The Papers

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TEMPERATE WESTERN VICTORIAN GRASSLAND INSECTS: THE INTERACTIONS BETWEEN NATIVE AND EXOTIC INSECTS AND PLANTS

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Introduction

Temperate grasslands in western Victoria have been considered important for conservation of flora and fauna and for increased agricultural productivity. They were also an important food habitat for indigenous Aborigines before European settlement (Australian Government, 2011). There has been a major reduction in the area of temperate grasslands in western Victoria since European settlement; there was an estimated one million ha of native grassland at the time of settlement, but this was quickly used for grazing introduced domesticated animals such as sheep and cattle, and also converted to crops. The result is, through the use of introduced pastures and fertiliser application, <0.5% of original native grassland remains.

The vast majority of remaining native grasslands are isolated small remnant patches or linear strips and these are prone to external threats including introduced plants and animals and inappropriate fire regimes. Most sites are narrow (roadside and railway reserves) and many sites are a mixture of native and exotic plants (both crops and weeds). Some are small conservation reserves, but most are on private land. Recently a larger grassland conservation reserve north of Werribee was established, but most of it is grazed land with high levels of exotic plants (DSE, 2011).

Very little information has been obtained about the significance of these grasslands for plants and animals. Most of the recent surveys have focused on plants and vertebrates. There is a lack of widespread data and a lack of both seasonal and long-term data for invertebrates. Sites have not been monitored over time, therefore seasonal and annual changes are not well documented. There is also an enormous lack of information about the invertebrate species, invertebrate fauna structures and ecological functions and on sudden population expansion of certain species (both native and exotic ones).

Methods

In Victoria some native grassland invertebrate surveys were undertaken in the 1990s, mid- 2000 (Yen et al., 1994, 1995, 1996; Yen unpublished data) and late 2010 (Faithfull, 2012). The reasons for the surveys and sampling approaches differed. In the 1990s surveys were conducted for conservation of threatened grasslands. Invertebrates were generally surveyed over all known native grassland sites using several collecting methods; instead all invertebrates were identified to order and some to a lower taxonomic level (e.g. Family or species; Yen et al., 1994, 1995, 1996). In the mid-2000s, invertebrate work was more focused on understanding the benefits of native grasslands for beneficial invertebrates for adjacent farms (Dorrough et al., 2004).

Results and Discussion

The results of the 1990 invertebrate surveys in western Victoria are based mainly on their identification of invertebrates collected to the higher taxonomic levels (orders, families, and to species for some orders). Seasonality and changes over time are

not well monitored. Insect species were collected from numerous (46) widespread small sites in Western Victoria using pitfall traps, sweep nets, suction traps and direct searching in the 1990s (Yen et al., 1994, 1995, 1996). A minimum of 221 species was identified from the 46 sites but the actual number of species was higher because spiders (Araneae) and non-ant Hymenoptera were only identified to the family level. In a study undertaken in late 2000, 215 species of grassland herbivores were collected on a large disturbed conservation reserve near Werribee (Faithfull, 2012) (Table 1).

Beetles collected from 12 of the western Victorian grassland sites in the 1990s were sampled over four seasons (Autumn, Winter, Spring and Summer) and identified to species level later (Yen and Kobelt, 2009). The sites were roadside reserves (5), railway reserves (3), cemetery (1), private property (2) and conservation reserve (1). Ten of the sites were disturbed (burnt or grazed) and two undisturbed. The beetles were collected using sweep nets, pitfall traps, suction traps and direct searching. There were 114 species of beetles from 26 families, but the fauna was dominated by four families (Carabidae, Staphylinidae, Scarabidae and Tenebrionidae) and there was only a small number of widespread species; over 63% of species were only found at 1–2 sites. The trophic levels were well represented were: predators (58 species), herbivores (24 species), detritivores (31 species), and fungivores (6 species). More species (66) were collected in spring compared to summer (36), but there were more individuals collected in summer (Yen and Kobelt, 2009).

Unpublished data on wasps collected at Shelford in Victoria using pitfall water traps, sweep nets and vacuum sampling over two seasons from 2005–2006 found 156 species of wasps from 28 families; the vast majority were parasitoids, but a few families of plant feeders occurred (Table 2). Early research (1994–1995 and 2005–2007) on small, mainly linear, grassland sites indicate higher numbers of native insects (especially predators and wasps) than adjacent crops.

One observation is colonisation of grasslands by exotic plant feeders such as the African black beetle *Heteronychus arator,* Portuguese millipedes *Ommatoiulus moreletii,* exotic slugs and exotic snails (e.g. Small Pointed Snail *Cochlicella barbara*). Some native insect species have also become pests; the Redheaded cockchafer *Adoryphorus couloni* (Burmeister), a pest since the 1950–60s, is now more abundant in ryegrass pastures and some crops (Berg et al., 2013) as is the Blackheaded cockchafer (*Acrossidius tasmaniae*) (Maelzer, 1962).

Conservation on native grasslands involves both flora and fauna. The Golden sun moth (*Synemon plana* Walker) was widespread and relatively continuous throughout its range at the time of European settlement. It feeds on wallaby grass (*Austrodanthonia caespitosa*) but is able to breed on the introduced and highly invasive weed Chilean needle grass *Nassella neesiana* (Trin. and Rupr.) Barkworth. The Golden sun moth has been eliminated over much of its former range mainly through loss of habitat because of agricultural expansion and urbanisation and loss of suitable food plants or by changes in the structure of grasslands. Other factors affecting its habitat include inappropriate fire regimes, weed invasion, overstocking (causing loss of habitat plants, changes to soil and plant structure or increased nutrient loads), changes to agricultural practices (e.g. fertiliser application, ploughing and overgrazing), rank growth (loss of inter-tussock spaces), and soil compaction.

Invertebrates associated with native grasslands in western Victoria are disadvantaged because: (1) there is virtually no monitoring to assess composition and changes in composition both seasonal and over the years; (2) the effects of changes in grasslands on the composition of insects is not well monitored; (3) the native grassland specificity of the insect species is not well studied; (4) controlling effects of introduced plants and invertebrates on both native grasslands and native invertebrates rarely occurs; (5) understanding functions of different invertebrates is not undertaken; and (6) the effects of land management outside the grasslands on the invertebrate fauna of the grasslands is not considered. Overall there seems to be more emphasis on a few threatened species and their conservation management may not always assist long term natural survival of the native grasslands and the majority of the native invertebrates.

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Table 1.
Comparison of invertebrate surveys conducted in numerous (46) widespread small sites in Western Victoria[1] using pitfalls, sweeps, suction trap and direct searching and grassland herbivores on large disturbed conservation reserve near Weribee[2].

Order	Common Group	Number of species	
		Western Victoria	*Werribee*
Oligochaeta	Earthworms	3	
	Scorpions	1	
Araneae	Spiders	? spp from 18 families	
Acarina			2
Opilionidae		3	
	Centipedes	2	
Odonata		6	
Blattodea		4	
Dermaptera		4	1
Orthoptera		16	4
Thysanoptera			29
Hemiptera		35	37
Coleoptera		105	42
Diptera			8
Lepidoptera			84
Hymenoptera	Non-ants	? spp from 16 families	
	Ants	42	
Hymenoptera			8
Total		**221**	**215**

[1]Yen et al., 1994, 1995 and [2]Faithfull, 2012

Table 2.
Families of wasps collected at Shelford, Victoria during two seasons (2005–2006) using pitfall traps, vacuum sampling, sweep netting and water traps.

Family	Number of species	Number of individuals	Functional group
Aphelinidae	1	2	Parasitoid
Apidae	2	333	Folivore
Bethylidae	2	47	Parasitoid
Braconidae	19	245	Parasitoid
Ceraphronidae	6	205	Parasitoid
Chalcididae	2	4	Parasitoid
Crabronidae	1	1	Predatory
Diapriidae	10	500	Parasitoid
Encyrtidae	19	126	Parasitoid
Eucharitidae	2	10	Parasitoid
Eulophidae	17	130	Parasitoid, phytophagous
Eurytomidae	2	3	Parasitoid, phytophagous
Evaniidae	1	1	Parasitoid
Figitidae	3	64	Parasitoid
Ichneumonidae	7	95	Parasitoid
Megaspilidae	2	3	Parasitoid
Mutillidae	1	1	Parasitoid
Mymaridae	10	110	Parasitoid
Pergidae	1	20	Phytophagous
Platygastridae	3	35	Parasitoid
Pompilidae	1	2	Predatory
Pteromalidae	14	84	Parasitoid
Scelionidae	23	497	Parasitoid
Scoliidae	1	6	Parasitoid
Sphecidae	1	4	Predatory
Tiphiidae	3	20	Parasitoid
Torymidae	1	2	Parasitoid, phytophagous
Trichogrammatidae	1	3	Parasitoid
Total	**156**	**2553**	