ballarat Regional Arboretum, Mt Helen, although they also increase butterfly observability. Particularly rich remnants include those along track margins in the Canadian State Forest, Webbs Hill Rd, Buninyong, Wombat State Forest and Tinworth Avenue, Mt Clear. Remnants with retained older trees (e.g. in Peady St Reserve, Mt Pleasant, University of Ballarat Regional Arboretum, Mt Helen, Union Jack Creek reserve and Webbs Hill Rd, Buninyong) may contain the locally uncommon Dark Purple Azure *Ogyris abrota* and the Silky Hairstreak *Pseudalmenus chlorinda zephyrus* and Imperial Hairstreak *Jalmenus evagoras*. All three require bark or wood crevices for at least one of the following activities: egg deposition, larval sheltering and pupation.

Cabbage Whites undergo several generations during their long flight season, becoming very abundant by autumn. They are especially common around canola crops and stands of cruciferous weeds such as *Brassica*, *Raphanus*, *Rorippa* and *Capsella*, but also frequent gardens with cruciferous vegetables or weeds.

Some species do not use urban areas (Table 1), and are confined to the vicinity of native vegetation remnants. These include:

- Those whose larvae largely or exclusively eat local native plants (most skippers except the grass-darts, Chequered Swallowtail *Papilio demoleus sthenelus*, Silver Xenica, Ringed Xenica, Forest Brown, lycaenids except the Long-tailed Pea-blue *Lampides boeticus* and Common Grass-blue);
- Those whose larvae feed on moist grasses or mat-rushes in sheltered sites over the warmer months (as described below);
- Those using leaf litter for larval shelters or pupation sites (ochres and other skippers);
- Those relying on adult camouflage against leaf litter (some nymphalids);
- Sedentary and localised species (designated 'loc' in Table 1; mainly hesperiids);



- Those having obligate relationships with ants. Many lycaenids have these relationships. The exceptions are either non-myrmecophiles (*Candalides* spp.) or facultative myrmecophiles (Long-tailed Pea-blue, Common Grass-blue);
- Forest understorey species (ochres *Trapezites* spp.; xenicas *Oreixenica*, *Geitoneura* spp.) that are sedentary and form localised colonies do not use urban areas except in the immediate vicinity of bushland remnants. The three ochres (Montane Ochre *Trapezites phigalioides*, Yellow Ochre *T. lutea* and Splendid Ochre *T. symmorus* soma) all form localised colonies and depend on leaf litter or tussock bases as larval shelters and pupation sites. The larvae feed on mat-rushes. The ochres may be locally rare or extinct because of habitat loss or understorey disturbance. The Yellow Ochre is discussed further under 'Management Issues'. Montane Ochres may be present but mistaken for the moderately common Heath Ochre *T. phigalia phigalia*. *Geitoneura* adults depend on camouflage against a background of leaf litter. Two of the xenicas, Ringed Xenica and Silver Xenica, have grass-feeding larvae and require moist sheltered conditions where grasses do not desiccate severely over summer.

### Vagrants

Five vagrant species are listed in Table 1. The Monarch or Wanderer *Danaus plexippus plexippus* is recorded from gardens in Lismore, Avoca, Creswick, Broomfield and Ballarat, (Thomas 1992a, 1993a, 1993b, 1997a) although doubtless it travels widely and appears elsewhere. The same applies to the Lesser Wanderer, which is recorded from Creswick (Thomas 1997b) as well as Ballarat (University of Ballarat campus, Mt Helen). Both wanderers occur sporadically in small numbers and are not seen every year. The larvae of both feed on Swan Plants or Milkweeds, usually the South African species *Asclepias pubescens* and *A. fruticosa* (Asclepiadaceae). The latter, though somewhat frost-tender, is sometimes available in local nurseries. Both wanderers apparently breed occasionally in the region.

The Tailed Emperor was first recorded in the Ballarat region during February/March 2001. A dead gravid female was discovered in the Rainforest Garden at the University of Ballarat, Mt Helen, near planted specimens of two larval foodplants, Flame Tree *Brachychiton acerifolium* and Kurrajong *B. populneus* (Sterculiaceae). The species is known to disperse widely and occasional records are noted from Victoria (Braby 2000). The Tailed Emperor has a wide range of larval foodplants, mostly legumes, but also kurrajongs and other rainforest trees (Braby 2000). The female may have dispersed from a small colony that was discovered in Castlemaine in 1993 and persisted for at least four years. Several members of the Castlemaine Field Naturalists' Club reported Tailed Emperors in Castlemaine in 2001 (R Thomas 2001 pers. comm. 10 March). Butterflies in that population favoured Silver Wattle *A. dealbata* and Cootamundra Wattle *A. baileyana* (Mimosaceae) as larval foodplants (R Thomas 2001 pers. comm. 10 March, quoting Gary Sobey, proprietor of 'Sky-dancers' butterfly farm in Castlemaine). Mr Sobey is also aware of unpublished sightings of the species in Stawell, Maldon and Bendigo. Males have been observed hilltopping at Mt Piper, Broadford, and Mt Paps, Mansfield (D. Britton 2004 pers. comm.).

### Management Issues

Sands and New (2002) evaluated the conservation status of Australian butterflies, considered the threatening processes involved and proposed an action plan to address these processes. None of the species recorded for the Ballarat region is listed as a threatened taxon in Victoria, although subspecies of three are listed for other states.

The Yellow Ochre has previously been noted in Beaufort, Mt Clear and Buninyong (Thomas 1990b). This species has a very brief flight period at any one site, is effectively camouflaged at rest, and thus is easily overlooked. It does survive in lightly grazed habitats, and may even benefit from having grass cover removed from around the larval foodplant (Wattle Mat-rush). Thomas (1992a) records a sighting

of the Yellow Ochre from Creswick late in the nineteenth century. It was also observed in the 1980s at the Buninyong cemetery (1981), the Canadian gully near Hocking Avenue, Mt Clear (1980), Beaufort (1981), 3.5 km east of Beaufort (1981) and on a roadside on a hill behind Castlemaine East High School (1987) (DF Crosby 2004 pers. comm.). In addition, hilltopping Yellow Ochres were observed in territorial disputes with Montane Ochres on a hill south of Chewton, near Castlemaine, on the Dingo Farm turnoff (DF Crosby 2004 pers. comm.). The fate of most of these populations is unknown. However, the Yellow Ochre may have been eliminated from the Buninyong cemetery during the 1990s because of an expansion of gravesite/ mown lawn areas, as well as more intensive mowing and extensive tidying operations by the Friends group. This needs to be verified. Mowing has significantly altered the structure and composition of the remnant grassland, which is dominated by Kangaroo Grass. The larval foodplant and nectar sources such as riceflowers *Pimelea* spp. and native daisies are now confined to relatively small areas at the periphery of the site and are kept low by mowing. Scarcely any native grassland survives outside the cemetery. Other small cemeteries with remnant grasslands that include Wattle Mat-rush (e.g. at Clarendon) would be worth searching for this and other species dependent on the groundcover flora. Cemeteries in towns not subjected to large population increases are likely to have better preserved grassland flora and fauna.

The Green Grass-dart has recently been seen in urban gardens in Ararat (2000, 2001, 2004), Mt Clear (2002) and Mt Helen (2004) between November and January, although it probably flies until about April. In each instance, only one individual was seen foraging for nectar. It appears that this species has established in small numbers in both Ararat and Ballarat. The grass-eating larvae are known to disperse in instant turf and may have originated in Sydney (Braby 2000), although they also appear to have separately extended their range, spreading along the Murray valley and into the Victorian Mallee and Wimmera as early as the mid-1980s (F

Douglas 2004 pers. comm.). However, the Ballarat climate is cooler and wetter than that of these areas. The Green Grass-dart tends to form small, localised colonies, often where the White-banded Grass-dart is also found. Its caterpillars require broad-bladed grasses that remain green over summer (F Douglas 2004 pers. comm.). Suburban gardens, with Panic Veldt-grass *Ehrharta erecta*, bromes *Bromus* spp. and various lawn grasses, are close to local sightings. Sites with suitable grasses may be more restricted in occurrence beyond urban areas, but might include gullies, riparian vegetation and stands of Kangaroo Grass.

The Chequered Swallowtail is a widely distributed and abundant migrant, but seldom reaches southern Victoria (Braby 2000). Its larvae feed on scurf-peas or Psoraleas *Cullen* spp. (Fabaceae). Small numbers of Chequered Swallowtails were discovered during the early 1990s, patrolling stands of Mountain Psoralea *C. adscendens* on the summit of Mt Warrenheip. They may breed there regularly or more likely re-establish at intervals via migrants. Similar but smaller stands at the summit of Mt Buninyong are not known to be used. Before the early 1990s, Mountain Psoralea was not known to be suitable for Chequered Swallowtail larvae. Plants grown from seeds obtained at the Mt Warrenheip site were supplied to Melbourne Zoo's Butterfly Department. The curator reported that Chequered Swallowtails in the Butterfly House laid eggs on the plants. The larvae completed all instar stages and successfully pupated (N Dowsett 1993 pers. comm. 22 June).

Chequered Swallowtails are at risk from the establishment of communications towers at the summit of Mt Warrenheip. A commercial FM transmitter erected in the 1990s largely eliminated the biggest patch of Mountain Psoralea at the site. Although Mt Warrenheip is a scenic reserve, it is sparingly managed. The absence of fire has caused tussocks of Common Tussock-grass to close over, severely restricting the intertussock spaces required by Mountain Psoralea and other forbs. (The species regenerated well from the soil seed bank following a small fire started by lightning in the mid-1990s.) Forget-me-not *Myosotis sylvatica* is invading intertussock spaces in

damper parts of the summit, but prefers damper and more shaded habitats than Mountain Psoralea.

Weed invasion of habitat remnants is common, particularly in volcanic soils and the richer, damper soil of gullies. Dry ridges and slopes are often comparatively weed-free. Many gullies are heavily infested with blackberries *Rubus* spp. These out-compete larval foodplants such as Slender Tussock-grass, Soft Tussock-grass, Weeping Grass, Hairy Rice-grass *Tetrarrhena distichophylla*, Forest Wire Grass *T. juncea* and wallaby-grasses *Austrodanthonia* spp. Many browns and skippers are disadvantaged by weedy gullies, especially those requiring summer shelter and moisture or larval foodplants (e.g. sedges and grasses) that do not desiccate over summer and early autumn. The Varied Sword-grass Brown *Tisiphone abeona albifascia* provides an example. In this region it is known from a vagrant in Mt Helen and two localised populations, one near Mt Buangor and the other, discovered in 2004, 2 km SW of Spargo Creek (pers. obs.). Both colonies are associated with drainage lines and wet gullies containing Red-fruited Saw-sedge *G. sieberiana*, the principal larval foodplant. Other potentially suitable habitats exist within several kilometres of both sites, although their size and quality vary. There is circumstantial evidence to suggest that the butterfly is capable of at least short-range dispersal, perhaps also occurring as a vagrant over larger distances (F Douglas 2004 pers. comm.). Consequently, the butterfly could discover and use surrounding patches of the sedge. Some gullies appear too dry to support many sedges. Other, damper gullies with richer soils, often near farmland, may be overgrown with blackberries. Red-fruited Saw-sedge has been almost eliminated over the past decade in two gullies near Spargo Creek as blackberries proliferated. This has permanently diminished opportunities for local colonisation of the most suitable sites by Sword-grass Browns, perhaps jeopardising the local metapopulation. The species may eventually be confined to smaller patches of foodplants in suboptimal sites.

The Grassland Copper *Lucia limbaria* was noted in pastures above the Woody

Yaloak River to the west of Cape Clear (Thomas, 1992c), near the south-western edge of the Enfield State Forest. It was seen with Common Grass Blues in early March 1992, but was difficult to observe because of windy conditions. The species was also recorded in March from near Newstead (Thomas, 1993b). The number of individuals seen is not recorded. As suggested by the common name, this species is found in open pastures and grassy plains. Its caterpillars feed on prostrate native wood-sorrels, the Shady Wood-sorrel *Oxalis exilis* and Grassland Wood-sorrel *O. perennans* (Oxalidaceae), previously listed under the exotic species Yellow Wood-sorrel *O. corniculata* (Braby 2000). These wood-sorrels are found widely in the region, even in somewhat disturbed grassy habitats and pastures. However, the butterfly tends to form small and often transient colonies (Douglas and Braby 1992) that may be widely separated. They may thus take a lot of effort to find. The larvae feed at night and have an obligate relationship with small black ants (*Iridomyrmex* species, *gracilis* group or *rufoniger* group) (subfamily Dolichoderinae) (Braby 2000). The ants tend them by day in galleries in the soil beneath the foodplant. They pupate in these galleries.

Populations of the Grassland Copper tend to be temporary and sporadic, although they may persist even in degraded or disturbed areas provided the ant and foodplants remain (Braby 2000). Given the fragmented and degraded state of many grasslands in the region, these two sightings should be followed up. Observations are needed to determine whether the populations are still extant or if new ones have formed. The size of any that currently exist should be estimated. Management issues should be identified and addressed.

The Bright Copper *Paralucia aurifer* is recorded from only one location, along roadside verges of Webbs Hill Rd, Buninyong, on the margin of the Garibaldi Forest. There are two generations annually, a smaller one in November–December and a larger one in late January–March. A small black ant, *Anonychomyrma* sp. (*nitidiceps* group) (subfamily Dolichoderinae) attends the Bright Copper (Braby 2000). Ant colonies and Bright Coppers

are invariably associated with stunted shrubs of Sweet Bursaria in drier and more sunlit locations. Foraging adults rarely travel more than 20 m from the colony, limiting their access to scattered Sweet Bursaria stands. This reduces the likelihood of new colonisations or recolonisation of stands with the appropriate ants. The Webbs Hill Rd population may be at risk from roadside grading, road widening, slashing or tilling for fire prevention or the spraying of woody weeds. Some locals mistakenly believe that Sweet Bursaria is a weed because it is a spiny shrub. It may be sprayed in any case because the roadside stands are interspersed with Gorse *Ulex europaeus* and Blackberry.

The forest-dwelling Silky Hairstreak is considered rare in Victoria (Braby 2000) and the species has undergone a serious decline in Tasmania (Couchman and Couchman 1977). It frequents wattles, including Blackwood, Late Black Wattle *A. mearnsii* and Silver Wattle and pupates under the bark of nearby trees (Common and Waterhouse 1981). The Silky Hairstreak is associated with the Forest Black Cocktail Ant *Anonychomyrma biconvexa* (formerly *Iridomyrmex foetans*, subfamily Dolichoderinae) that forms colonies in tree trunk heartwood or the ground layer. Understorey clearing (Prince 1988) and other processes (New 1990) may disadvantage both ant and butterfly. Small, localised populations of the Silky Hairstreak have been found to the south-east of Ballarat. Adults were first seen in the region between 1996 and 1998, on the margin of the Garibaldi Forest at Webbs Hill Rd, Buninyong, and at the University of Ballarat Regional Arboretum (pers. obs.). Three pupae were located at the summit of Mt Buninyong in February 1998. They were found under the loose bark of a Manna Gum growing beside a large Blackwood. These pupae were reared, with adults emerging in spring (F Douglas 1999 pers. comm.). Prior to this, the species was known in Western Victoria only from the Grampians and sites east of Gisborne (Common and Waterhouse 1981). However, Braby (2000) gives some additional localities for this species in the Ballarat region, including Mt Buangor State Park, Trentham Falls, the Wallace-

Gordon district, Korweinguboorra and Bullarto South.

The Amethyst Hairstreak is recorded in the region only from adults and pupae collected in December 1982, 3.5 km east of Beaufort at a bend in the Langi Kal Road (DF Crosby 2004 pers. comm.). They were closely associated with a roadside stand of Late Black Wattle, now felled for unknown reasons. Although roadside verges can preserve some local native plants and their fauna, they are not necessarily secure from a variety of damaging processes.

Drier understoreys in many Ballarat remnants bear dense stands of exotic shrubby peas (brooms *Cytisus* and *Genista*, Furze or Gorse). These can exclude most other understorey plants and contribute long-lived seeds to the seed bank. As some consolation, the Long-tailed Pea-blue uses them as larval foodplants. Ironically, butterflies are attracted to the nectar, pollinating shrubs that are stifling the understorey. Remnants adjacent to pine plantations (e.g. Tinworth Avenue, Mt Clear and parts of Canadian State Forest) are colonised by pine seedlings. In the absence of fire, these mature to provide dense shade and more seeds. By degrees, the understorey is obliterated by shading. Volunteering pine seedlings must be removed from high quality butterfly habitat or the understorey should be burnt at intervals, before young pines cast substantial shade or litter and prior to their setting seed.

In summary, management for native butterflies in the region is primarily a matter of habitat management. Habitat degradation, fragmentation and loss occur as a result of agriculture and urban development, weed invasion, infrastructure works and detrimental activities on roadsides and other public land. Some species in the region are too poorly documented to permit the development of management strategies.

#### Acknowledgements

I thank Neil Hives for his extensive fieldwork, discussions and entomological advice. Fabian Douglas, Roger Thomas, David Crosby, Gary Sobey and David Britton provided valuable suggestions and information. The 'Nature Notes' column by Roger Thomas, published in the Ballarat *Courier* over many years, made a sub-



stantial contribution to the tabulated data. Thanks to Marion O'Keefe for creating the map.

## References

- Anderson E and Spry FP (1893) *Victorian Butterflies and How to Collect Them*. (H. Hearne and Co: Melbourne)
- Braby MF (2000) *Butterflies of Australia. Their Identification, Biology and Distribution*. (CSIRO Publishing: Collingwood, Victoria)
- Common JFB and Waterhouse DF (1981) *Butterflies of Australia*. Revised edition. Australian Natural Science Library. (Angus and Robertson: Sydney)
- Couchman LE and Couchman R (1977). The butterflies of Tasmania. *Tasmanian Year Book*, 11, 11-96.
- Crosby DF (1998) The butterflies of Mount Buffalo National Park. *The Victorian Naturalist* 115, 222-225.
- Douglas F and Braby MF (1992) Notes on the distribution and biology of some Hesperidae and Lycaenidae (Lepidoptera) in Victoria. *Australian Entomological Magazine* 19, 117-124.
- Gullan PK (2002) *Wild Things of the Ballarat Area*. CD-ROM. Viridans Pty. Ltd., Bentleigh East, Victoria.
- Harris J (1993) *The Life History of the Australian Admiral, Vanessa itea, in the Ballarat District*. (Unpublished report, Biological Resource Management, Ballarat University College: Ballarat)
- Land Conservation Council, Victoria (1981) *Proposed Recommendations. Ballarat Study Area*. (LCC: Melbourne)
- New TR (1990) Conservation of butterflies in Australia. *Journal of Research on the Lepidoptera* 29, 237-253.
- Prince GB (1988) The National Conservation Status of the hairstreak butterfly *Pseudalmenus chlorinda* Blanchard in Tasmania. (Report to Tasmanian Department of Lands, Parks and Wildlife: Hobart)
- Sands DPR and New TR (2002) *The Action Plan for Australian Butterflies*. (Environment Australia: Canberra)
- Thomas R (1990a) Butterflies Say Spring is Here. *Courier*, Ballarat, 29 September, p. 37.
- Thomas R (1990b) Skipper Butterflies Similar to Moths. *Courier*, Ballarat, 19 May, p. 38.
- Thomas R (1991) Insect Life is on the Move. *Courier*, Ballarat, 13 April, p. 69.
- Thomas R (1992a) Creswick Butterflies from the Past. *Courier*, Ballarat, 4 April, p. 25.
- Thomas R (1992b) The Wildlife of Mt. Buninyong. *Courier*, Ballarat, 29 February, p. 33.
- Thomas R (1992c) Butterfly Spotted at Woody Yallock. *Courier*, Ballarat, 28 March, p. 63.
- Thomas R (1993a) Rare visitor is a First for Region. *Courier*, Ballarat, 20 February, 1993, p. 28.
- Thomas R (1993b) Passage of a Rare Butterfly. *Courier*, Ballarat, 6 March, p. 36.
- Thomas R (1993c) Insects Working Together. Ants Tend to Butterflies in Early Stages of Life. *Courier*, Ballarat, 17 April, p. 14.
- Thomas R (1994) Hungry Swallows eat Butterflies. *Courier*, Ballarat, 12 March, p. 28.
- Thomas R (1995) Wattles are Important for Butterflies. *Courier*, Ballarat, 19 August, p. 32.
- Thomas R (1997a) Meet the Wanderer. *Courier*, Ballarat, 20 December, p. 28.
- Thomas R (1997b) Lesser Wanderer is a Surprising Butterfly. *Courier*, Ballarat, 6 December, p. 35.
- Thomas R (1998) Hot Winds Bring Butterflies. *Courier Weekend Magazine*, Ballarat, 31 October, p. 17.
- Wainer JW and Yen AL (2000) A Survey of the Butterfly Fauna at the Paps Scenic Reserve, Mansfield, Victoria. *The Victorian Naturalist* 117, 131-140.

Received 26 August 2004; accepted 16 December 2004