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Influence of farmland revegetation on the abundance and diversity of surface-active invertebrates: a case study for the Gondwana Link initiative

ALCOA FOUNDATION'S CONSERVATION AND SUSTAINABILITY FELLOWSHIP PROGRAM

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gondwana link

Advancing Sustainability

Curtin University of Technology

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THE GONDWANA LINK PROGRAM SEEKS TO RESTORE THE ECOLOGICAL CONNECTIVITY OF THE REGION FROM THE SOUTHWEST FORESTS, THROUGH TO THE STIRLING RANGES, THE FITZGERALD BIOSPHERE REGION AND NORTH TO THE GREAT WESTERN WOODLANDS. IT HAS IDENTIFIED FRAGMENTS AND CORRIDORS OF NATIVE VEGETATION AND IS FACILITATING THE REVEGETATION OF INTERVENING FARMLAND BY DIRECT PURCHASE OF LAND, AND BY ENCOURAGING COMMUNITY GROUPS AND LANDHOLDERS TO REHABILITATE AREAS. TO DATE, MOST ATTENTION HAS BEEN PAID TO ESTABLISHING THE VEGETATION, ALTHOUGH SOME KNOWLEDGE OF THE RESPONSES OF VERTEBRATE ANIMALS HAS BEEN GAINED. HOWEVER, LITTLE OR NOTHING IS KNOWN ABOUT THE RESPONSES OF INVERTEBRATES. THIS STUDY INVESTIGATED THE RESPONSE OF GROUND-SURFACE INVERTEBRATES TO 2 AND 3 YEAR-OLD REVEGETATION. NATIVE MALLEE AND NON-REVEGETATED PASTURE PLOTS WERE ALSO SAMPLED TO PROVIDE BEFORE/AFTER BENCHMARKS. ALTHOUGH THE VARIETY OF INVERTEBRATES IN THE REVEGETATION WAS REASONABLY HIGH, IT WAS NOT APPRECIABLY GREATER THAN IN THE PASTURE, AND WAS WELL BELOW THAT OF THE NATIVE MALLEE. THIS PROBABLY REFLECTED THE FACT THE TREES AND SHRUBS WERE STILL CONFINED TO THE ROWS WHERE THEY HAD BEEN PLANTED. THE INTERVENING AREAS WERE STILL PASTURE-LIKE, WITH NO SHADE OR BUILD UP OF LEAF LITTER. IT IS CONCLUDED THAT RESTORATION SHOULD BE MONITORED OVER LONGER PERIODS OF TIME, OR IN OLDER AREAS OF RESTORATION IN ORDER TO SEE WHAT LONG-TERM BENEFITS ARE RESULTING FROM THE PLANTING OF NATIVE VEGETATION.

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Series Editors: Professor Jonathan Majer & Professor Daniela Stehlik

Introduction

The Gondwana Link program is an initiative that pertains to the south-west of Australia, which has been recognised as one of the worlds top 25 (now 34) biodiversity hotspots (Hopper *et al.* 1996; Myers *et al.* 2000). Despite the high diversity in the region, much of the area has been cleared for agricultural development. Indeed, State government programs and initiatives up until the early 1980's encouraged the local farming community to clear at least a million acres (*sic*) a year of vegetation. Over 10 million hectares of south-western Australia's vegetation communities were cleared, resulting in about 7% of the original wheatbelt vegetation remaining. In additional to loss or reduction of ecological communities, this clearing has resulted in severe fragmentation of the native vegetation, which itself carries its own ecological consequences. The Gondwana Link initiative, which derives its name from the numerous relictual Gondwanan taxa that persist in the area, seeks to restore the connectivity of the region from the south-west forests, to the Stirling Ranges, the Fitzgerald Biosphere region and north east to the great western woodlands. The 1000 km long pathway is divided into eight operational areas and the area between the Stirling Range and the Fitzgerald River National Park is referred to as the Fitz-Stirling operational area (Figure 1 - inset).

The program is a loose collaboration between various organizations, with Greening Australia, Bush Heritage Australia and the Nature Conservancy being the main collaborators in the Fitz-Stirling, assisted on specific projects in the area by groups including Fitzgerald Biosphere Group, Friends of Fitzgerald River National Park, Shell and South Coast Natural Resources Management. In other parts of the Gondwana Link initiative, groups such as Green Skills and The Wilderness Society Australia are collaborating. In the Fitz-Stirling area, the Gondwana Link groups have identified a number of conservation targets and are working to implement several strategies for their protection and restoration. One of these strategies is the purchase and rehabilitation of farmland to reconnect the fragments of native vegetation and encouraging community groups and landholders to rehabilitate other areas. The result of this is a program of ecological restoration on a massive scale. Much of this work is being carried out by contractors or directly by the landholders and community groups concerned.

To date, most attention has been paid to establishing the vegetation, although some knowledge of the responses of vertebrate animals has been gained. However, when we consider the fauna of these areas, we must take into account the fact that 99% of animal species on land are invertebrates. There is more to consider than just the conspicuous mammals, birds, reptiles and amphibians, which is further illustrated by the fact that,

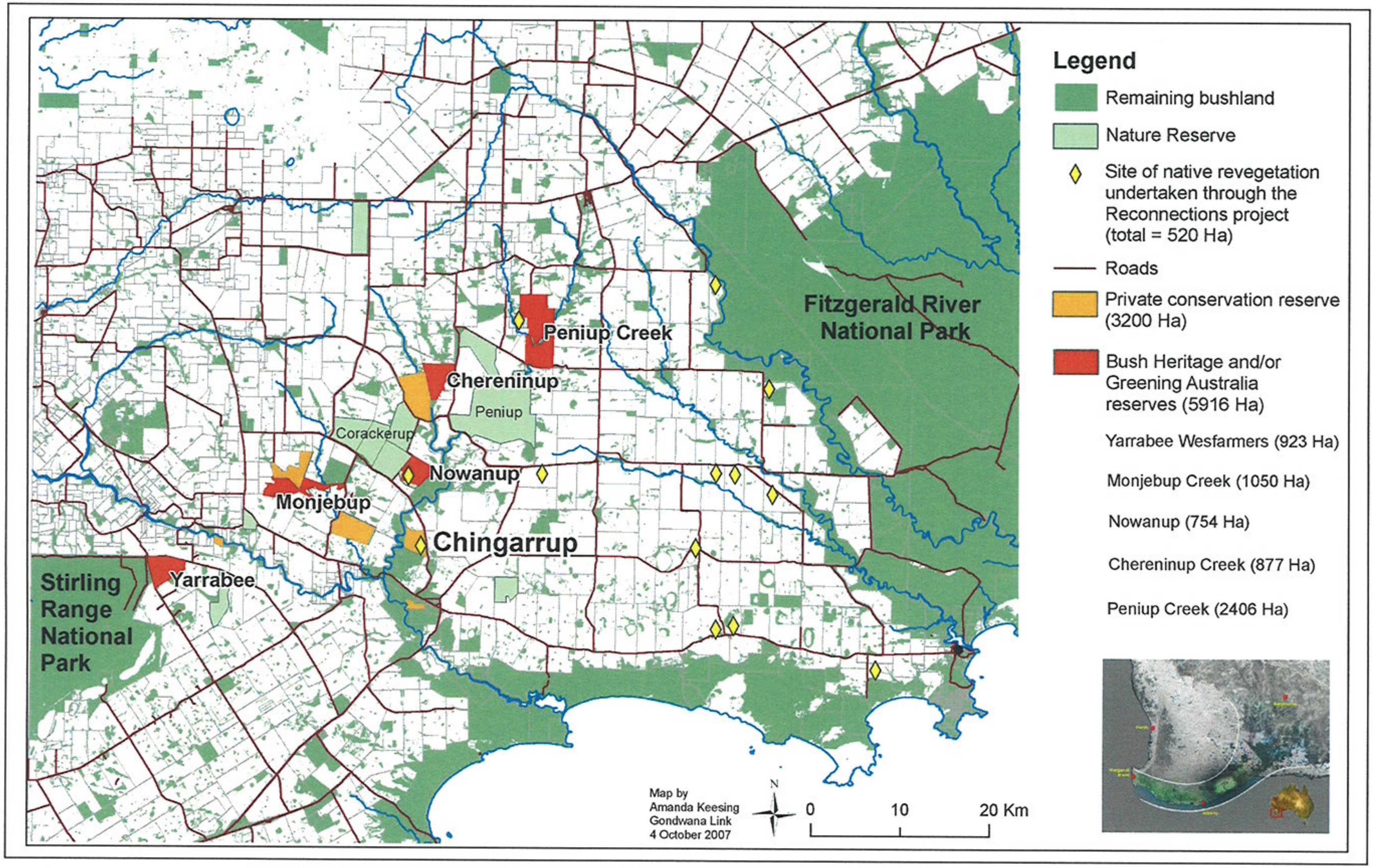

Figure 1. Map showing how private and other conservation reserves contribute to connections between the Stirling Range and Fitzgerald River National Parks. The inset shows the Gondwana Link concept.

collectively, the invertebrates in a parcel of land weigh more than the vertebrates that occupy the same area.

The various invertebrates, which include snails, worms, slaters, spiders, centipedes, millipedes, springtails and plethora of different types of insects, play a pivotal role in the functioning of the ecosystem. Burrowing invertebrates aerate the soil and allow rain to soak in, other soil animals regulate nutrient cycling, while various insects pollinate flowers or disperse seeds. In addition to this, they provide a food source for many species of birds, mammals, reptiles and amphibians. Some of these vertebrates have specialised invertebrate diets, so they cannot survive without an adequate supply to feed on.

The aim of this preliminary investigation is to evaluate how current rehabilitation prescriptions are contributing to the return of surface-active invertebrates. By gaining this information, it should be possible to derive insight into the efficacy of the rehabilitation prescription that is being used and to obtain some insight into how well the early stages of the ecosystem are developing.

Site selection and methods

The investigation took place in the Fitz-Stirling operational area, and was carried out on a privately-purchased property named Chingarrup Sanctuary, which is approximately 6 km NNE of Boxwood Hill (Figure 1). This site, referred to as Lot 51, Boxwood Hill, is a 572 ha property which was originally released for agriculture under the post-World War 2 soldier settlement program. The area had been cleared during the early stages, but all except the extreme eastern portion had regrown following abandonment of the original cleared areas (Figure 2). The remaining 10% of cleared land had been used for pastoral activities before being sold to the present owner in 2002. The property was purchased for conservation purposes and to contribute to the Gondwana Link objectives.

An area of 8 ha of native vegetation was established by Greening Australia–appointed contractors in August 2004. Vegetation was established by direct seeding 3 m apart using a modified Chatfield machine at a rate of approximately 0.75 kg of seed per hectare. Survival counts by Greening Australia in August 2007 indicated approximately 7,600 plants per hectare in the area that was sampled for invertebrates. A second 40 ha area was established using the same techniques in April 2005 at a row spacing of 3.5 m. Survival counts of germinants in August 2007 showed densities of approximately 24,000 plants per hectare in the area where invertebrates were sampled. The species planted in the two areas are listed in Table 1 and the positions of these two areas, which are termed 'older' (O) and 'younger' (Y) respectively, are shown in Figure 2. By October 2007, the height of the vegetation in the younger and older plots was 50-200 cm and 30-100 cm, respectively; the corresponding swathe widths were ~ 120 cm and ~ 80 cm. In addition to the planted vegetation, approximately 12 volunteer species of native plants had appeared in the rehabilitated areas.

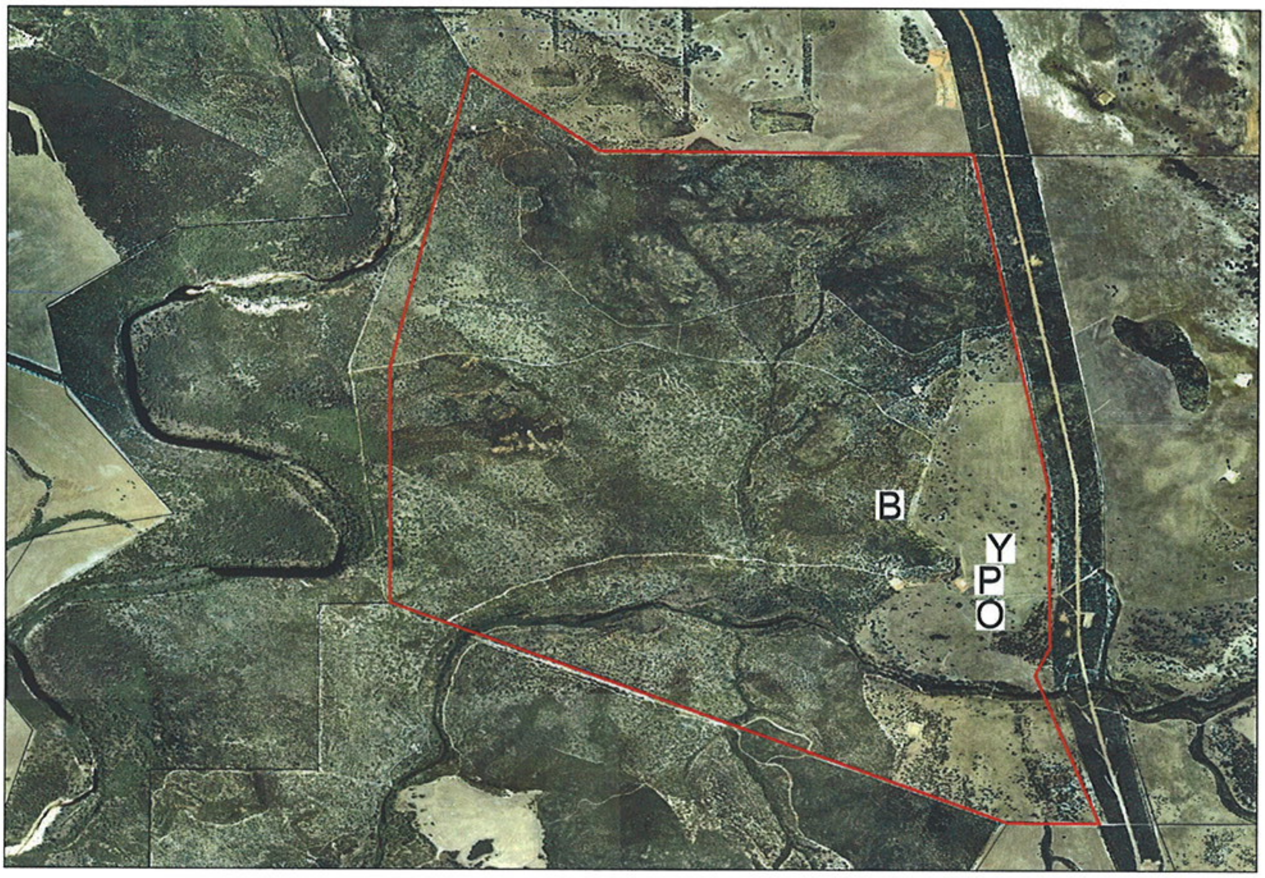

Figure 2. Map of Chingarrup Sanctuary, delimited by red line. B = bushland transect; P = pasture transect; Y = 'younger' 2005 revegetation transect; O = 'older' 2004 revegetation transect.

In addition to the two rehabilitated areas, an area of unrehabilitated pasture (P) and of native mallee (B) were selected for investigation (Figure 2). General views of the four areas are shown in Figure 3.

A 30 m transect was marked out in each of the four areas in April 2007. Ten pitfall traps were established at 3 m intervals along each transect. These consisted of 54 mm internal diameter plastic pots containing 50 ml of ethylene glycol. These were inserted in the ground with an auger and left open for 7 day sampling periods. Sampling was performed once in April 2007 and again in October 2007. The invertebrates from the pitfall traps were sorted and counted to the 'order' level. Trends for the more numerous taxa were then expressed graphically and differences between the four transects were compared using one-way analysis of variance. In order to obtain information on species richness, the ants were further sorted and identified to the species level. This group was selected for its excellent bioindicator potential for information on the nature of the environment and their ability to act as surrogates for information on many other invertebrate taxa (Majer *et al.* 2007).

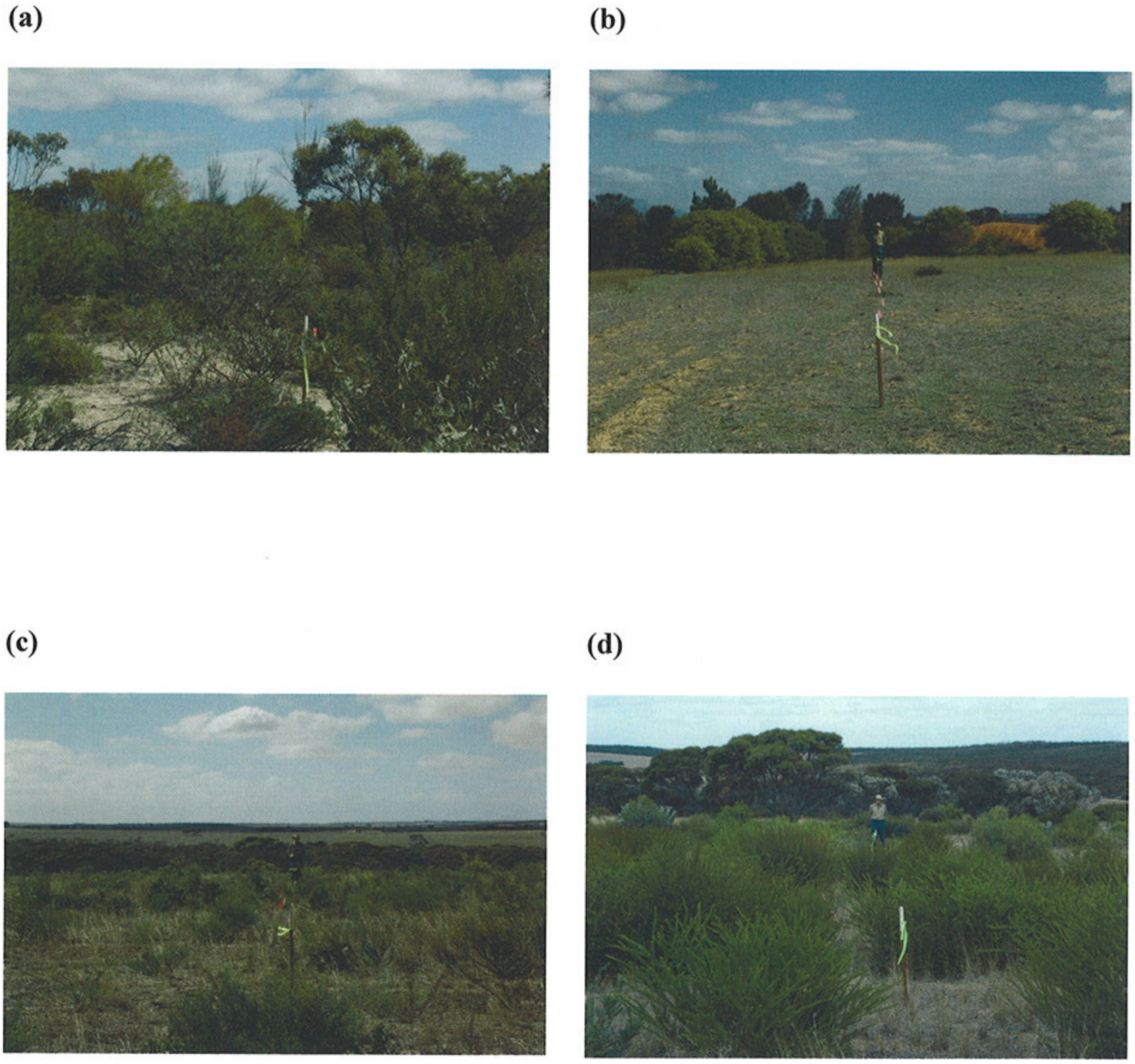

Figure 3. Views of the (a) bushland transect, (b) pasture transect, (c) 'younger' revegetation transect and (d) 'older' revegetation transect. Photos taken in May 2007.

Table 1. List of species planted in the 2004 and 2005 Chingarrup Sanctuary revegetation programs.

Species	2004 (older)	2005 (younger)
Acacia chamaeleon	*	*
Acacia cochlearis		*
Acacia consobrina	*	*
Acacia cupularis	*	*
Acacia cyclops	*	*
Acacia declinata	*	*
Acacia dictyaneura	*	
Acacia harveyi		*
Acacia maxwellii		*
Acacia newbyi	*	
Acacia pinguiaulosa		*
Acacia saligna		*
Acacia sphacelata var. *recurva*	*	*
Acacia sulcata var. *sulcata*		*
Allocasuarina huegeliana	*	*
Allocasuarina lehmanniana		*
Callistemon phoeniceus	*	*
Calothamnus quadrifidus	*	*
Daviesia benthamii subsp. *acanthoclona*		*
Dodonaea sp.		*
Eucalyptus affin. *hypochlamydea*	*	*
Eucalyptus affin. *medialis*	*	*
Eucalyptus annulata		*
Eucalyptus conglobata	*	*
Eucalyptus decipiens subsp.*desmophloiea*	*	*
Eucalyptus falcata	*	*
Eucalyptus gardneri		*
Eucalyptus grandiflora		*
Eucalyptus neutra	*	*
Eucalyptus phaenophylla	*	*
Eucalyptus phenax	*	
Eucalyptus pleurocarpa	*	*
Eucalyptus pluricaulis subsp. *pluricaulis*		*
Eucalyptus thamnoides subsp. *thamnoides*	*	*
Eucalyptus uncinata	*	*
Exocarpus sparteus		*
Gastrolobium parviflorum		*
Glisharocaryon aureum		*
Goodenia scapigera		*
Goodia lotifolia		*
Hakea commutata		*
Hakea pandanicarpa subsp *crassifloia*		*
Hakea strumosa		*
Hakea verrucosa		*
Indigofera sp.		*
Melaleuca acuminata	*	*
Melaleuca hamata		*
Melaleuca pentagona		*
Melaleuca polycephala		*
Melaleuca sp. 1(Chingarrup)	*	*
Melaleuca sp. 2(Chingarrup)	*	*
Melaleuca uncinata	*	*
Patersonia occidentalis		*
Senna artemisoides subsp. *artemisoides*		*
Total species	24	48

Results

A total of 20 orders were sampled in the transects (Table 2). The numbers of orders per transect are graphed in Figure 4, and the mean numbers of invertebrates within the most consistently occurring orders are shown in Figures 5 – 13.

The number of classes or orders per transect did not vary much between treatments (Figure 4), although it was slightly lower in the pasture and revegetation than in the mallee during the April samples. No trends between pasture and revegetation, nor between revegetation ages were evident.

Two taxa, the Dermaptera in October (Figure 8) and the Hymenoptera in October (Figure 13), were significantly more abundant in the pasture than in the revegetation and in the mallee, suggesting that pasture conditions were favourable to certain species within these two groups.

A further two taxa appeared to be enhanced by the revegetation of the pasture. Homoptera (Figure 10) were elevated in younger revegetation in October, while Coleoptera (Figure 11) were elevated in the older revegetation during April. In both cases, levels were higher than in the mature mallee.

The only other taxon where significant trends were detected was the Collembola (Figure 7). Here, numbers in the pasture and revegetation were lower than in the mallee during April, but higher in pasture and older revegetation than in mallee during October.

Table 3 shows the ant species that were sampled during April and October, and for both sampling periods combined. Frequencies out of 10 pitfall traps are provided for the two individual sampling periods. The totals are shown graphically in Figure 14.

A total of 49 species were sampled, although most of these were from the mallee (41 species). There were no clear trends in species richness between the pasture (16 species), younger revegetation (17 species) and older revegetation (16 species). However, inspection of the list of ants shown in Table 4 indicates that three species that were not present in the pasture were sampled at moderate to high frequencies in the younger and/or older revegetation. There were *Cardiocondyla nuda, Doleromyrma rottnestensis* and *Iridomyrmex bicknelli.* *Solenopsis clarki* also appeared at low frequencies in the revegetation, although it was not found in the pasture.

Table 2. Mean (SE) number of arthropods sampled in 10 pitfall traps run during April and October 2007 in pasture (P), younger revegetation (Y), older revegetation (O) and native mallee vegetation (B).

Taxon		Apr-07								Oct-07							
		P		Y		O		B		P		Y		O		B	
		ME	SE	ME	SE	ME	SE	ME	SE	ME	SE	ME	SE	ME	SE	ME	SE
Araneae	Araneae	1.1	0.3	0.7	0.3	0.5	0.2	1.3	0.3	0.5	0.2	1.0	0.4	1.5	0.3	1.2	0.3
Araneae	Acarina	0.0	0.0	0.0	0.0	0.0	0.0	2.5	0.7	0.2	0.2	0.0	0.0	0.3	0.2	1.1	0.5
Araneae	Scorpionida	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Crustacea	Isopoda	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	4.8	1.8	0.0	0.0	0.0	0.0	0.0	0.0
Chilopoda		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.1	0.1
Diplopoda		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0
Collembola		4.1	1.6	6.2	1.5	15.4	3.3	38.5	7.7	126.8	16.9	20.4	3.8	77.2	10.1	26.1	3.5
Diplura		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.1	0.1	0.1	0.1
Insecta	Blattodea	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.0
Insecta	Isoptera	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2
Insecta	Dermaptera	0.1	0.1	0.0	0.0	0.1	0.1	0.0	0.0	1.3	0.5	0.0	0.0	0.2	0.1	0.3	0.2
Insecta	Orthoptera	0.0	0.0	0.0	0.0	0.1	0.1	0.3	0.2	0.0	0.0	0.4	0.2	0.1	0.1	0.0	0.0
Insecta	Psocoptera	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0
Insecta	Homoptera	0.0	0.0	0.7	0.7	0.0	0.0	0.0	0.0	1.0	0.4	3.1	1.0	1.4	0.6	0.4	0.2
Insecta	Heteroptera	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
Insecta	Thysanoptera	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
Insecta	Coleoptera	6.2	1.3	2.7	0.7	9.1	1.7	1.6	0.5	2.3	0.8	1.5	0.7	3.6	1.0	1.3	0.6
Insecta	Diptera	0.6	0.3	1.2	0.4	2.0	0.8	1.0	0.4	1.2	0.4	2.1	0.7	1.8	0.6	1.1	0.4
Insecta	Lepidoptera	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Insecta	Hymenoptera	18.9	5.0	24.5	2.5	22.8	3.3	17.6	3.5	122.2	30.0	26.4	5.4	41.6	17.3	24.7	6.9
Total orders sampled		8		6		7		9		11		10		13		12	

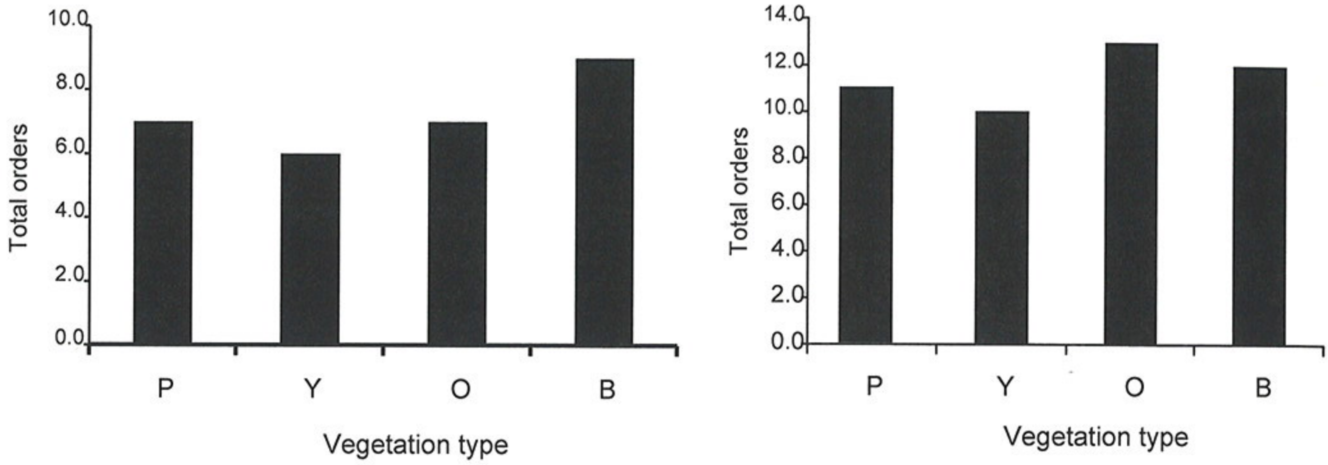

Figure 4. Total orders sampled by pitfall traps in paired pasture (P), younger revegetation (Y), older revegetation (O) and mallee (B) plots during April (left) and October (right) 2007.

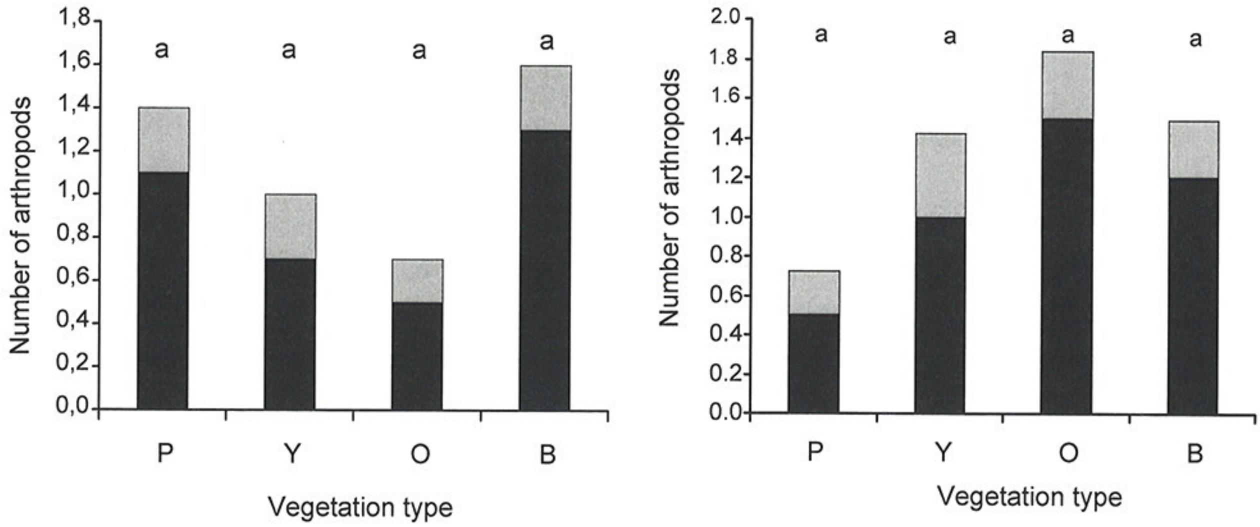

Figure 5. Mean (+ SE in gray) number of Araneae sampled by pitfall traps in the pasture (P), younger revegetation (Y), older revegetation (O) and mallee (B) plots during April (left) and October (right) 2007. For each sampling method, plot types sharing the same letter do not significantly differ from each other at P< 0.05; one-way ANOVA with Tukey's HSD post hoc tests.

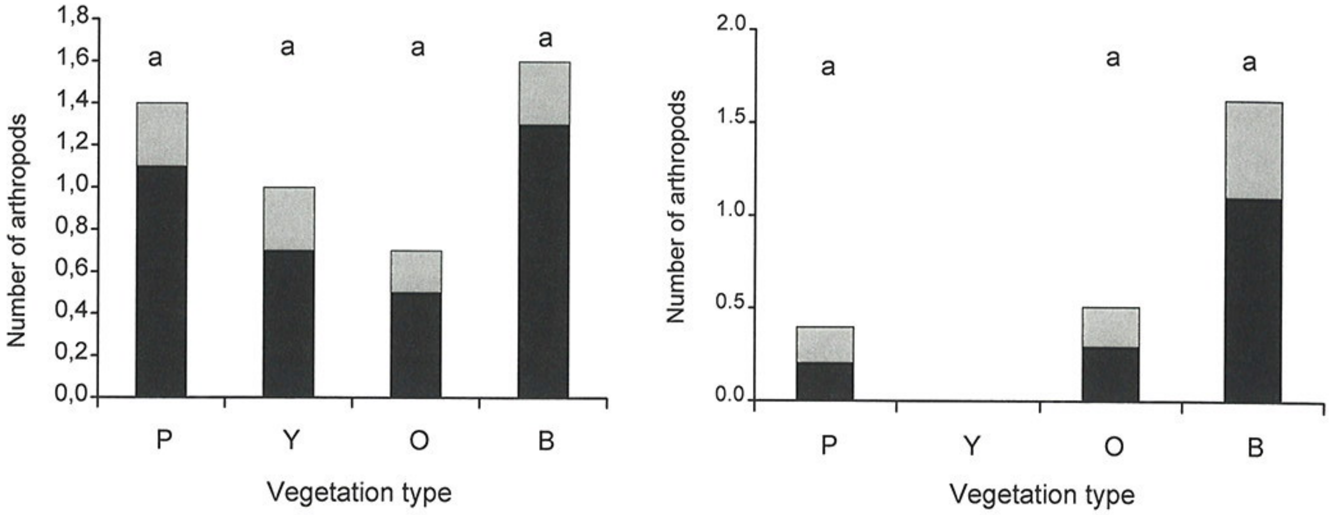

Figure 6. Mean (+ SE in gray) number of Acarina sampled by pitfall traps in the pasture (P), younger revegetation (Y), older revegetation (O) and mallee (B) plots during April (left) and October (right) 2007. Scorpionida were not found in pitfall trap samples in April. For each sampling method, plot types sharing the same letter do not significantly differ from each other at P< 0.05; one-way ANOVA with Tukey's HSD post hoc tests.

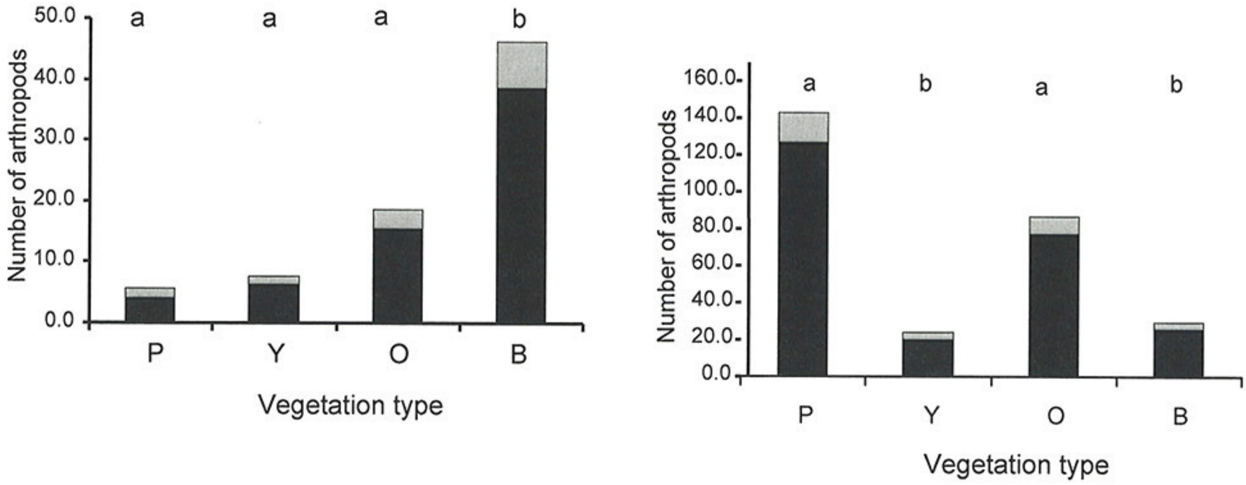

Figure 7. Mean (+ SE in gray) number of Collembola sampled by pitfall traps in the pasture (P), younger revegetation (Y), older revegetation (O) and mallee (B) plots during April (left) and October (right) 2007. For each sampling method, plot types sharing the same letter do not significantly differ from each other at P< 0.05; one-way ANOVA with Tukey's HSD post hoc tests.

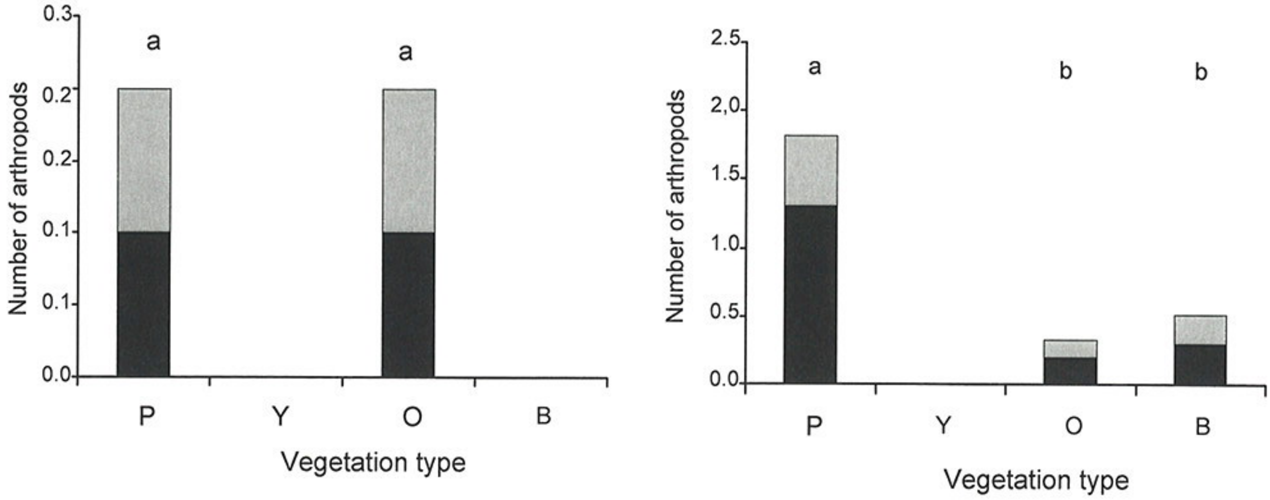

Figure 8. Mean (+ SE in gray) number of Dermaptera sampled by pitfall traps in the pasture (P) in the pasture, younger revegetation (Y), older revegetation (O) and mallee (B) plots during April (left) and October (right) 2007. For each sampling method, plot types sharing the same letter do not significantly differ from each other at P< 0.05; one-way ANOVA with Tukey's HSD post hoc tests.

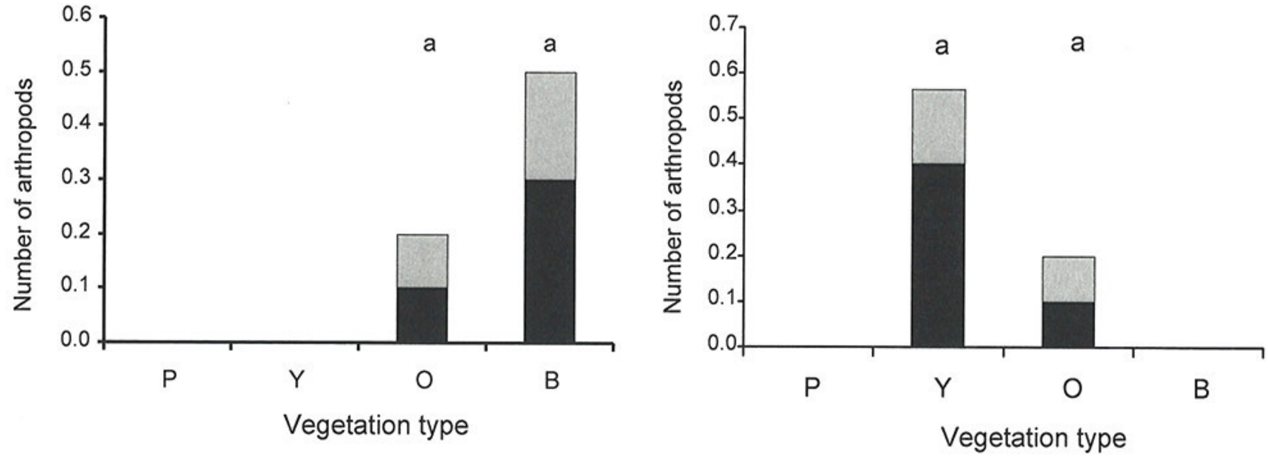

Figure 9. Mean (+ SE in gray) number of Orthoptera sampled by pitfall traps in the pasture (P), younger revegetation (Y), older revegetation (O) and mallee (B) plots during April (left) and October (right) 2007. For each sampling method, plot types sharing the same letter do not significantly differ from each other at P< 0.05; one-way ANOVA with Tukey's HSD post hoc tests.

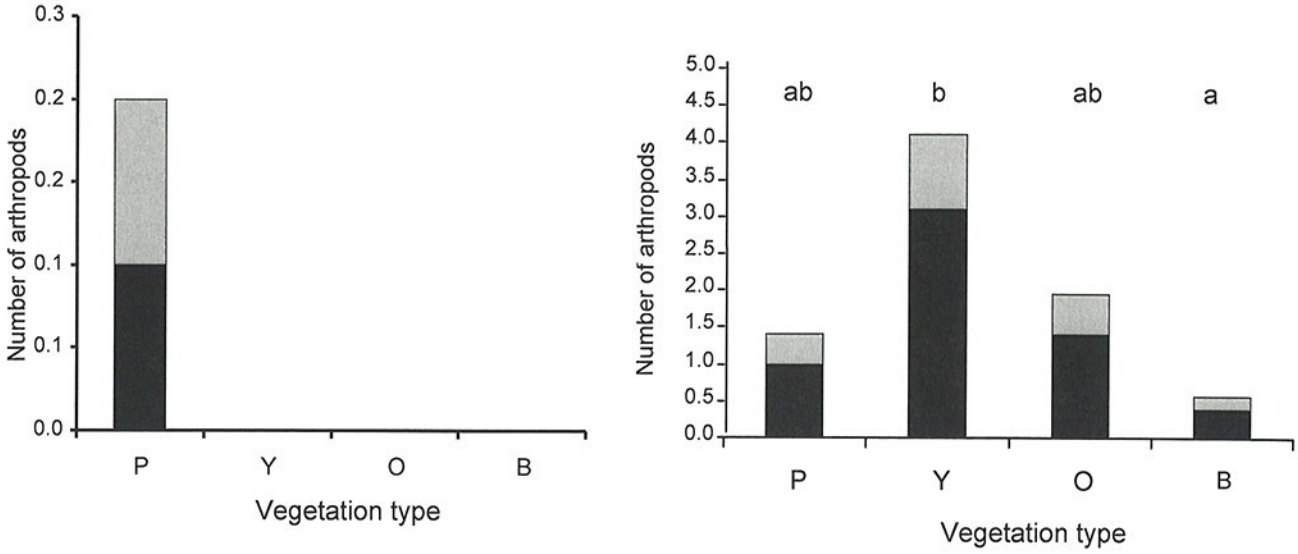

Figure 10. Mean (+ SE in gray) number of Homoptera sampled by pitfall traps in the pasture (P), younger revegetation (Y), older revegetation (O) and mallee (B) plots during April (left) and October (right) 2007. For each sampling method, plot types sharing the same letter do not significantly differ from each other at P< 0.05; one-way ANOVA with Tukey's HSD post hoc tests.

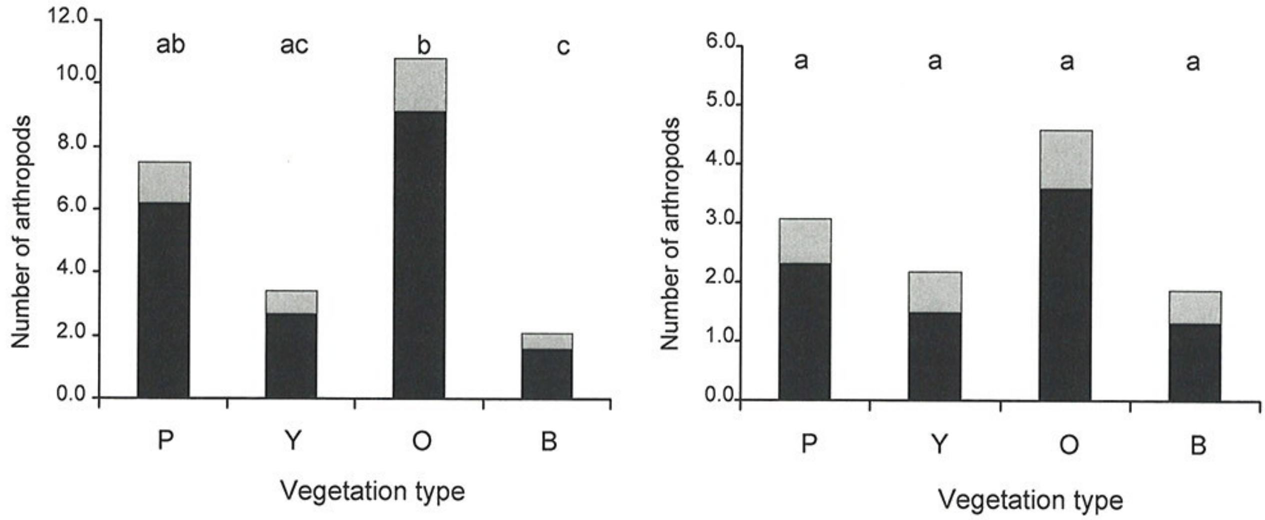

Figure 11. Mean (+ SE in gray) number of Coleoptera sampled by pitfall traps in the pasture (P), younger revegetation (Y), older revegetation (O) and mallee (B) plots during April (left) and October (right) 2007. For each sampling method, plot types sharing the same letter do not significantly differ from each other at P< 0.05; one-way ANOVA with Tukey's HSD post hoc tests.

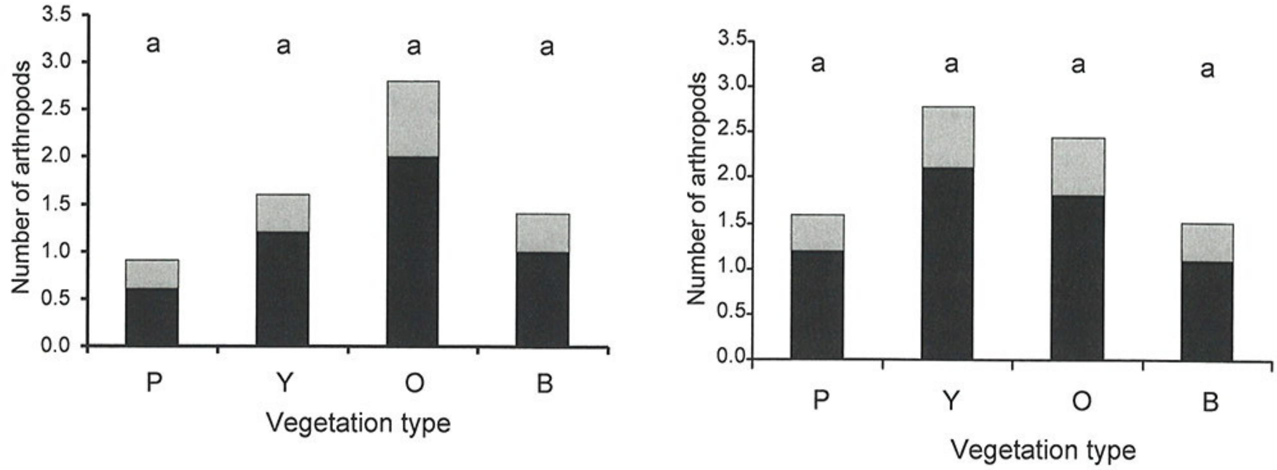

Figure 12. Mean (+ SE in gray) number of Diptera sampled by pitfall traps in the pasture (P), younger revegetation (Y), older revegetation (O) and mallee (B) plots during April (left) and October (right) 2007. For each sampling method, plot types sharing the same letter do not significantly differ from each other at P< 0.05; one-way ANOVA with Tukey's HSD post hoc tests.

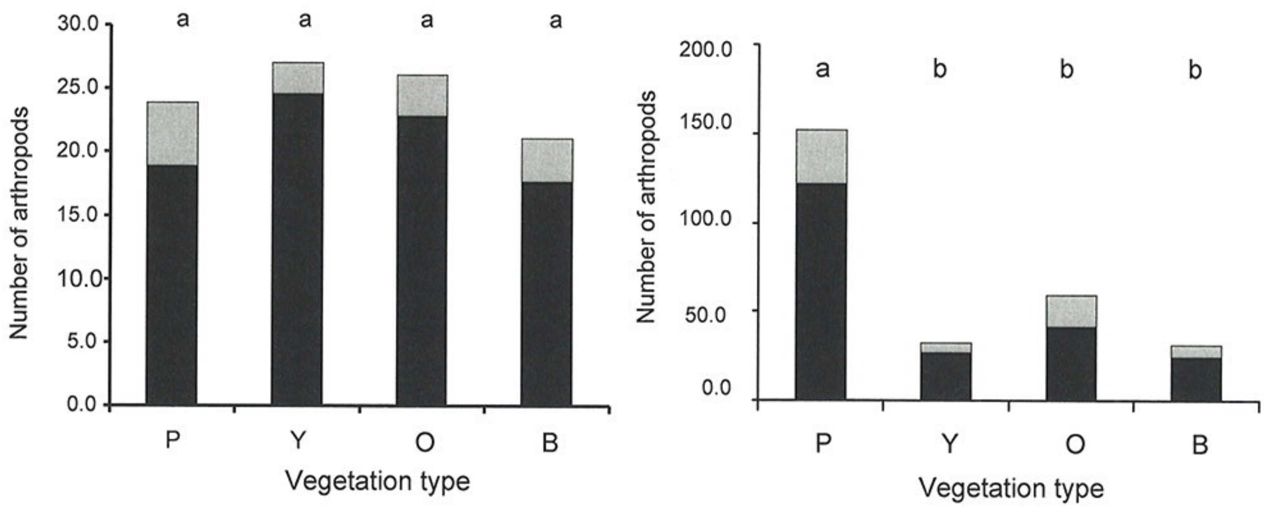

Figure 13. Mean (+ SE in gray) number of Hymenoptera sampled by pitfall traps in the pasture (P), younger revegetation (Y), older revegetation (O) and mallee (B) plots during April (left) and October (right) 2007. For each sampling method, plot types sharing the same letter do not significantly differ from each other at P< 0.05; one-way ANOVA with Tukey's HSD post hoc tests.

Table 3. Frequency of each ant species in 10 pitfall traps run druring April and October 2007 in pasture (P), younger revegetation (Y), older revegetation (O) and native mallee vegetation (B). The presence of species in the transects for both periods combined is also shown.

Species	Apr-07				Oct-07				Both periods			
	P	Y	O	B	P	Y	O	B	P	Y	O	B
Camponotus ceriseipes complex sp. JDM 105				1								*
Camponotus claripes gp. sp. JDM 63				1				1				*
Camponotus cowlei Froggatt				1								*
Camponotus dryandrae McArthur & Adams				2								*
Camponotus ephippium (F. Smith)	1								*			
Camponotus evae zeuxis Forel				1								*
Camponotus lownei Forel								1				*
Camponotus prostans Forel		1	1		3				*	*	*	
Camponotus scratius Forel				1								*
Camponotus cf. *sponsorum* Forel								1				*
Camponotus terebrans (Lowne)				6				4				*
Camponotus whitei Wheeler	1								*			
Cardiocondyla nuda (Mayr)		3	6				2			*	*	
Crematogaster frivola Forel				5				2				*
Crematogaster queenslandica gp. sp. JDM 428				2				1				*
Doleromyrma darwiniana fida Forel		1				3				*		
Doleromyrma rottnestensis (Wheeler)		6	2	7		4	3	6		*	*	*
Iridomyrmex bicknelli Emery		8	7	1		5	6	1		*	*	*
Iridomyrmex chasei Forel				1								*
Iridomyrmex conifer Forel				1								*
Iridomyrmex discors Forel				1								*
Iridomyrmex exsanguis Forel				2	1	3	1	1	*	*	*	*
Iridomyrmex greensladei Shattuck	1	1	3	5					*	*	*	*
Iridomyrmex rufoniger suchieri Forel (pop. 1)	9	7	7	2	10	10	8	1	*	*	*	*
Iridomyrmex viridiaeneus Viehmeyer					4		6	6	*		*	*
Melophorus insularis Wheeler				3				5				*
Melophorus turneri Forel	1	6	3		9	4	8	6	*	*	*	*
Melophorus sp. JDM 176	1							3	*			*
Meranoplus rugosus Crawley								1				*
Meranoplus sp. JDM 74								1				*
Monomorium aithoderum Heterick				2				1				*
Monomorium decuria Heterick				1								*
Monomorium fieldi Forel (ss)				6								*
Monomorium fieldi Forel ('*laeve nigrius*')								5				*
Monomorium rothsteini Forel			3		1	1	3	4	*	*	*	*
Monomorium sordidum Forel				3				7				*
Pachycondyla (*Brachyponera*) *lutea* (Mayr)	3			1				3	*			*
Pachycondyla (*Trachymesopus*) *rufonigra* (Mayr)	2	1							*	*		
Pheidole ampla perthensis Crawley	8	9	10		8	10	9	2	*	*	*	*
Pheidole megacephala (Fabricius)		1								*		
Pheidole nr. *variabilis* Mayr (JDM 177)				1								*
Pheidole sp. JDM 164				2				3				*
Polyrhachis leae Forel				1								*
Rhytidoponera metallica (F. Smith)	7	10	10	7	8	9	8	3	*	*	*	*
Rhytidoponera violacea (Forel)	6	1	1	3	8				*	*	*	*
Solenopsis clarki Crawley		1					1	1		*	*	*
Stigmacros aemula (Forel)				3				1				*
Tapinoma sp. JDM 981							2				*	
Tetramorium impressum (Viehmeyer)	1	6	5	1	5	4	1		*	*	*	*
COUNT	12	15	12	30	10	10	13	26	16	17	16	41

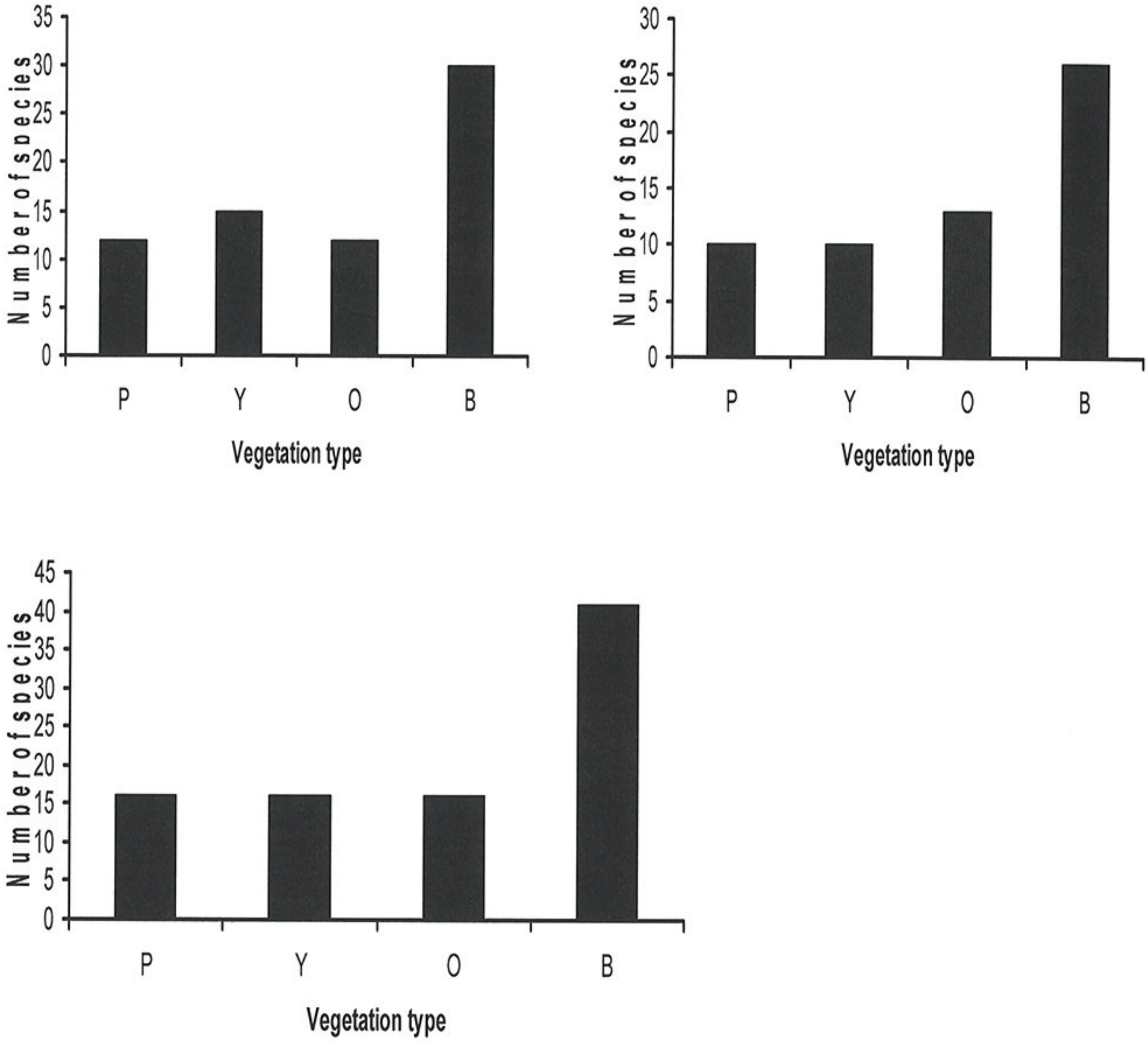

Figure 14. Total number of ant species sampled by pitfall traps in paired pasture (P), younger revegetation (Y), older revegetation (O) and mallee (B) plots during April (left) and October (right) 2007; beneath is a graph for the two seasons combined.

Discussion

The results of this pitfall trap sampling program indicate that both the pasture and the revegetation support a diverse range of invertebrates, many of which play an important role in essential ecological processes.

However, the difference between the revegetation and pasture is not large, with perhaps four ant species being encouraged, along with certain members of the Homoptera (sucking bugs) and the Coleoptera (beetles). These taxa would have responded to the presence of small trees and shrubs, which provide new food resources and microhabitats. However, the fact that canopy closure had not taken place, and that wide swathes of pasture-like conditions still persisted between the planted rows, suggests that conditions had not changed sufficiently to encourage an invertebrate fauna that is characteristic of the native vegetation. Indeed, much of the fauna present was still characteristic of that of the original pasture. This is consistent with the conclusions of Cramer *et al.* (2007), that southwestern Australian old fields are notoriously difficult to restore without massive human inputs, on account of the highly fragmented and abiotically harsh landscape in this region.

Having said this, the Gondwana Link initiative is providing considerable input into the restoration process, so recovery of the old farmland may well proceed with the passage of time. The two areas of restoration were very young, so insufficient time may have lapsed to allow substantial change in the invertebrate fauna. For this reason a further study is planned for 2008 in which older samples of Gondwana Link revegetation will be examined.

The pitfall traps only sample the ground surface, or epigaeic, fauna. The invertebrates of other strata (soil fauna, shrub-associated fauna etc.) should also be considered. There would doubtlessly be invertebrates on the foliage of the revegetation that would not be present in the pasture. The 2008 study will extend the sampling regime to consider this component of the invertebrate fauna.

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sustaining gondwana

Harnessing local, place-based knowledge for sustainable outcomes

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ALCOA FOUNDATION'S CONSERVATION AND SUSTAINABILTY PROGRAM

Sustaining Gondwana is a strategic initiative of Curtin University of Technology that has been funded by the Alcoa Foundation's Conservation and Sustainability Fellowship Program and by the University. Its aim is to research conservation and sustainability issues along the south coast of Western Australia, from Walpole to just east of Esperance. The vegetation and fauna of this area is so diverse that it is considered to be one of the world's bio-diversity hotspots. The five year program, which is connected internationally with other Universities and Sustainability Institutes, was launched in November 2005.

The initiative is co-ordinated by three cabinet members, professors Daniela Stehlik, Jonathan Majer and Fiona Haslam McKenzie. Six postdoctoral fellows are being appointed to work on issues related to this region, and their research will be augmented by activities of the cabinet members themselves as well as their graduate students. It is anticipated that the findings will be published in journals, conference proceedings and books. However, there is a need to communicate early findings, data sets and activities of group members in a timely manner so that stakeholders can benefit from outputs as soon as they become available. This is the aim of the *Sustaining Gondwana Working Papers* Series, which will be produced on an occasional basis over the life of the initiative.

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