INVERTEBRATE BIODIVERSITY IN THE TINGLE AND OTHER FORESTS OF THE WALPOLE-NORNALUP NATIONAL PARK IN SOUTH WESTERN AUSTRALIA

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ABSTRACT

A one year study of the effects of prescribed fires on the surface-active litter invertebrates was carried out using pitfall trapping in the forests of the Walpole-Nornalup National Park. Approximately 40,000 specimens were collected during the four seasons of sampling. The sample abundance and richness were determined for spring 1996 samples at the taxonomic level of order. The 16,000 specimens of the spring 1996 samples were also sorted to morphospecies for all invertebrate orders to provide a markedly greater depth of biogeographical and ecological information.

Within the forest litter invertebrate community of the Walpole-Nornalup national park, the 701 morphospecies trapped in spring 1996 were dominated by beetles (Coleoptera) which was the most species rich taxon, followed by flies (Diptera), wasps and bees (Hymenoptera), spiders (Araneae), mites (Acarina) and springtails (Collembola). Of the 701 morphospecies trapped (regional alpha richness), 66 (9%) were common to all sites irrespective of their fire history, another 310 (44%) were only trapped from forest sites burnt less than 12 years previously, while another 230 (33%) were only trapped from sites unburnt for more than 29 years, the remaining 95 (14%) morphospecies had inconsistent trapping distributions, as they were no present at all sites, although trapped at both recently burnt and long unburnt sites. This trend in total richness was paralleled by a similar trend in the richness of the unique morphospecies (local beta) exclusively captured at each site, as there was a higher average richness of 51.7 morphospecies for each of the 6 forest sites burnt less than 12 years previously, while the 6 sites unburnt for more than 29 years had a lower unique richness of 38.3 morphospecies per site.

In the Walpole-Nornalup national park, the survey of each of the 12 forest sites resulted in the capture of an average of 58.4 morphospecies per site (alpha richness), of these morphospecies, an average of only 5.5 species were common to all 12 forest sites. The remainder of morphospecies were unique to a sub-set of forest sites with a specific fire history or plant composition. The jarrah forest sites unburnt for 30 years had the greatest number of unique morphospecies at 58.0 per additional site (beta richness), also jarrah forest sites burnt less than 1 year previously had a high unique richness of 43.0 unique morphospecies per site. Karri forest had the lowest average of 33.5 unique morphospecies per site, with a lower richness of unique morphospecies in more recently burnt compared to long unburnt sites. The Tingle forest sites had a average unique richness that was higher than the Karri forest sites, but lower than that of the Jarrah forest sites. The highest unique richness in Tingle forest was 44.0 morphospecies, at the creek line sites burnt 9 years previously, while the lowest unique richness of 29.0 morphospecies occurred at both the ridge top sites burnt 9 years previously and 61 years previously. In the Walpole-Nornalup national park the floristic richness of Jarrah forest is higher than that of Karri forest, while the floristic richness of the Tingle forest is intermediate and dependent on the plant composition of the adjacent forest type, either Jarrah or Karri. Floristic and invertebrate richness appear to be related, as unique richness of invertebrates was highest in Jarrah forest and lowest in Karri forest.

The taxonomic composition of the litter invertebrate communities in the forests of the Walpole-Nornalup National Park, in common with the unique richness, varied between sites with different fire histories and plant compositions. Long unburnt (30yrs.) Jarrah forest sites, in comparison to the other forest sites, had the highest average unique richness of wasps, bees and ants (Formicidae). The highest unique richness of spiders (Araneae) and beetles (Coleoptera) were also collected at the Jarrah forest site burnt 1 month previously. Karri forest had the highest unique richness of snails (Gastropoda) and bugs (Hemiptera) at sites 30 years post-fire and 11 years post-fire, respectively. In comparison, the Tingle forest had the highest average unique richness of springtails (Collembola), mites (Acarina) and flies (Diptera). In the Tingle forest the springtails reached their maximum unique richness at a creekline site burnt 61 years previously. The mites reached their maximum unique richness at a creekline site burnt 9 previously, while the flies reached their maximum unique richness at a creekline site burnt 3 years previously. The unique richness of spiders and beetles was also high in Tingle forest, although lower than both long unburnt and recently burnt Jarrah forest sites. Tingle forest sites with the highest unique richness of spiders were creekline sites burnt either 3 or 9 years previously. The unique richness of beetles in Tingle forest was highest at the ridge site burnt 9 years previously.

This invertebrate fauna had a large component of Gondwanan relict taxa and showed strong affinities to the faunas of forests in south east Australia that had past associations with *Nothofagus* forests. The distribution of the morphospecies of relict taxa, between the study sites in the Walpole-Nornalup forests, strongly suggests that forest sites with different plant compositions and fire ages each have their own unique relict invertebrate communities.

The unique invertebrate communities of the different microhabitats, landscapes and fire ages of each forest type indicate that a complete regional invertebrate biodiversity should be conserved by maintaining a mosaic of fire regimes ranging from frequently burnt to long unburnt. Each fire regime should contain representative areas of the less common refuge microhabitats of the vegetation communities of the Walpole-Nornalup National Park.

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RECOMMENDATIONS

OBJECTIVES

(see Walpole-Nornalup National Park, Management Plan 1992-2002, 8.0 Fauna, pg. 25)

Protect all native species, particularly those that are threatened or vulnerable to disturbance.

ACTIONS

1) – 4) (see Management Plan).

5) Determine the species composition of selected groups of invertebrates likely to include species that are vulnerable and of high conservation value (for example, molluscs and spiders) in the full range of community types.

RECOMMENDATION

The 1996 survey (Van Heurck, Burbidge and Wheeler 2000) of the litter invertebrates of the forest types of the Walpole-Nornalup National Park determined that Jarrah, Karri and Tingle forest sites of a wide range of fire ages, each had a community of unique invertebrate morphospecies. To conserve the biodiversity of the litter invertebrate taxa, a mosaic of recently burnt, intermediately burnt and long unburnt areas should be maintained in the full range of vegetation community types (see Management Plan, 10.0 Fire, Map 4).

6) Determine the ecology, taxonomic status, management and climate requirements of endemic relictual invertebrates species of narrow habitat requirements.

RECOMMENDATION

The survey (Van Heurck, Burbidge and Wheeler 2000) of the litter invertebrates of the forest types of the Walpole-Nornalup National Park determined that relict Gondwanan taxa occurred in Jarrah, Karri and Tingle forest types at a wide range of fire ages. A number of relict taxa, not trapped in this survey, are known to favour microhabitats such as unburnt litter patches, decaying logs, moss swards, tree butt bark, the deep litter of tree butts and the banks of the major rivers. To conserve the biodiversity of Gondwanan relict invertebrate species, a mosaic of a wide range of fire ages should be maintained in the full range of vegetation communities. This fire age mosaic should maintain the full diversity of the less common microhabitats by preserving unburnt patches within each prescribed fire. A range of vegetation community types, fire ages and fire regimes should continue to be surveyed to further determine the continued preservation, ecology and microhabitat requirements of the relict taxa, particularly those trapped from a single forest site or known to have a restricted distribution (See Table 1 & Discussion, Van Heurck, Burbidge and Wheeler 2000).

INTRODUCTION

Historical environment:

Australia is recognized as one of Earth's 12 megadiverse countries. The South-West region of Australia is one of the most diverse areas on earth. The rich biodiversity and high level of endemism of the South-West biota is highlighted by the relatively well collected vascular plants which are estimated to number approximately 8000 species, of which at least 75% are endemic to the South-West region. The rich biodiversity and the high level of endemism of the South-West biota appear to have evolved as a result of a unique combination of geological and climatic conditions. The coexistence of ancient Gondwanan relict taxa and taxa of recently evolved speciose genera was favoured by three conditions. First, the geological separation of the Australian continent from Antarctica, approximately 65 million years ago, was followed by its slow northward drift, resulting in a gradual change in the South-West climate from a cool humid climate to a more seasonal Mediterranean climate with summer drought. The relatively gradual climatic change favoured the persistence of relict taxa in moist refugia. Second, the South-West region has remained free of glaciation and above sea level for more than the last 200 million years, again favouring the persistence of many relict taxa. Third, during the Miocene about 30 million years ago very mild mountain building led to the uplift of the Darling Scarp and the Ravensthorpe Ramp. This uplift diverted the Tertiary east-flowing river systems to the west and south, through the High Rainfall Zone, possibly favouring the continued existence of the moist habitats of relict Gondwanan taxa. In the late Tertiary about 5 million years ago the formation of lateritic landforms indicates that the forested High Rainfall Zone bordered by the west and south coasts remained as a favourable wetter refuge for many taxa of the ancient Gondwanan rainforests. In contrast, in the Transitional Rainfall Zone, east of the wetter forested zone, active erosion of the Tertiary lateritic soil profiles led to the formation of a complex mosaic of soils. This soil mosaic and the possible differential impact of Quaternary climatic fluctuations facilitated the explosive speciation of recently evolved, arid-adapted sclerophyll genera that now characterize the biodiversity of the Transitional Rainfall Zone (Hopper et al. 1996).

During the last 6,000 years, within the eucalypt forests of the High Rainfall Zone, there have been large alternations and distributional changes of the dominant eucalypt species (Churchill 1967) as a result of marked changes in climate and the frequency of fire. These recent climatic fluctuations have continued to favour a more seasonally adapted biota in south-west Australia, with a high level of endemism (Kemp 1981, White 1990, Hopper et al. 1996). Evidence of an increase in fire frequency in the recent past suggests that Aboriginal burning practices were a major factor in the persistence of the sclerophyll vegetation in Australia (Singh et al. 1979). The current climate of those parts of southern Australia with cool wet winters followed by hot dry summers with frequent thunderstorms has led to a particularly fire-prone environment with numerous lightning-ignited wildfires occurring annually (Collett *et al.* 1993, CALM 1994). The high biodiversity of the biota of the South-West region has persisted in this fire prone environment and is largely represented by two groups of taxa, the Gondwanan relicts, in moist refugia and the recently evolved arid and fire adapted taxa in the drier more seasonal areas. This wide spectrum of biodiversity, besides representing an immense wealth of genetic technology to future society, also represents a unique scientific opportunity to compare the ecological characteristics of both relict taxa and recently evolved taxa in adapting to differing rates of historical environmental change. The slow rate of morphological change of the Gondwanan relict taxa over vast periods of geological time, notwithstanding the presence of refuge habitats, suggests a high level of adaptability in these remaining extant relict taxa. The greater understanding of these adaptive genetic technologies and ecological tolerances of Gondwanan relicts would be extremely valuable to the sustainable development and conservation of the South-West region in the unpredictable future.

Gondwanan relict invertebrate research to-date:

Recent research on spiders and other invertebrate groups has indicated that ancient invertebrates of the Cretaceous and Tertiary periods, relicts of the continent Gondwana, have survived and evolved in high rainfall, moist and humid remnant forests in South America, South Africa, New Zealand and cooler moist refuge areas of Australia such as the mountain peaks of the Daintree rainforest, Otway Ranges, Stirling Range, Porongurup Range and the cool temperate forests of Tasmania and remnant mixed Karri-Tingle forests of South-West Australia (see Table 1, adapted from Hopper et.al. 1996). In the forests of South West Australia many of these relict taxa occur in habitats such as swamps, granite rocks and stream zones, areas that may need special conservation management. The relict taxa in the geographically restricted south-coastal tingle forests, such as spiders, are largely undescribed and small and they appear to pre-dominantly occur in moist microhabitats such as deep litter, moss, under bark and tree butts and in fire-created hollow butts and overhanging fallen logs. These microhabitats are usually small scale, difficult to map and may be easily overlooked in large-scale conservation reserve design and future fire management.

Also, the tingle forest may be a successor of the cool temperate Gondwanan *Nothofagus* forests, and therefore less able to cope with fire than the surrounding karri and jarrah forests (Main 1987). The post-fire regeneration strategies of the three species of tingle, Red Tingle (*Eucalyptus jacksonii*), Yellow Tingle (*E. guilfoylei*) and Rate's Tingle (*E. brevistylis*) are currently not fully understood. Yellow Tingle, however, is regarded to be the most fire hardy, while Yate's Tingle and Red Tingle are vulnerable to "hollow butting" caused by fire entering the tree at the interface between the trunk and roots (Smith 1996). Yate's Tingle and Red Tingle's sporadic flowering appears to be an adaptation to regeneration in gaps caused by fallen trees, although "pulses" in the stand structure of Red Tingle forests may be evidence of regeneration after catastrophic fires. Yellow Tingle appears well adapted to fire with rapid post-fire refoliation and prolific flowering and seedling regeneration.

Representative areas of these south west forests, such as the high rainfall Jarrah and Karri forests and the remnant Tingle forests, are preserved within the Walpole-Nornalup National Park. This park is becoming a locally and internationally renowned tourist destination, with the need to manage the increasing demand for recreation and to protect the local community from intense wildfires. In addition, the major goals of the current management plan (CALM 1992) for this national park are to conserve the ecological and aesthetic values of the natural communities. This need to protect both human and natural communities from intense wildfires has necessitated the use of prescribed fire to reduce the flammable fuels within buffer areas of the park. When the management plan was formulated, the impact of the frequency of prescribed burning on the Gondwanan relict invertebrate taxa within the park was not well understood.

In the winter of 1996 a study of the forest floor invertebrates of the ancient remnant Tingle Forests of the Walpole-Nornalup National Park was established. This study of the impact of fire management operations on the forest floor invertebrates has a two pronged approach. The first is to compare the biodiversity of common forest floor invertebrates in the dominant high rainfall Jarrah, Karri and Tingle forests and determine each species preferences for a number of habitats, such as creeklines; hill tops and slopes, that ranged from recently burnt to unburnt for more than 60 years. Secondly the study surveyed the preferences of unique Gondwanan relict species for a variety of microhabitats, such as the litter of the forest floor and the deep litter piled against the tree buttresses.

Objectives of the project

a) To survey the common terrestrial invertebrate fauna of the Jarrah, Karri and Tingle forests of the Walpole-Nornalup National Park and compare and compile differences in the biodiversity of these forest types.

b) To survey and compile possible differences in the biodiversity of the terrestrial invertebrate fauna, at varying times after prescribed fire, in these forest types.

c) To survey and compile information on the microhabitat preferences of uncommon or relict invertebrates at different fire ages in the Walpole-Nornalup forests.

MATERIALS AND METHODS

Study design

The study area was located in the Walpole-Nornalup National Park (18,390 ha), which surrounds the small town of Walpole on the south coast of Western Australia. The climate is sub-Mediterranean characterized by cold wet winters and mild summers (Gentilli 1979). The mean annual rainfall is 1324 mm. Rain falls on an average of 185 days spread over a lengthy growing season of 10 months. The major forests types of the Walpole-Nornalup National Park are the jarrah (*Eucalyptus marginata)* forest which dominates on the coastal winter flooded sandplains, while karri (*E. diversicolor)* forest and tingle forests dominate on the more fertile and gravelly soils of the slopes and hilltops. The unique Tingle forest is a remnant of Quaternary vegetation and maybe a recent successor of the southern beech (*Nothofagus sp.)* which dominated in the south-west when climatic conditions were moist, humid and less seasonal during the Tertiary.

Three forest communities, characterized partially by the presence of one of the three tingle species (Red tingle *Eucalyptus jacksonii,* Yellow tingle *E. guilfoylei* and Rate's tingle *E. brevistylis*) which were defined by a survey of the "tingle mosaic"(Wardell-Johnson et. al. 1995), only occur on the remnant Tertiary lateritic brown gravelly soils of the uplands of the south coast and are restricted to about 40,000 ha in area. The Jarrah/Marri (*Corymbia calophylla*)/ Rate's Tingle open forest community occurs on brown gravelly freely drained upland soils in the medium rainfall zone (1130-1200 mm/yr). Both the Jarrah/Marri/ Yellow Tingle open forest and the Karri/Red Tingle tall open forest community-types occur in upland areas with an average annual rainfall of 1275-1330 mm and brown gravelly soils, however the Karri/Red Tingle community-type tends to occur in upland areas with more fertile soil. This survey of the "tingle mosaic" also determined that the overall woody plant species composition of the three tingle community-types is similar to that of the adjacent common forest community-types. The species composition of Karri/Red Tingle tall open forest is similar to one of the Karri tall open forest community-types, while the Jarrah/Marri/Yellow Tingle forest is close to the Jarrah/Marri open forest on the same soil type. The Jarrah/Marri/Rate's Tingle open forest is similar in species composition to adjacent Jarrah/Marri/Yellow Tingle forest and Jarrah/Marri forest on the same soils.

A "space for time" survey approach was used which allowed the study of a wide range of fire histories (see Figure 1). Twelve sites, ranging from recently burnt to unburnt since 1937 (see Figures 2,3,4 &5), were sampled four times over one year (once in winter 1996, spring 1996, summer 1997 and autumn 1997). Eight of the twelve sites were established in tingle forest as four paired sites (ridge and valley floor near streams). The remaining four sites consisted of two jarrah forest sites (one recently burnt and one long unburnt) and two karri forest sites (one recently burnt and one long unburnt), established as close as possible to tingle sites of similar fire history.

Sample collection

Invertebrates were sampled using pitfall traps, beginning in August 1996 at all 12 sites. These sites were sampled at least once per season between winter 1996 and autumn 1997, resulting in 4 sample periods up to April 1997.

Each sampling site comprised a transect of 16 pitfall traps. Each pitfall trap was a cup 90mm diameter and 110 mm deep, placed inside a sleeve of PVC piping (permanently established), with the top level with the surface of the A soil horizon, so as to minimize disturbance to the soil. Each pitfall trap was surrounded by a litter exclusion mesh-tube (10mm x 10mm mesh) with four macro-invertebrate access holes (50mm wide x 30mm high). The diameter of these cups was chosen to be larger than the largest invertebrate species that were expected to be collected during this study (i.e. orthopterans, carabid beetles and mygalomorph spiders). This method avoided any possible sampling bias that may occur when pitfall traps with smaller diameters are used.

Four co-dominant eucalypt trees were selected per site and four pitfall traps were established around each tree. Two of these pitfalls were situated in the deep litter near the tree butt and the other two pitfalls were situated 10m away in the shallower litter of the forest floor (see Figure 6). Traps were opened for a 10 day period in each of the four seasons and each trap was 3/4 filled with Galt's solution preservative (5% sodium chloride, 1% potassium nitrate, 1% chloral hydrate, a trace of glycerine and 93% water) (Friend and Williams 1996). At the end of each trapping period the contents of each trap was fine sieved (0.2 mm x 0.2 mm mesh size) to collect all meso and macro-invertebrates. These were then transferred to a solution of 70% ethanol for transportation to the laboratory. The four traps from the butts of two trees were then bulked into one sample. The four forest floor traps from two trees were similarly bulked into a single sample. The collection of the 16 traps around the four trees at each site resulted in four samples, two butt litter samples and two forest floor litter samples. A sampling session of the twelve sites produced 48 samples. Traps were closed by removing the trapping cups from the PVC tubes and replacing them with cups filled with soil and surface litter to allow normal surface activity of the litter invertebrates between trapping sessions.

Sorting and identification of invertebrates

Invertebrate samples were sorted using a binocular microscope, usually using the 6.5 x 10 objectives. All macro and meso-invertebrate specimens (those greater than 0.2 mm body dimensions) were identified and separated to order level using the keys of Harvey and Yen (1989). For each invertebrate order the number of individuals and the number of different morphospecies were counted within each sample to estimate sample richness.

All orders were identified to morphospecies using the methods of Oliver and Beattie (1992). Both adult and larval morphospecies were distinguished and compared to the morphospecies reference collection to estimate total richness at each site and between all sites within the study area. Morphospecies were assigned a species code and the number of individuals of each was counted. Each morphospecies was further identified to family level using the keys of CSIRO (1991).

Oliver and Beattie (1992, 1996) have shown that surveys of beetle, spider and ant morphospecies have strong concordances with conventional beetle, spider and ant species surveys. They also demonstrated that morphospecies inventories are a rapid cost-effective method of determining both richness (alpha-diversity) and turnover between different samples and sites (beta-diversity) of select invertebrate taxa (particularly ants and beetles).

The sorting was commenced on the spring 1996 samples, for the following reasons. Firstly the richness of litter invertebrates in south west forests usually reaches an annual high in the spring season (Van Heurck et. al., 1998). Secondly it was considered that the spring samples would contain a greater number of trophic groups, ranging from decomposers to pollinators and predators, all favoured by the co-occurrence of moist soil and litter with warmer air temperatures. However, due to the unexpected high richness of the spring samples and the resulting time constraints, we did not proceed with the sorting of the summer, autumn and winter samples. All samples will be lodged in the Western Australian Museum to make them available for future study.

RESULTS

Total richness and abundance in forest types

A total of approximately 40,000 litter invertebrates were collected in the four seasons of trapping. This paper summarizes the results of sorting approximately 16,000 specimens from the spring (November) 1996 trapping season only, due to limited time. Previous studies indicate that invertebrate richness and abundance in south-west forests varies greatly across different seasons and different years, although spring richness is usually twice that of the other seasons in most years (Van Heurck et.al. 1998). Also, the statistical analysis and prediction of long-term biodiversity trends based on a short trapping period in a single season is highly unreliable (Underwood 1991, Friend and Williams 1996). Therefore, the results of this single season are summarized by compiling site morphospecies lists to highlight each site's taxonomic uniqueness (beta richness) and then simply comparing sites by ranking the gross differences in total (alpha) and unique (beta) site richness. This descriptive summary identified the preferences of a large number of unique or relict taxa for specific microhabitats and fire ages and was a major objective of this study.

The total sample richness (alpha richness) in spring 1996 of hilltop forests in the Walpole-Nornalup National Park was highest at the butt of trees in Jarrah forest 30 years post-fire. This was closely approximated by the sample richness at tree butts in Jarrah forest 2 months post-fire (see Figure 7 & Table 2). In Jarrah forest the sample richness in the litter close to the butt of trees always ranked higher than that from the litter on the forest floor of the same fire age. The next highest sample richness occurred in the forest floor litter of the Karri forest 30 years post-fire. This was 7 morphospecies higher than the floor litter of Karri forest 11 years post-fire and 2 morphospecies higher (turnover or beta richness) than the most species rich hilltop tingle forest site at the butt of trees 60 years after fire. In Karri forest the mean richness of forest floor samples was always higher than those close to the tree butts. In addition, the sample abundance of spring 1996 litter invertebrates from slope and hilltop forests largely confirms the patterns in sample richness, with 30 year post-fire Jarrah forest having the one of the highest sample abundances, Jarrah butt abundance always higher than Jarrah forest floor, Karri forest floor abundance always higher than Karri butt abundance (Figure 8 & Table 2).

The sample richness of the majority of tingle forest sites was lower than both the Jarrah and Karri forest sites. In hilltop tingle forest the highest richness occurred in the deep litter of the tree butts in forest 60 years post-fire, with the next highest sample richness occurring also in the litter of tree butts in tingle forest 3 years post-fire (see Figure 7& Table 2). A similar pattern of richness occurred at Tingle forest sites near creeklines with alpha richness reaching a high peak by 3 years post-fire, then declining to a low richness at 9 years post-fire and then reaching another high peak in richness by 61 years post-fire (see Figure 9 & Table 2). In the majority of Tingle forest sites the butt litter richness was higher than the floor litter richness, irrespective of the post-fire period. This trend was also confirmed by the sample abundance at Tingle forest sites.(Figures 8,10 & Table 2).

The unique taxonomic composition in forest types

Within the forest litter invertebrate community of the Walpole-Nornalup National Park, the 701 morphospecies trapped in spring 1996 were dominated by beetles (Coleoptera) which was the most species rich taxon, followed by flies (Diptera), wasps and bees (Hymenoptera, except Formicidae), spiders (Araneae), mites (Acarina) and springtails (Collembola) (Table 3 & 4). Of the 701 morphospecies trapped (regional alpha richness), 66 were common to all sites irrespective of their fire history, another 310 were trapped only from forest sites burnt less than 12 years previously, while another 230 were only trapped from sites unburnt for more than 29 years. The survey, on average captured, 51.7 new morphospecies per site for the 6 forest sites burnt less than 12 years previously and 38.3 new morphospecies per site at the 6 sites unburnt for more than 29 years.

In the Walpole-Nornalup national park, the survey of each of the 12 forest sites resulted in the capture of an average of 58.4 new and unique morphospecies per site. Of these new morphospecies, an average of only 5.5 species was common to one or more of the 12 forest sites (Table 3). The remainder of these new morphospecies were unique to a sub-set of forest sites with specific fire history or plant composition. The Jarrah forest sites had the highest average of 55.5 unique morphospecies per site, with Jarrah forest sites unburnt for 30 years having the greatest number of unique morphospecies at 58.0 (local beta richness) per site, while sites burnt less than 12 years previously had 43.0 unique morphospecies per site. Karri forest had the lowest average of 33.5 unique morphospecies per site, with a lower richness of unique morphospecies in more recently burnt sites compared to long unburnt sites. The Tingle forest sites had a average unique richness of 46.2 morphospecies which was lower than the Jarrah forest sites, but markedly higher than the Karri forest sites. The highest unique richness in the Tingle forest was 44.0 morphospecies, at the creekline sites burnt 9 years previously, followed by creekline sites burnt 3 years previously and also creekline sites unburnt for 61 years, both with similar unique richness of 38.0 and 37.5 morphospecies per site, respectively.

The taxonomic composition of the litter invertebrate communities of the forests of the Walpole-Nornalup National Park, in common with the unique richness, varied between sites with different fire histories and plant composition. Long unburnt (30yrs) Jarrah forest sites, in comparison to the other forest sites, had the highest average unique richness of wasps, bees and ants (Formicidae). The highest unique richness of beetles (Coleoptera) and spiders (Araneae) was collected at the Jarrah forest site burnt 1 month previously. Karri forest had the highest unique richness of snails (Gastropoda) at sites 30 years post-fire and bugs (Hemiptera) 11 years post-fire. Tingle forest had the highest average unique richness of springtails (Collembola), mites (Acarina) and flies (Diptera). These were respectively trapped at a creekline site 61 years post-fire, a creekline site 9 years post-fire and a creekline site 3 years post-fire. The unique richness of spiders was also high in Tingle forest and similar to that of both Jarrah forest sites. Tingle forest sites with the highest unique richness of spiders were creekline sites burnt either 3 or 9 years previously (Table 3 & 4).

The taxonomic composition of the litter invertebrates in the Walpole-Nornalup forests showed some differences in the average unique richness (beta richness) between recently burnt and long unburnt sites. The 6 recently burnt sites (less than 12 years post-fire) included unique richnesses that were more than three times richer for wasps and bees; and approximately twice as rich for spiders, ants and bugs. The 6 long unburnt sites (unburnt for more than 29 years) included unique richnesses that were more than three times richer for Lepidoptera (caterpillars), while other taxa with higher unique richnesses included snails (Gastropoda), cockroaches (Blattodea) and centipedes (Chilopoda) (Table 3 & 5).

DISCUSSION

Total richness and abundance in forest types

Compared with the spring richness of other forest sites in south-west Australia, the spring 1996 richness (local alpha, Table 2) at forest sites in the Walpole-Nornalup National Park was comparable but generally lower. In the Central Jarrah forest, east of the town of Collie about 200 kilometers to the north, a previous study using the same trapping techniques, monitored the litter invertebrate richness for 14 sites in the upland Jarrah forest from November 1992 to March 1997 (Van Heurck, Friend and Williams 1998). Over the three springs of this study period the average richness for sites 10 years unburnt was 89.9 morphospecies compared to summer, autumn and winter seasons whose richness ranged from 54.0 to 55.1 morphospecies. In comparison the southern forest sites in the Walpole-Nornalup National Park had a comparable but lower spring richness that ranged from 83.5 morphospecies at the butt of trees in Jarrah forest burnt 30 years previously to 46.5 morphospecies on the floor of Tingle forest burnt 61 years previously. These biogeographic patterns of forest floor invertebrate communities in south-west forests indicate that the general magnitude of their biodiversity is determined and stabilized by factors operating at a large seasonal and regional scale. Local oscillations in the magnitude of this large-scale invertebrate biodiversity appear to be related to local differences in the taxonomic composition and post-fire structure of the vegetation in these forests. Future regional comparisons between studies will only be possible if the same trapping techniques are used.

In these southern forests the oscillations in the richness and composition of the forest floor invertebrate communities at sites with different post-fire ages parallel those found previously in the central Jarrah forest communities. Several months after spring fires, in the central Jarrah forest, the richness (local alpha) at 3 sites markedly increased due to the capture of a large number of ant (Formicidae) and beetle (Coleoptera) morphospecies in these central Jarrah forest communities. As in the southern forest sites the post-fire central Jarrah forest sites had a short-term 3 to 4 year decline in site richness, which increased above the richness in unburnt sites by 4 years. Also similarly to the southern sites the taxonomic composition of the forest floor invertebrate communities was unique to different ages of post-fire sites resulting in an increase in regional richness and biodiversity across all sites. For example the beetle (Coleoptera) faunas captured in the central Jarrah forest were unique to sites burnt at different times and different seasons. The number of unique beetle morphospecies captured per fire type were 29 species from sites burnt 10 years previously, 18 species from sites burnt in autumn 1993 (3.9 years post-fire), 39 species from sites burnt in spring 1994 (2 years post-fire), while 63 species were common to two or more of the different post-fire site types. In the central Jarrah forest, the beetle faunas unique to each of the post-fire sites resulted in a regional beetle richness totaling 149 species.

Another common biodiversity trend between the southern Jarrah forest sites and the central Jarrah forest sites was a higher richness of ants (Formicidae), wasps and bees (Hymenoptera) compared to the Karri and Tingle forests. The resulting differences in total (regional alpha, Table 3) invertebrate richness between the forest types of Karri and Tingle when compared to Jarrah may be partly explained by the higher plant richness of open forests such a Jarrah and Marri (Hopper et. al., 1992, pg. 3) favouring seed harvesting and pollinator invertebrate species. However, differences in the litter invertebrate composition of sites within the same forest type appear to be related to post-fire changes in the vegetation and microhabitat structure.

In the Tingle forest, the total richness trend appears to be closely related to changes in the post-fire vegetation and microhabitat structure. At the 3 year post-fire tingle sites the "Early Post-fire Structure" of the forest appears to contain fallen and burnt logs that are rapidly colonized by mosses and may act as future fire refuges and obligate microhabitats for many relict invertebrates (Taylor 1990). These recently burnt sites appear to be characterized by the rapid increase in height of the initially low and dense understorey vegetation (Fig. 2 & 3). At 9 years post-fire the "Mid Post-fire Structure" of forest appears to be characterized by the understorey vegetation reaching a maximum height, becoming senescent, dying, collapsing and opening up (Fig. 4). This stage is related to the lowest sample richness of litter invertebrates which may be the result of this transitional forest structure being unsuitable for both "Early & Late" litter invertebrates in the hilltop tingle forests. At 61 years post-fire the "Late Post-fire Structure" of Tingle forest appears to be characterized by a very floristically simplified and open understorey, large moss swards on old logs and the lower butt of tingle trees and the maximum depth of litter built-up against tingle tree butts (Fig. 5). These 3 structural stages may contain the majority of the habitat diversity in the tingle forests.

Composition of unique relict taxa in forest types

In the Walpole-Nornalup national park, the survey of the 12 forest sites resulted in the capture of many morphospecies which were unique to a sub-set of forest sites with a specific fire history or plant composition or structure. The taxonomic composition of the litter invertebrates in the Walpole-Nornalup forests also showed some differences in the average unique richness (beta richness) between recently burnt and long unburnt sites. The recently burnt sites included unique richness that were more than three times richer for wasps and bees; and approximately twice as rich for spiders, ants and bugs. The long unburnt sites included unique richness that were more than three times richer for Lepidoptera (caterpillars), while other taxa with higher unique richness included snails (Gastropoda), cockroaches (Blattodea) and centipedes (Chilopoda) (Table 3 & 5). These invertebrate biodiversity patterns again appear to be related to the post-fire composition and structure of the forest vegetation. At recently burnt sites the greater floristic richness would favour the trophic guilds of seed harvesters and flower pollinators such as ants, wasps and bees. While the sap-feeding bugs would be favoured by the nutrient rich regenerating foliage and the predatory spiders would be favoured by an increase in forest floor active prey, at these recently burnt sites. In contrast, at the long unburnt sites the deep litter layer appeared to favour unique invertebrate taxa in the detritivore guild such as snails and cockroaches and taxa in the sub-surface predatory guild such as centipedes.

The jarrah forest type had the highest average unique richness per site, with Jarrah forest sites unburnt for 30 years having the greatest number of unique morphospecies. Long unburnt (30yrs.) Jarrah forest sites, in comparison to the other forest sites, had the highest average unique richness of wasps, bees and ants (Formicidae). The highest unique richness of spiders was also collected at the Jarrah forest site burnt 1 month previously. The higher average unique richness of these taxa at Jarrah forest sites may be partly explained by the high plant richness of this open forest type, possibly favouring a greater number of invertebrate pollinator (wasps and bees) species (Christensen and Annels 1985, Hopper et. al. 1996). However, small-scale changes in the microhabitats at these sites appear to have large effects on richness. For example, at the Jarrah sites the sample richness (local alpha) of the butt litter was always higher than that of the forest floor, possibly due to greater litter depth or the channeled movement of invertebrates up the trunks of Jarrah trees, irrespective of fire age.

Although jarrah forest sites had the highest unique richness of wasps and bees, morphospecies of relict families of these taxa were trapped in all three forest types. Five of these families had Gondwanan affinities (Table 6). The relict wasp family Diapriidae was trapped from both recently burnt and long unburnt Tingle forest. In Jarrah and Karri forest, species of this family were only trapped in forest patches at least 11 years post fire. The relict Gondwanan families Mutillidae, Pergidae and Tiphiidae were trapped from tingle forest 9 years post-fire or less. The Ichneumonidae also has Gondwanan affinities and were only trapped in jarrah forest more than 30 years post-fire. This current survey trapped 7 of the 10 families trapped by Ahern and Yen in the Otway Ranges of southern Victoria, suggesting strong similarities in the relict invertebrate faunas of these two regions of wet sclerophyll forest, both of which had past affinities with Southern Beech (*Nothofagus*) forests.

Although the average unique richness of spiders was highest at the recently burnt Jarrah forest site, it was closely approximated by the unique richness of spider species at the 3 year and 9 year post-fire Tingle forest sites. A total of 88 morphospecies from 21 spider (Araneae) families were trapped from all forest types (Table 7). Spider families trapped, that had Gondwanan affinities included the Micropholcommatidae, Nemesiidae, Actinopodidae, Pararchaeidae and Orsolobidae. The first three relict families had morphospecies that were unique to both recently burnt and long unburnt forest sites, while the species of the last two relict families were restricted to Tingle or Karri forest unburnt for at least nine years or 30 years, respectively. A number of relict spider taxa, including these last two families and other families not trapped in this survey, have been postulated to be sensitive to fire and to occur more abundantly in long unburnt moist microhabitats such as deep litter, moss, under bark of tree butts, in hollows, under logs and along creek banks (Main 1987, Hopper et. al. 1996) (see Table 1). To conserve the biodiversity of these relict taxa a mosaic of diverse fire ages of all the plant communities and all the refuge microhabitats of each forest type, should be maintained. Populations of a small number of relict taxa, including Gondwanan spiders, that were not caught by the pitfall trapping method of this survey, need to be located and viable populations protected in unburnt sections of their favoured microhabitats (Table 1).

Karri forest had the lowest average unique richness per site, with the richness of unique morphospecies being little different between, either the more recently burnt or the long unburnt sites. The low unique richness of litter invertebrates in Karri forest parallels the lower richness recorded for the plant communities in this forest type

(Wardell-Johnson et. al. 1989). However, Karri forest, of the three forest types, had the highest unique richness of snails (Gastropoda), which occurred at the Karri site burnt 30 years previously. In the past several snail species of the relict genus *Bothriembryon* have been collected from both Karri and Tingle forest, and may be restricted to long unburnt and riparian areas along the rivers in these forest types (Table 1). Other infrequently collected snail species of the carnivorous family Rhytididae may also occur in these forest types and are only known from very wet situations in deeply-shaded and heavily-wooded gullies, in the Stirling Range, Pemberton and Albany areas (Hopper et. al. 1996). Species of the Rhytididae and Charopidae are also known from the wet sclerophyll forests of the Otway Ranges and rainforests along the east and south-east coasts (Ahern and Yen 1977, Main 1993). The Karri forest, also, had the highest unique richness of bugs (Hemiptera) occurring at the more recently burnt, 11 years post-fire, site. Little is known of the distributions of relict Hemipteran taxa in the forests of the Walpole-Nornalup area, however the relict taxa of the families Delphacidae, Cicadellidae, Psyllidae and Lygaeidae are known to occur in the Otway Ranges and cool forests of south-east Australia and these may also occur in the Walpole-Nornalup forests. Other Gondwanan relict hemipteran taxa, which may occur in the Walpole-Nornalup forests included species of the families Peloridiidae, Arididae, Schizopteridae, Tingidae and Mesoveliidae which have been collected from cool moist eastern Australian forest microhabitats such as mosses, logs, leaf litter and on monocot plants such as sedges (Cyperaceae)(see Table 1).

The Tingle forest type had a lower average unique richness than the Jarrah forest type. The highest unique richness in the Tingle forest was at the creekline sites burnt 9 years previously followed by creekline sites burnt 3 years previously and also creekline sites unburnt for 61 years with similar unique richness. The Tingle forest had the highest average unique richness of springtails (Collembola), mites (Acarina) and flies (Diptera) which were trapped respectively at a creekline site 61 years post-fire, at a creekline site 9 years post-fire and at a creekline site 3 years post-fire. The unique richness of spiders was also high in Tingle forest and similar to that of both Jarrah forest sites. Tingle forest sites with the highest unique richness of spiders were creekline sites burnt either 3 or 9 years previously.

The unique richness of the Tingle forest was more similar to that in the Jarrah forest, although intermediate between the lower Karri forest richness and higher Jarrah forest richness. The intermediate unique richness of litter invertebrates in the Tingle forest may be partly explained by the similarity of Tingle forest vegetation composition to adjacent forest types. A survey of the "tingle mosaic" indicated that the vegetation composition of the Jarrah/Marri/Yellow Tingle forest was similar to that in Jarrah/Marri forest, while Karri/ Red Tingle forest species composition were most similar to that in a Karri forest type (Wardell-Johnson et. al. 1995). The differing invertebrate taxonomic composition at the different post-fire ages in Tingle forest may be related to the structure and availability of microhabitats and food resources at these sites. The high unique richness of springtails at the long unburnt Tingle sites may be explained by these detritivorous species being favoured by the large accumulation of the leaf litter resource in Karri/Red Tingle forest (22 tonnes/ha. at 48 years post-fire, Wardell-Johnson 1996b).

Different springtail (Collembola) species appear to favour particular periods in time after burning in each forest type (Table 8). The unique richness of collembolan species was equally spread between recently burnt forest sites and long unburnt forest sites (Table 3). This result demonstrates the importance of concurrently maintaining a sequence of different seral forest structures, ranging from less than 1 year post-fire to 61 years post-fire in each forest type. The richness of collembolan species in Tingle forest suggests that further taxonomic and ecological studies may reveal some interesting relict taxa and clarify their associations with fire created microhabitats such as decaying logs, moss swards and also long unburnt microhabitats such as the deep litter built-up around tree butts. Taxa possibly to be found in tingle forests may include the ancient subfamily Uchidanurinae (Neanuridae) which are large species of biogeographic and phylogenetic importance. The species of this taxon are associated with decaying logs and moss in temperate and subtropical rainforests. The family Brachystomellidae includes the genus *Rapoportella* that is known only from a species on Kangaroo Island and several species from the Americas. The family Oncopoduridae are rare cave and soil dwelling forms and one species of *Oncopodura* is known from leaf litter and rotting logs in *Nothofagus* rainforest in southern Victoria and Tasmania. Another relict taxon that may occur in the tingle forests is the subfamily Katianninae (Sminthuridae). This subfamily is well developed in the cool humid southern parts of Australia and contains many undescribed species. A species of *Adelphoderia* is known from *Nothofagus* forests in southern Australia (see Table 1).

The mites (Acarina) may include Gondwanan taxa in the Walpole-Nornalup forests but little is known at the present time (see Table 1). It is highly probable that relict mite taxa with Gondwanan origins are present in the Walpole-Nornalup forests based on the high number of other Gondwanan arachnid taxa, such as the spider families, captured during this survey.

The distribution patterns of fly (Diptera) morphospecies appear to parallel those of the springtails, with higher unique richness in the Tingle forest. The dipteran morphospecies pattern of similar unique richness in recently burnt and long unburnt Tingle forest reinforces the need to maintain a diversity of post-fire forest structures (Table 3). The dipteran fauna of Walpole-Nornalup National Park was largely dominated by families with Gondwanan affinities, which is markedly different from the Australia-wide dipteran fauna (Table 9). Of the 20 dipteran families trapped in this study 16 were from the Gondwanan taxa in sub-order Nematocera or division Orthorrhapha and 4 families were from the cosmopolitan taxa in the division Cyclorrhapha. In comparison the Australia wide fauna contains 36 families in the Gondwanan taxa and 61 families in the more cosmopolitan Cyclorrhapha. A number of Gondwanan families were trapped in all forest types, one of these families the Psychodidae (Moth flies) is an ancient relict taxa containing the rare genera *Nemopalpus*, *Sycorax* and *Trichomyia*. Another particularly ancient family of Gondwanan origin was the Perissomatidae containing only one genus with 5 species which was trapped in karri forest of all post-fire ages. Several other relict Gondwanan taxa were only trapped from a specific forest site: these were Thereviidae from Jarrah forest 30 years after fire; Agromyzidae and Dolichopodidae from Tingle forest 3 years after fire; and Bibionidae and Scatopsidae from Tingle forest, 61 years after fire.

The unusually high proportion of Gondwanan families in the dipteran fauna of these south-west forests is consistent with the Otway Ranges of south-east Australia (Ahern and Yen 1977). Ahern and Yen trapped a number of relict invertebrates in these wet sclerophyll eucalypt forests, and of the 13 adult dipteran families captured, 10 had Gondwanan affinities suggesting a marked domination of the dipteran fauna. Of the 13 Otway Range dipteran families, 10 were also trapped in the wet sclerophyll forests of the current survey of the Walpole-Nornalup National Park. This suggests that strong affinities in the invertebrate fauna may exist between these relict forests of south-west and south-east Australia, both of which had past associations with Southern Beech (*Nothofagus*) forests.

CONCLUSIONS:

The species richness of the litter invertebrate communities in the forests of the Walpole-Nornalup National Park shows clear trends that appear to be related to the richness of the plant communities of each forest type and the post-fire age of these forest communities. It is not known if the 701 morphospecies trapped in November 1996 represent a significant proportion of the total regional richness of litter invertebrate communities of the Walpole-Nornalup forests. This invertebrate fauna has a large component of Gondwanan relict taxa and shows strong affinities to the faunas of forests in south east Australia that had past associations with *Nothofagus* forest. The distribution of the morphospecies between the study sites in the Walpole-Nornalup forests demonstrates that forest sites with different plant compositions and fire ages each have their own unique invertebrate communities which include many relict species. Wasp, bee, ant, spider and bug taxa had higher unique richness in forest sites burnt less than 12 years previously, while Lepidoptera, snails, cockroaches and centipede taxa had higher unique richness in forest sites unburnt for more than 29 years.

In the Walpole-Nornalup National Park, distinct and unique forest floor litter invertebrate communities appear to favour both different forest types and different post-fire forest structures. Yen and Butcher (1997), in their extensive overview of the conservation of non-marine Australian invertebrates, infer from our current limited knowledge that the use of the structure of large-scale plant communities as a basis for conservation decisions is the most effective way of adequately conserving most invertebrate taxa. Usher and Jefferson (1991), in another recent review of insect conservation, pointed out that a number of distinctive invertebrate communities were associated with particular successional stages of plant communities. Active management of these successions was required to maintain local populations of invertebrate species within these communities. In order to conserve the complete biodiversity of the litter invertebrate communities within the Walpole-Nornalup National Park, based on our current incomplete knowledge of the invertebrate fauna of this region, it is necessary to maximize the range of microhabitats by maintaining a wide range of forest compositions and structures.

Heterogeneity in the forest composition and structure can be achieved by creating and maintaining a mosaic of post-fire ages. Such a fire age mosaic is one of the objectives of the Walpole-Nornalup National Park management plan (1992-2002). The strategies of this management plan are to create a fire age mosaic made-up of a system of three fire regimes. These three fire regimes are 1) Fuel Reduction Regime with a high fire frequency of 6 to 8 years to act as buffer areas between the park and high risk areas such as private property; 2) Vegetation Management Regime with a fire frequency of 10 to 20 years, largely to contribute to the habitat diversity of vegetation communities and protect regenerating plant species; and 3) No Planned Burn Regime which contains a number of large central areas of the park which will have maximum protection from fire for prolonged periods (> 30 yrs.) of time.

Relevant actions itemized in the fire management plan included locating populations of threatened fauna and burning or not burning based on the requirements of the particular species; and monitoring and determining the fire response and association of relict invertebrates with each post-fire seral stage. In addition the association of relict invertebrates with uncommon refuge microhabitats should continue to be monitored at different fire ages and fire regimes. The prescribed burning of each vegetation community should create a diverse range of microhabitats including burnt areas containing fire-felled logs and log ashbeds, while retaining unburnt patches of forest floor, stream and riverbanks. Unburnt patches should contain viable populations of relict invertebrates in significant areas of microhabitats such as deep floor litter, decaying logs, moss swards, deep tree butt litter and tree butts with thick unburnt bark in all forest vegetation communities.

These actions will ensure that the long-term conservation of the forest floor invertebrate communities is well supported by the Walpole-Nornalup National Park management plan (1992-2002).

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Fig. 7: The species richness of litter invertebrates on the forest floor and around the butts of forest trees occurring on upper slopes and hill tops in November 1996.

Fig. 8: The abundance of litter invertebrates on the forest floor and around the butts of forest trees occurring on the upper slopes and hill tops in November 1996.

Fig. 9: The species richness of litter invertebrates on the forest floor and around the butts of Tingle trees occurring along creeklines in November 1996.

Fig. 10: The abundance of litter invertebrates on the forest floor and around the butts of Tingle trees occurring along creeklines in November 1996.

Table 1. A selected review of fauna with Gondwanan affinities found in the Southern Forest Region (SFR). Adapted from CSIRO 1991, Hopper et. al. 1996, which was partly validated by field observations by Main and Main (1991). *indicates taxon found outside SFR.

Taxonomic group	Geographic affinities	Habitat	Status within SFR
PHYLUM PLATYHELMINTHES			
(flatworms)			
Temnocephalidae	Australia, New Zealand, South America		
Temnocephala sp.		Parasites of freshwater crayfish	Widespread in freshwater streams
PHYLUM MOLLUSCA			
Order Pelecypoda			
Mutelidae (freshwater mussels)	Australia, South America		
Westralunio cartei		Freshwater	Widespread, southern rivers
Class Gastropoda			
Order Sigmurethra			
Bulimulidae (land snails)	Australia, South America		
Bothriembryon brazieri		Terrestrial	Widespread, high areas and south coast
B. glauerti		Terrestrial	Widespread, Stirling Range, rocks in damp gullies
*Bothriembryon melo**		Terrestrial	Widespread in coastal, calcareous sandy heaths
*B. kingii**		Terrestrial	Coastal sands
B. jacksonii		Terrestrial	Restricted, Karri, tingle forests
B.revectus		Terrestrial	Restricted, Boco and Deep rivers

Taxonomic group	Geographic affinities	Habitat	Status within SFR
Charopidae	Australia, South America		
sp. 1		Litter and rocks of scree slopes	Restricted, Stirling Ranges
sp. 2		Litter and rocks of scree slopes	Restricted, Stirling Ranges
sp. 3		Litter and rocks of scree slopes	Restricted, Stirling Ranges
Other spp. aff.		?	South coastal areas
Rhytididae	Australia, South America		
sp. 1		Deeply shaded, heavily-wooded gullies	Restricted, Stirling Ranges
Other spp. aff.		moist gullies ?	Widespread, Pemberton, Albany, south-east coastal rainforests
PHYLUM ANNELIDA			
Class Oligochaeta			
Order Lumbricina (earthworms)			
Megascolecoidea	Gondwanan		
Megascolex	Australia, southern India		
M. swarbrickii		moist shaded soils	Unknown, Porongurup Range, south coastal
M. syndetoporus		moist shaded soils	Unknown
PHYLUM ONYCHOPHORA			
(velvet worms)	Australia, New Zealand, South America, South Africa		
Occiperipatoides occidentalis		Terrestrial	Widespread but patchy, Stirling Range

Taxonomic group	Geographic affinities	Habitat	Status within SFR
PHYLUM CHELICERATA			
Class Arachnida			
Order Scorpionida (scorpions)			
Bothriuridae	Australia, South America		
*Cercophonius sulcatus**		Under rotten logs and stones	Widespread
Order Acarina (ticks and mites)			
Ameronthiidae (water mites)	South Africa, Australia		
Chudalupia meridionalis		Freshwater	Restricted, Mt. Chudalup
Order Pseudoscorpionida (pseudoscorpions)			
Garypidae			
*Synsphyronus**	New Zealand, Australia		
S. apimelus		Scree slope	Restricted, Toolbrunup Peak
*S. hansenii**		Terrestrial	Restricted, also in southeastern Australia
Chernetidae			
Conicochernes globosus	Gondwanan	Under eucalypt bark	Restricted, Porongurup Range and south coast.
*Sundochernes**	South America, south-east Asia, Australia		
S. australiensis		Terrestrial	Restricted
Order Opiliones (harvest spiders)			
Megalopsalididae	South America, South Africa, Australia, New Zealand		
*Spinicrus minimus**		Terrestrial	?
Triaenonychidae	Gondwanan		
Dingupa glauerti		?	?

Taxonomic group	**Geographic affinities**	**Habitat**	**Status within SFR**
Order Araneae (spiders)			
Infraorder Mygalomorphae (trapdoor spiders)			
Migidae	South America, South Africa, Madagascar, Australia, New Zealand, New Caledonia		
*Moggridgea**	South Africa, Australia		
M. tingle		Stream banks and tingle tree butts	Restricted, south coastal forests
M. sp		Wet gullies	Restricted, Stirling Range
Actinopodidae	South America, Australia		
*Missulena hoggi**		Terrestrial	Widespread
*Missulena sp.**		Terrestrial	Widespread
Idiopidae			
*Aganippe**	Gondwanan		
A. spp		Different species in gullies or higher slopes	Restricted, Stirling Range
*Arbanitis**	New Zealand, Australia	Terrestrial	Widespread
Eucyrtops	south-west Australia		
E. spp		Different species in gullies or higher slopes	Restricted, Stirling Range
Neohomogona	south-west Australia		
N. stirlingi		Burrows in sandy and loamy soils	Restricted, Stirling and Porongurup Ranges

Taxonomic group	Geographic affinities	Habitat	Status within SFR
Nemesiidae			
*Aname**	Gondwanan		
A. spp		Damp shaded habitats	Restricted, Stirling Range
*Chenistonia**	Gondwanan		
C. spp		Damp shaded habitats	Restricted, Stirling Range
*Stanwellia**	New Zealand, Australia		
S. sp		moist gullies	Restricted, Stirling and Porongurup Range, south coastal forests
*Teyl**	Gondwanan		
T. sp		swamps and gullies	Restricted, Stirling Range
Infraorder Araneomorphae (true spiders)			
Orslobidae	South America, South Africa, Australia, New Zealand		
*Tasmanoonops**			
T. australis		Litter and humus	Widespread, southern forests
Anapidae	South America, Australia, New Zealand, New Caledonia		
*Chasmocephalon neglectum**		wet gullies	Restricted, Windy Harbour
*C. pemberton**		fallen logs and hollow butts	Widespread, southern forests
*C. flinders**		moist microhabitats	
C. tingle		fallen logs and hollow butts	Restricted, south coastal forests.
*Elassoctenus** (=*Diallomus?*)	South India		?
Elassoctenus spp.		Terrestrial	?

Taxonomic group	Geographic affinities	Habitat	Status within SFR
Linyphiidae			
*Laetesia**	New Zealand, Australia		?
*Laperousea**	New Zealand, Australia		
Laperousea quindecimpunctata		Terrestrial	?
Micropholcommatidae	Gondwanan		
*many undescribed spp.**		litter and moss swards	southern forests and cool mountain peaks of eastern rainforests
PHYLUM CRUSTACEA			
Class Malacostraca			
Order Decapoda			
Parastacidae (crayfish)	Australia, New Zealand, South America		
*Cherax tenuimanus** *(marron)*		Permanent freshwater streams	Widespread
*C. quinquecarinatus** *(gilgie)*		Freshwater permanent streams to semi-permanent swamps	Widespread
*C. preissii** *(koonac)*		Headwaters of freshwater rivers	Widespread
*C. crassimanus**		Freshwater rivers, but not headwaters	South coast to Hay River
C. plebejus? syn C. preissii		Freshwater swamps	Widespread
Engaewa subcoerulea (burrowing crayfish)		Freshwater	Restricted

Taxonomic group	Geographic affinities	Habitat	Status within SFR
Order Isopoda			
Phreatoicoidea	Australia, New Zealand, South Africa, southern India		
Amphisopus lintoni (shrimps)*		Freshwater	Coastal seeps, peaty swamps, headwater runnels along south coast
*Paramphisopus palustris**		Freshwater	Temporary runnels of Karri forest
Order Amphipoda			
Neoniphargidae	Australia, Madagascar		
Neoniphargus branchialis (shrimp)		Freshwater	Coastal tempory swamps
Order Cladocera (water fleas)			
Daphina	Gondwanan		
D. occidentalis		Freshwater	Restricted
PHYLUM UNIRAMIA			
Class Collembola			
Neanuridae	Cosmopolitan		
Uchidanurinae	Cosmopolitan	Terrestrial, decaying logs & moss.	?, 3 endemic genera.
Brachystomellidae	Cosmopolitan	Terrestrial, leaf litter & grasses	?, *Rapoportella sp.* from Kangaroo Island.
Entomobryidae	Cosmopolitan	Terrestrial, leaf litter	?, *Australotomurus* endemic to southern Australia.
Paronellidae	Australia, New Zealand	Terrestrial, leaf litter	?, *Paronellia* many undescribed species in Tasmania.
Oncopoduridae	Cosmopolitan	Terrestrial, leaf litter & rotting logs.	?, *Oncopodura* from *Nothofagus* forests.
Tomoceridae	Cosmopolitan	Terrestrial, leaf litter	?, an undescribed genus from Tasmania.
Sminthuridae	Cosmopolitan		
Katianninae	Southern Australia	Terrestrial, leaf litter	?, *Adelphoderia* from *Nothofagus* forest.

Taxonomic group	Geographic affinities	Habitat	Status within SFR
Class Insecta			
Order Odonata (dragon flies)			
Megapodagrionidae	Australia, South America, South Africa, Madagascar		
*Agriolestes minimus**		Freshwater (larvae)	Widespread, swamps and streams
*A. pusillus**		Freshwater (larvae)	Widespread, streams
A. pusillisimus		Freshwater (larvae)	Widespread, streams
Gomphidae			
Gomphinae	Gondwanan		
*Armagomphus armiger**		Freshwater (larvae)	Permanent rapid streams
*Austrogomphus collaris**		Freshwater (larvae)	Permanent rapid streams
*A. lateralis**		Freshwater (larvae)	Permanent rapid streams
Cordulidae			
Gomphomacromiinae	Gondwanan		
Synthemistinae			
*Hesperocordula berthoudi**		Freshwater (larvae)	Permanent rapid streams
*Lathrocordula metallica**		Freshwater (larvae)	Permanent rapid streams
*Synthemis cyanotincta**		Freshwater (larvae)	Permanent rapid streams
Order Plecoptera (stone flies)			
Griptopterigidae	Australia, New Zealand, South America		
Leptoperla australica		Freshwater (larvae)	Restricted
Newmanoperla exigua		Freshwater (larvae)	Restricted

Taxonomic group	Geographic affinities	Habitat	Status within SFR
Order Hemiptera			
Psylloidea	Australia	Terrestrial	?endemic species on endemic plant hosts.
Aphididae			
Drepanosiphinae	circumantarctic		
Neophyllaphis spp.	Australia, New Zealand, New Guinea	Terrestrial	11 species on *Podocarpus spp.*
Taiwanaphis spp.	Australia, New Zealand, New Guinea	Terrestrial	6 Aust. species on *Nothofagus* & *Melaleuca spp.*
Coccoidea	Cosmopolitan	Terrestrial	?endemic species on *Eucalyptus*, *Leptospermum*, *Allocasuarina*.
Cicadellidae			
Cephalelini	Australia, South Africa, New Zealand	Terrestrial	?endemic species on Restionaceae
Eurymelidae	Australia	Terrestrial	?endemic species on *Eucalyptus* & *Casuarina*.
Delphacidae	Cosmopolitan	Terrestrial	?mostly feed on monocots.
Notuchus spp.			?
Peloridiidae	Australia, New Zealand, South America	Terrestrial	among moss in cool rainforests and *Nothofagus* forest.
Schizopteridae	Cosmopolitan	Terrestrial, leaf litter, logs, bogs and ponerine ant nests.	? many undescribed endemic species in wet eastern forests.
Mesoveliidae	cosmopolitan		
Austrovelia	North Queensland	Terrestrial, leaf litter at high altitudes.	?
Miridae	Cosmopolitan		
Cylapine	Australia	Terrestrial, mycetophagous.	? many undescribed species.
Tingidae	Cosmopolitan		
Tinginae	Australia	Terrestrial, on woody shrubs, leaf litter, moss and ant nests.	? endemic species on *Eucalyptus*, *Casuarina*, *Grevillea* & *Thryptomene*.
Thaumastocoridae	Australia, India, South America		
Thaumastocrinae	Australia, India.	Terrestrial, phytophagus	? endemic species on *Eucalyptus*, *Acacia*, *Banksia* & *Melaleuca*.

Taxonomic group	Geographic affinities	Habitat	Status within SFR
Aradidae	cosmopolitan		?, high diversity of endemic species in cool rainforests.
Isoderminae	Australia, New Zealand, South America	Terrestrial, mycetophagus on dead or dying wood.	?, endemic species in south west.
Chinamyersiinae	Australia, New Zealand, New Caledonia	Terrestrial, mycetophagus on dead or dying wood.	?, relict *Kumaressa spp.* in eastern Australia.
Mezirinae	Cosmopolitan	Terrestrial, termites nests	*Aspisocoris sp.* in south west.
Idiostolidae	Australia, South America	Terrestrial, habits and food unknown.	?, all species in *Nothofagus* forests.
Lygaeidae	Cosmopolitan		
Rhyparochrominae (Cleradini)	Australia, New Zealand, SE Asia	Terrestrial, feed on blood of small marsupials.	?, several endemic genera.
Blissinae	Australia	Terrestrial, sap of grasses & sedges.	?, endemic genus *Archaeodemus*
Acanthosomatidae	Cosmopolitan	Terrestrial	?, many genera in moist southern Australia.
Order Megaloptera (alder flies)			
Corydalidae			
Archicauliodes	Australia, New Zealand, South America		
*A. cervulus**		Freshwater (larvae)	
Order Trichoptera (caddis flies)			
Hydrobiosidea	Australia Neotropical		
Apsilochorema urdalum		Freshwater (larvae)	
Taschorema pallescens		Freshwater (larvae)	
Philorheithridae	Australia Neotropical		
Kosrheithrus boorarus		Freshwater (larvae)	Restricted
Order Lepidoptera (moths and butterflies)			
Castniidae	Gondwanan		
Synemon directa		Larvae in *Lepidosperma* and other sedge swamps	Widespread

Table 2: Mean sample richness (local alpha) and abundance of litter invertebrates in the forests of the Walpole-Nornalup National Park trapped in November 1996.

Forest Type	Post-fire Age(yrs)	Habitat	Slope & Hill Tops Mean Richness (rank)	Slope & Hill Tops Mean Abundance (rank)	Creeklines Mean Richness (rank)	Creeklines Mean Abundance (rank)
Jarrah	Site 2, 0.2	Butt	77(2)	161.5(11)		
		Floor	68.5(4)	125(17)		
	Site 1, 30	Butt	83.5(1)	205(3)		
		Floor	60(10)	168(9)		
Karri	Site 4, 11	Butt	58.5(11)	177.5(6)		
		Floor	62(7)	282.5(1)		
	Site 3, 30	Butt	61.5(8)	120.5(18)		
		Floor	69(3)	178.5(5)		
Tingle	Site 7, 3	Butt	60.5(9)	188(4)	65(6)	158.5(13)
		Floor	60.5(9)	140.5(15)	47(17)	103(20)
	Site 8, 9	Butt	57(12)	91.5(22)	53(14)	129.5(16)
		Floor	47.5(16)	89.5(23)	44.5(19)	103(20)
	Site 10,60	Butt	67(4)	169.5(8)	60.5(9)	145.5(14)
		Floor	53.5(13)	173(7)	66.5(5)	209(2)
	Site 11,60	Butt	52(15)	101(21)	60.5(9)	166.5(10)
		Floor	46.5(18)	112(19)	52(15)	160.5(12)

Table 3: Total richness (regional alpha) and unique richness of morphospecies (local beta) exclusively trapped from each of the forest sites in the Walpole-Nornalup National Park in November 1996. J = jarrah sites, K = karri, T = tingle sites; Time since fire = 0.2 year, = 03 years, = 09 years, =11 years, = 30 years and = 61 years. r = ridge sites and c = creek sites. Tree butt = b and forest floor = f.

Taxa	Total Rich.	All Forest Type			Jarrah Forest			Karri Forest			Tingle Forest						
Years unburnt:		All	< 12	> 29	All	.2	30	All	11	30	All	3c	3r	9c	9r	61 c	61r
Number of Sites:	12	12	6	6	2	1	1	2	1	1	8	1	1	1	1	2	2
Decomposers:																	
Collembola	54	5	26	27	7	3	4	6	3	3	29	1	4	1	1	10	5
Oligochaete	1	0	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0
Isopoda	13	5	5	1	3	2	0	0	0	0	3	1	0	0	1	0	1
Diplopoda	8	3	1	1	1	1	0	2	0	1	1	0	0	0	0	0	0
Omnivores:																	
Acarina	59	3	22	27	3	2	2	7	5	1	40	1	4	10	2	6	5
Gastropoda	4	0	0	4	0	0	0	3	0	3	0	0	0	0	0	0	0
Diptera	116	23	37	40	4	1	2	8	3	3	79	12	7	9	5	21	14
Blattodea	4	0	0	4	1	0	1	1	0	1	2	0	0	0	0	0	2
Dermaptera	4	0	0	2	2	0	2	0	0	0	0	0	0	0	0	0	0
Hemiptera	19	0	10	5	4	0	4	6	6	0	6	1	1	3	0	0	1
Coleoptera	135	3	56	42	28	14	9	19	6	10	65	6	7	8	10	11	11
Orthoptera	9	1	7	1	1	0	1	0	0	0	3	1	1	0	0	0	0
Hymenoptera	104	9	62	18	16	3	10	5	3	2	57	4	5	2	5	14	10
Formicidae	30	5	11	7	12	4	7	1	1	0	8	1	0	1	0	1	0
Herbivores:																	
Lepidoptera	23	0	4	15	5	0	5	4	0	4	11	0	4	0	0	2	2
Thysanoptera	4	1	1	1	0	0	0	0	0	0	2	1	0	0	0	1	0
Predators:																	
Araneae	88	5	59	24	19	10	9	2	0	2	51	8	3	9	3	8	4
Trichoptera	10	2	3	2	0	0	0	0	0	0	5	1	0	0	1	0	1
Chilopoda	4	0	1	3	1	1	0	0	0	0	3	0	0	0	0	1	1
Pseudoscorpionida	4	1	2	0	2	2	0	0	0	0	1	0	0	0	0	0	0
Opilionida	6	0	2	4	2	0	2	2	0	2	2	0	0	0	1	0	0
Arthropleana	2	0	1	1	0	0	0	0	0	0	2	0	0	1	0	0	1
TOTAL:	701	66	310	230	111	43	58	67	27	33	370	38	36	44	29	75	58
Mean Unique Richness per Site:	58.4	5.5	51.7	38.3	55.5	43	58	33.5	27	33	46.2	38	36	44	29	37.5	29

Table 4: Mean abundance and site richness (local alpha) of the morphospecies of litter invertebrate taxa trapped from specific sites in the forests of the Nornalup-Walpole National Park in November 1996. J = jarrah, K = karri, T = tingle sites; Time since fire = 0.2 year, = 03 years, = 09 years, =11 years, = 30 years and = 61 years. r = ridge sites and c = creek sites. Tree butt = b and forest floor = f.

Forest Type:	Tr	Tc	Tr	Tc	J	J	K	K	Tr	Tc	Tr	Tc	
Post Fire Years:	61	61	61	61	30	.2	30	11	3	3	9	9	

Taxon:	Morpho Spp:	Habitat & Forest Type:	10a	10b	11a	11b	1a	2a	3a	4a	7a	7b	8a	8b	(blank)	Grand Total
Formicidae	1	1b		1						1						2
		1f				1										1
		2b						1								1
		2f												1		1
	1 Total	TJKbf>0.2		1		1		1		1				1		5
	2	1b		1		1	1			1		1		1		6
		1f								1						1
	2 Total	TJKbf>8		1		1	1			2		1		1		7
	3	1b		1												1
	3 Total	Tb=61		1												1
	4	1b		1	1	1						1				4
		1f				1										1
	4 Total			1	1	2						1				5
	5	1b					1	1		1				1		4
		1f			1	1								1		3
		2f												1		1
	5 Total	TJKbf>0.2			1	1	1	1		1				3		8
	6	1b	1		1	1	1			1	1	1		1		8
	6 Total	TJK>2	1		1	1	1			1	1	1		1		8
	7	1b	1		1									1		3
	7 Total	Tb>8	1		1									1		3
	8	1b												1		1
	8 Total	Tb=9												1		1
	9	1b												1		1
	9 Total	Tb=9												1		1
	10	1b	1											1		2
		2f												1		1
	10 Total	Tbf>8	1											2		3
	11	1b	1											1		2
		1f				1										1
	11 Total	Tbf>8	1			1								1		3
	12	1b	1		1	1		1		1	1	1				7
		1f			1	1						1				3
	12 Total	TJKbf>0.2	1		2	2		1		1	1	2				10

Forest Type: / Post Fire Years:			Tr 61	Tc 61	Tr 61	Tc 61	J 30	J .2	K 30	K 11	Tr 3	Tc 3	Tr 9	Tc 9		
	13	1b										1				1
	13 Total	Tb=9										1				1
	14	1b				1										1
		1f								1						1
	14 Total	TKbf>10				1				1						2
	15	1b	1								1					2
	15 Total	Tb>2	1								1					2
	16	1b					1	1								2
		1f					1									1
	16 Total	Jbf=30-0.2					2	1								3
	17	1b					1									1
	17 Total	Jb=30					1									1
	18	1b					1									1
	18 Total	Jb=30					1									1
	19	1b					1									1
	19 Total	Jb=30					1									1
	20	1b					1									1
	20 Total	Jb=30					1									1
	21	1b					1									1
	21 Total	Jb=30					1									1
	22	1b					1									1
	22 Total	Jb=30					1									1
	24	1f								1						1
	24 Total	Kf=11								1						1
	25	1f					1									1
	25 Total	Jf=30					1									1
	26	2f												1		1
	26 Total	Tf=9												1		1
	27	1b						1								1
	27 Total	Jb>0.2						1								1
	28	1b						1								1
	28 Total	Jb>0.2						1								1
	29	1b						1								1
	29 Total	Jb>0.2						1								1
	30	1b						1								1
	30 Total	Jb>0.2						1								1
Total	=30spp		6	4	6	10	12	8		8	3	6		13		76
Acarina	1	1b								1						1
	1 Total	Kb=11								1						1
	2	1b		1						1		1				3
	2 Total	TKb>2		1						1		1				3
	3	1b								1						1
	3 Total	Kb=11								1						1
	4	1b	1	1	1	1	1			1						6
		2b								1			1			2
	4 Total	TJKb>8	1	1	1	1	1			2			1			8

Forest Type: Post Fire Years:			Tr 61	Tc 61	Tr 61	Tc 61	J 30	J .2	K 30	K 11	Tr 3	Tc 3	Tr 9	Tc 9		
	5	1b								1						1
	5 Total	Kb=11								1						1
	6	1b				1		1		1						3
		1f				1										1
	6 Total	TJKbf>10				2		1		1						4
	7	1b								1						1
	7 Total	Kb=11								1						1
	8	1b			1											1
	8 Total	Tb=61			1											1
	9	1b	1	1	1											3
	9 Total	Tb=61	1	1	1											3
	10	1b			1											1
	10 Total	Tb=61			1											1
	11	1b												1		1
	11 Total	Tb=9												1		1
	12	1b												1		1
	12 Total	Tb=9												1		1
	13	1b				1								1		2
	13 Total	Tb>8				1								1		2
	14	1b												1		1
	14 Total	Tb=9												1		1
	15	1b												1		1
	15 Total	Tb=9												1		1
	16	1b	1			1					1	1		1		5
	16 Total	Tb>8	1			1					1	1		1		5
	17	1b												1		1
	17 Total	Tb=9												1		1
	18	1b												1		1
	18 Total	Tb=9												1		1
	19	1b												1		1
	19 Total	Tb=9												1		1
	21	1b					1									1
	21 Total	Jb=30					1									1
	24	1b				1										1
	24 Total	Tb=61				1										1
	25	1b	1			1										2
	25 Total	Tb=61	1			1										2
	26	1b				1					1					2
	26 Total	Tb>2				1					1					2
	27	1b	1	1		1										3
	27 Total	Tb=61	1	1		1										3
	32	1b		2												2
	32 Total	Tb=61		2												2
	33	1b		2												2
	33 Total	Tb=61		2												2

Forest Type: Post Fire Years:			Tr 61	Tc 61	Tr 61	Tc 61	J 30	J .2	K 30	K 11	Tr 3	Tc 3	Tr 9	Tc 9		
	34	1b		1												1
	34 Total	Tb=61		**1**												**1**
	35	1b		1												1
	35 Total	Tb=61		**1**												**1**
	36	1b	1	1												2
	36 Total	Tb=61	**1**	**1**												**2**
	37	1b		1												1
	37 Total	Tb=61		**1**												**1**
	38	1b	1	1												2
	38 Total	Tb=61	**1**	**1**												**2**
	39	1b		1												1
	39 Total	Tb=61		**1**												**1**
	40	1b	1	1												2
	40 Total	Tb=61	**1**	**1**												**2**
	41	1b	1													1
	41 Total	Tb=61	**1**													**1**
	42	1b	1								1					2
	42 Total	Tb>2	**1**								**1**					**2**
	43	1b	1													1
	43 Total	Tb=61	**1**													**1**
	44	1b	1													1
		2b							1							1
	44 Total	TKb>29	**1**						**1**							**2**
	45	1b	1													1
	45 Total	Tb=61	**1**													**1**
	46	1b	1													1
	46 Total	Tb=61	**1**													**1**
	47	1b	1													1
	47 Total	Tb=61	**1**													**1**
	48	1b			1											1
	48 Total	Tb=61			**1**											**1**
	51	1b								1						1
	51 Total	Kb=11								**1**						**1**
	52	1b										1				1
	52 Total	Tb=3										**1**				**1**
	53	1b									1					1
	53 Total	Tb=3									**1**					**1**
	54	1b									1					1
	54 Total	Tb=3									**1**					**1**
	55	1b									1					1
	55 Total	Tb=3									**1**					**1**
	56	1b									1					1
	56 Total	Tb=3									**1**					**1**
	57	1f						1						1		2
		2f								1						1
	57 Total	TJKbf>0.2						1		1				1		3

Forest Type: Post Fire Years:			Tr 61	Tc 61	Tr 61	Tc 61	J 30	J .2	K 30	K 11	Tr 3	Tc 3	Tr 9	Tc 9		
	58	1b						1								1
	58 Total	Jb=o.2						1								1
	59	1b						1								1
	59 Total	Jb=0.2						1								1
	62	1f							1							1
	62 Total	Kf=11							1							1
	63	1f	1													1
		2f					1									1
	63 Total	TJf>29	1				1									2
	64	2f					1									1
	64 Total	Jf=30					1									1
	65	2b											1			1
	65 Total	Tb=9											1			1
	66	2b											1			1
	66 Total	Tb=9											1			1
	67	2f							1							1
	67 Total	Kf=30							1							1
Total	=59spp.		16	15	5	9	4	4	3	10	7	3	3	10		89
Hemiptera	1	1b								1						1
	1 Total	Kb=11								1						1
	2	1b								1						1
	2 Total	Kb=11								1						1
	3	1b								1						1
	3 Total	Kb=11								1						1
	4	1b		1	1					1		1				4
	4 Total	TKb>2		1	1					1		1				4
	5	1b								1						1
	5 Total	Kb=11								1						1
	7	1b		1	1						1					3
		1f		1		1										2
	7 Total	Tbf>2		2	1	1					1					5
	8	1b												1		1
	8 Total	Tb=9												1		1
	9	1b												1		1
	9 Total	Tb=9												1		1
	10	1b					1									1
	10 Total	Jb=30					1									1

Forest Type: Post Fire Years:			Tr 61	Tc 61	Tr 61	Tc 61	J 30	J .2	K 30	K 11	Tr 3	Tc 3	Tr 9	Tc 9		
	11	1b					1									1
	11 Total	Jb=30					1									1
	12	1b					1									1
	12 Total	Jb=30					1									1
	13	1b					1									1
	13 Total	Jb=30					1									1
	14	1b				1					1					2
	14 Total	Tb>2				1					1					2
	15	1b	1													1
	15 Total	Tb=61	1													1
	16	1b								1						1
	16 Total	Kb=11								1						1
	17	1b										1				1
	17 Total	Tb=3										1				1
	18	1b									1					1
	18 Total	Tb=3									1					1
	19	2b								1						1
	19 Total	Kb=1								1						1
8 Total	=19spp.		1	3	2	2	4			7	3	2		2		26
Orthoptera	1	1b					1	1		1		1				4
		1f	1			1	1	1			1	1				6
		2b						1				1				2
		2f		1			1	1								3
	1 Total	TJKbf>0.2	1	1		1	3	4		1	1	3				15
	2	1b									1	1				2
		1f		1								1				2
		2b						1			1	1				3
	2 Total	TJbf>0.2		1				1			2	3				7
	3	1b									1	1				2
		2b						1			1	2				4
	3 Total	TJb=0.2-3.0						1			2	3				6
	4	1b									1					1
		1f									1					1
	4 Total	Tbf=3									2					2
	5	1f											1			1
		2b						1			1					2
	5 Total	TJ=0.2-9.0						1			1		1			3
	6	1f									1	1				2
		2b									1					1
		2f						1								1
	6 Total	TJbf=0.2-3.0						1			2	1				4
	7	2f								1				1		2
	7 Total	TKf=9-11								1				1		2
	8	2b										1				1
	8 Total	Tb=3										1				1

Forest Type: Post Fire Years:			Tr 61	Tc 61	Tr 61	Tc 61	J 30	J .2	K 30	K 11	Tr 3	Tc 3	Tr 9	Tc 9		
	9	2b										1				1
		2f	1													1
	9 Total	Tbf>2	1									1				2
9 Total	=9spp.		2	2		1	3	8		2	10	12	1	1		42
Pscoptera	1	1b					1									1
	1 Total	Jb=30					1									1
10 Total	=1sp.						1									1
Isopoda	1	1b		1	2	1	1		1		1					7
		1f	1	1	1	1					1					5
		2b	1	1	1	1										4
		2f	1			1										2
	1 Total	TJKbf>2	3	3	4	4	1		1		2					18
	2	2b										1				1
	2 Total	Tb=3										1				1
	3	1b						1	1	1						3
		1f		1			1		1		1			1		5
		2b	1				1	1	1	1	1	1	1			8
		2f	1	1			1	1	1	1				1		7
	3 Total	TJKbf>0.2	2	2			3	3	4	3	2	1	1	2		23
	4	1b	1													1
		2b											1			1
	4 Total	Tb>8	1										1			2
	5	1f						1	1							2
		2b										1				1
	5 Total	TJKbf=0.2-30						1	1			1				3
	6	1b	1													1
		1f						1	1		1					3
		2b	1						1			1	1			4
	6 Total	TJKbf=0.2-30	2					1	2		1	1	1			8
	7	1b						1		1						2
		1f											1			1
		2b						1								1
	7 Total	TJKbf=0.2-11						2		1			1			4
	8	1b						1					1			2
		1f						1								1
		2b						1								1
		2f	1						1							2
	8 Total	TJbf>0.2	1					3	1				1			6
	9	1b						1								1
		1f											1			1
	9 Total	TJbf=0.2-9						1					1			2
	10	2f	1													1
	10 Total	Tf=61	1													1

Forest Type: Post Fire Years:			Tr 61	Tc 61	Tr 61	Tc 61	J 30	J .2	K 30	K 11	Tr 3	Tc 3	Tr 9	Tc 9		
	11	2b						1								1
		2f					1	1								2
	11 Total	Jbf=0.2-30					1	2								3
	12	2f						1								1
	12 Total	Jf=0.2						1								1
	13	2f						1								1
	13 Total	Jf=0.2						1								1
12 Total	=13spp.		10	5	4	4	5	15	9	4	5	4	6	2		73
Chilopoda	2	2b				1										1
	2 Total	Tb=61				1										1
	3	1b	1													1
		1f		1												1
	3 Total	Tbf=61	1	1												2
	4	1f	1													1
	4 Total	Tf=61	1													1
	5	2f						1								1
	5 Total	Jf=0.2						1								1
13 Total	=4spp.		2	1		1		1								5
Blattodea	1	1f	1													1
	1 Total	Tf=61	1													1
	2	1f	1													1
	2 Total	Tf=61	1													1
	3	2f					1									1
	3 Total	Jf=30					1									1
	8	2b							1							1
	8 Total	Kb=30							1							1
15 Total	=4spp.		2				1		1							4
Dermaptera	1	1b						1								1
		2b			1	1		1								3
		2f			1		1	1								3
	1 Total	TJbf>0.2			2	1	1	3								7
	2	1b						1								1
		1f						1						1		2
		2b										1				1
		2f		1			1									2
	2 Total	TJbf>0.2		1			1	2				1		1		6
	4	1f					1									1
	4 Total	Jf=30					1									1
	5	2f					1									1
	5 Total	Jf=30					1									1
18 Total	=4spp.			1	2	1	4	5				1		1		15

Forest Type: Post Fire Years:			Tr 61	Tc 61	Tr 61	Tc 61	J 30	J .2	K 30	K 11	Tr 3	Tc 3	Tr 9	Tc 9		
Thysan optera	1	1b				1							1			2
		2b							1							1
	1 Total	TKb>8				1			1				1			3
	2	1b					1	1		1				1		4
		1f						1								1
		2b						1								1
		2f											1			1
	2 Total	TJKbf=0.2-30					1	3		1			1	1		7
	3	1b				1										1
	3 Total	Tb=61				1										1
	7	2b										1				1
	7 Total	Tb=3										1				1
20 Total	=4spp.					2	1	3	1	1		1	2	1		12
Pseudo scorpionida	1	1b	1		1											2
		1f						1								1
		2b	1				1		1				1			4
		2f		1												1
	1 Total	TJKbf>0.2	2	1	1		1	1	1				1			8
	2	1b											1			1
		1f		1												1
	2 Total	Tbf>8		1									1			2
	3	2b						1								1
	3 Total	Jb=0.2						1								1
	4	2b						1								1
	4 Total	Jb=0.2						1								1
21 Total	=4spp.		2	2	1		1	3	1				2			12
Opilionida	1	1f									1	1				2
	1 Total	Tf=3									1	1				2
	2	2f					1									1
	2 Total	Jf=30					1									1
	3	2f					1									1
	3 Total	Jf=30					1									1
	4	2f											1			1
	4 Total	Tf=9											1			1
	5	2b							1							1
	5 Total	Kb=30							1							1
	6	2b							1							1
	6 Total	Kb=30							1							1
22 Total	=6spp.						2		2		1	1	1			7
Diplopoda	1	1b	1	1	1	1	2	1		1	1	1	1	1		12
		1f	2	1	2	1			1		1		1	1		10
		2b	1	1	1	1	1		1	1			1			8
		2f	1	1	1	1	1	1	1	1			1	1		10
	1 Total	TJKbf>0.2	5	4	5	4	4	2	3	3	2	1	4	3		40

Forest Type: / Post Fire Years:				Tr 61	Tc 61	Tr 61	Tc 61	J 30	J .2	K 30	K 11	Tr 3	Tc 3	Tr 9	Tc 9	
		2	1b				1									1
			2b										1			1
			2f		1											1
	2 Total		Tbf>2		1		1						1			3
		3	1b	1				1				1	1		1	5
			1f		1								1	1		3
			2b			1			1	1		1	1	1		6
			2f		1		1							1		3
	3 Total		TJKbf>0.2	1	2	1	1	1	1	1		2	3	3	1	17
		4	1f	1					1							2
			2f	2												2
	4 Total		TJf>0.2	3					1							4
		5	1f	1												1
			2b						1					1		2
			2f		1	1	1									3
	5 Total		TJbf>0.2	1	1	1	1		1					1		6
		6	1f		1	1										2
			2b						1			1				2
			2f						1	1	1					3
	6 Total		TJKbf>0.2		1	1			2	1	1	1				7
		8	1f						1							1
	8 Total		Jf=0.2						1							1
		9	2f							1						1
	9 Total		Kf=30							1						1
23 Total	=8spp.			10	9	8	7	5	8	6	4	5	5	8	4	79
Gastropoda		1	1b	1												1
			2f							1						1
	1 Total		TKbf=30-61	1						1						2
		2	1b							1						1
	2 Total		Kb=30							1						1
		3	2b							1						1
	3 Total		Kb=30							1						1
		4	2b							1						1
	4 Total		Kb=30							1						1
25 Total	=4spp.			1						4						5
Oligochaete		1	1b							1						1
	1 Total		Kb=30							1						1
27 Total	=1spp.									1						1
Arthropleana		2	1b			1										1
	2 Total		Tb=61			1										1
		3	1b												1	1
	3 Total		Tb=9												1	1
34 Total	=2spp.					1									1	2
Grand Total=171spp				52	42	29	37	43	55	28	38	35	36	23	36	45 4
Forest Type: / Post Fire Years:				Tr 61	Tc 61	Tr 61	Tc 61	J 30	J .2	K 30	K 11	Tr 3	Tc 3	Tr 9	Tc 9	

Table 5: Mean abundance and total richness of Lepidoptera morphospecies trapped from specific sites in the forests of the Nornalup-Walpole National Park in November 1996. J = jarrah , K = karri, T = tingle sites; Time since fire = 0.2 year, = 03 years, = 09 years, =11 years, = 30 years and = 61 years. r = ridge sites and c = creek sites. Tree butt = b and forest floor = f.

Forest Type: Post Fire Years:	Tr 61	Tc 61	Tr 61	Tc 61	J 30	J .2	K 30	K 11	Tr 3	Tc 3	Tr 9	Tc 9	

Morpho Spp.	Habitat	Forest Type	10a	10b	11a	11b	1a	2a	3a	4a	7a	7b	8a	8b	Grand Total
8	1b						1								1
8 Total		Jb=30					1								1
9	1f						1								1
9 Total		Jf=30					1								1
10	1f						1								1
10 Total		Jf=30					1								1
12	1f						1								1
12 Total		Jf=30					1								1
13	1f						1					1			2
13 Total		Jf=30					1					1			2
14	1b								1						1
14 Total		Kb=30							1						1
17	1f								1						1
17 Total		Kf=30							1						1
18	1f								1						1
18 Total		Kf=30							1						1
20	1f								1						1
20 Total		Kf=30							1						1
15	1b													1	1
	1f								1						1
15 Total		TKbf =9-30							1					1	2
16	1f								1						1
	2b													1	1
16 Total		TKbf =9 - 30							1					1	2
19	1b		1												1
	1f								1						1
19 Total		TKbf =30-61	1						1						2

Forest Type: Post Fire Years:			Tr 61	Tc 61	Tr 61	Tc 61	J 30	J .2	K 30	K 11	Tr 3	Tc 3	Tr 9	Tc 9	
11	1b										1				1
11 Total		**Tb = 3**									**1**				**1**
21	1b										1				1
21 Total		**Trb = 3**									**1**				**1**
22	1b										1				1
22 Total		**Trb = 3**									**1**				**1**
23	1b										1				1
23 Total		**Trb = 3**									**1**				**1**
5	2f			1											1
5 Total		**Tf = 61**		**1**											**1**
24	1b		1												1
24 Total		**Trb = 61**	**1**												**1**
25	1b		1												1
25 Total		**Trb = 61**	**1**												**1**
26	1b		1												1
	2b					1									1
	2f			1											1
26 Total		**Trcbf = 61**	**1**	**1**		**1**									**3**
27	1b		1												1
	2b					1									1
27 Total		**Trcb = 61**	**1**			**1**									**2**
28	2b			1											1
28 Total		**Tcb = 61**		**1**											**1**
30	1f				1										1
30 Total		**Tcf = 61**			**1**										**1**
(blank)	(blank)														
Grand Total		**23spp.**	8	5	4	5	7	4	9	4	7	4	4	4	65

Table 6: Wasp and bee (Hymenoptera, except Formicidae) morphospecies trapped from 12 sites in the forests of the Nornalup-Walpole National Park in November 1996. J = jarrah sites, K = karri, T = tingle sites; Time since fire = 0.2 year, = 03 years, = 09 years, =11 years, = 30 years and = 61 years. R = ridge sites and C = creek sites. Tree butt = b and forest floor = f. Families trapped only at this forest type = **.

Wasp Taxa:	Morpho Species Code:	Forest Type	Larval Trophic Guild:	Biogeographic Affinities:
Scelionidae	16	TJK>0.2bf	Parasitoids of the eggs of Orthoptera, Heteroptera, Coleoptera and spiders.	Cosmopolitan, endemic genera Crama, Jarabambius, Neoscelio, Mirobaeoides.
Scelionidae	24	TJK>0.2bf	Parasitoids of the eggs of Orthoptera, Heteroptera, Coleoptera and spiders.	Cosmopolitan, endemic genera Crama, Jarabambius, Neoscelio, Mirobaeoides.
Scelionidae	40	TJK>0.2bf	Parasitoids of the eggs of Orthoptera, Heteroptera, Coleoptera and spiders.	Cosmopolitan, endemic genera Crama, Jarabambius, Neoscelio, Mirobaeoides.
		TJK>0.2bf=3		
Apocrita	5	TJK>03bf	Various guilds	Many endemic genera in moist temperate forests
Apocrita	22	TJK>03bf	Various guilds	Many endemic genera in moist temperate forests
Cynipoidea	4	TJK>03bf	Parasitoids of insects or in plant galls.	Cosmopolitan, endemic genera Thrasorus.
Mymarommatidae	6	TJK>03bf	Biology unknown	Australian species occur in moist forest regions.
		TJK>03bf=4		
Apocrita	2	TJK<11bf	Various guilds	Many endemic genera in moist temperate forests
		TJK<11bf=1		
Apocrita	36	TJK>11bf	Various guilds	Many endemic genera in moist temperate forests
		TJK>11bf=1		
		TJK=9		
Apocrita	15	TJ>0.2bf	Various guilds	Many endemic genera in moist temperate forests
Apocrita	27	TJ>0.2bf	Various guilds	Many endemic genera in moist temperate forests
		TJ>0.2bf=2		
Apocrita	42	TJ<03b	Various guilds	Many endemic genera in moist temperate forests
		TJ<03b=1		
Apocrita	26	TJ>03bf	Various guilds	Many endemic genera in moist temperate forests
Mymarommatidae	28	TJ>03bf	Biology unknown	Australian species occur in moist forest regions.
Scelionidae	18	TJ>03bf	Parasitoids of the eggs of Orthoptera, Heteroptera, Coleoptera and spiders.	Cosmopolitan, endemic genera Crama, Jarabambius, Neoscelio, Mirobaeoides.
Sphecidae	20	TJ>03bf	Mostly solitary predators or cleptoparasites of various insect taxa	Larrinae, Crabroninae and Nyssoninae are sub-families which include endemic genera
		TJ>03bf=4		
Chrysididae	12	TJ>09b	Parasitise eggs of Phasmatodea and nests of Vespidae	76 Australian species with cosmopolitan and oriental affinities
Apocrita	35	TJ>09bf	Various guilds	Many endemic genera in moist temperate forests
Braconidae	11	TJ>09bf	Parasitoids of most insect larvae	Four sub-families endemic with only 10 described species
Megaspilidae	33	TJ>09bf	Parasitoids of Diptera and hyperparasitoids of Braconids	40 species in Australia associated with primitive diptera families
		TJ>09bf=4		
		TJ=11		

Wasp Taxa:	Morpho Species Code:	Forest Type	Larval Trophic Guild:	Biogeographic Affinities:
Apocrita	41	J=0.2b	Various guilds	Many endemic genera in moist temperate forests
Braconidae	43	J=0.2b	Parasitoids of most insect larvae	Four sub-families endemic with only 10 described species
		J=0.2b=2		
Mymaridae*	21	J>0.2b	Eggs of Hemiptera, Pscoptera, Curculionidae and Tettigoniidae.	Cosmopolitan, Stethynium contains many Australian species.
		J>0.2b=1		
Apocrita	25	J=30b	Various guilds	Many endemic genera in moist temperate forests
Apocrita	30	J=30b	Various guilds	Many endemic genera in moist temperate forests
Apocrita	32	J=30b	Various guilds	Many endemic genera in moist temperate forests
Colletidae*	37	J=30b	Adults construct and provision soil or wood burrows with Myrtaceous pollen and honey.	Euryglossinae endemic with distinctive arid fauna
Apocrita	34	J=30b	Various guilds	Many endemic genera in moist temperate forests
Megastigminae	31	J=30b	Gallformers or parasitiods of gall insects.	Several endemic genera including Xenostigmus
Apocrita	29	J=30bf	Various guilds	Many endemic genera in moist temperate forests
Apocrita	39	J=30f	Various guilds	Many endemic genera in moist temperate forests
Apocrita	106	J=30f	Various guilds	Many endemic genera in moist temperate forests
Diapriidae	38	J=30f	Most endoparasitic in prepupal or pupal Diptera.	Ambostrinae have a Gondwanan distribution, several undescribed endemic genera
		J=30=10		
Apocrita	17	J>30b	Various guilds	Many endemic genera in moist temperate forests
Ichneumonidae*	13	J>30b	Parasitoids of larval insects, spiders and spider egg sacs.	Endemic and Gondwanan genera in southern Australia
Pteromalidae*	14	J>30b	Parasitoids of eggs, larvae and pupae of many insect orders	Many endemic genera associated with galls of Eucalypts and Acacias
		J>30b=3		
		J=16		
Apocrita	44	JK<30bf	Various guilds	Many endemic genera in moist temperate forests
		JK<30bf=1		
Apocrita	19	JK=30b	Various guilds	Many endemic genera in moist temperate forests
		JK=30b=1		
		JK=2		
Apocrita	51	K=11b	Various guilds	Many endemic genera in moist temperate forests
Apocrita	52	K=11b	Various guilds	Many endemic genera in moist temperate forests
Diapriidae	1	K=11bf	Most endoparasitic in prepupal or pupal Diptera.	Ambostrinae have a Gondwanan distribution, several undescribed endemic genera
		K=11=3		
Apocrita	45	K=30b	Various guilds	Many endemic genera in moist temperate forests
Apocrita	49	K=30f	Various guilds	Many endemic genera in moist temperate forests
		K=30=2		
		K=5		

Wasp Taxa:	Morpho Species Code:	Forest Type	Larval Trophic Guild:	Biogeographic Affinities:
Apocrita	46	TK>03bf	Various guilds	Many endemic genera in moist temperate forests
Scelionidae	48	TK>03bf	Parasitoids of the eggs of Orthoptera, Heteroptera, Coleoptera and spiders.	Cosmopolitan, endemic genera Crama, Jarabambius, Neoscelio, Mirobaeoides.
		TK>03bf=2		
Chrysididae	47	TK>11bf	Parasitise eggs of Phasmatodea and nests of Vespidae	76 Australian species with cosmopolitan and oriental affinities
		TK>11bf=1		
Apocrita	50	TK<30bf	Various guilds	Many endemic genera in moist temperate forests
		TK<30bf=1		
		TK=4		
Apocrita	53	T=03b	Various guilds	Many endemic genera in moist temperate forests
Mutillidae*	61	T=03bf	Parasitiods of Mostly solitary predators or cleptoparasites of various insect taxa , Vespidae and Apoidea	Endemic genera with affinities to South American genera
Apocrita	66	T=03f	Various guilds	Many endemic genera in moist temperate forests
Megaspilidae	68	T=03f	Parasitoids of Diptera and hyperparasitoids of Braconids	40 species in Australia associated with primitive diptera families
Apocita	112	TC=03b	Various guilds	Many endemic genera in moist temperate forests
Apocrita	70	TC=03b	Various guilds	Many endemic genera in moist temperate forests
Microgasterinae*	69	TC=03b	Endoparasitic on larvae of Lepidoptera	Cosmopolitan
Pergidae*	113	TC=03b	Phytophagus and leafmining larvae of mostly Myrtaceae	Many endemic genera in southern Australia with South American affinities
Apocrita	71	TC=03f	Various guilds	Many endemic genera in moist temperate forests
Apocrita	60	TR=03b	Various guilds	Many endemic genera in moist temperate forests
Braconidae	57	TR=03b	Parasitoids of most insect larvae	Four sub-families endemic with only 10 described species
Apocrita	63	TR=03f	Various guilds	Many endemic genera in moist temperate forests
Apocrita	65	TR=03f	Various guilds	Many endemic genera in moist temperate forests
Apocrita	67	TR=03f	Various guilds	Many endemic genera in moist temperate forests
		T=03=14		
Apocrita	64	T>03bf	Various guilds	Many endemic genera in moist temperate forests
Apocrita	72	T>03bf	Various guilds	Many endemic genera in moist temperate forests
Apocrita	73	T>03bf	Various guilds	Many endemic genera in moist temperate forests
Diapriidae	54	T>03bf	Most endoparasitic in prepupal or pupal Diptera.	Ambostrinae have a Gondwanan distribution, several undescribed endemic genera
Diapriidae	59	T>03bf	Most endoparasitic in prepupal or pupal Diptera.	Ambostrinae have a Gondwanan distribution, several undescribed endemic genera
Megaspilidae	55	T>03bf	Parasitoids of Diptera and hyperparasitoids of Braconids	40 species in Australia associated with primitive diptera families
Megaspilidae	110	T>03bf	Parasitoids of Diptera and hyperparasitoids of Braconids	40 species in Australia associated with primitive Diptera
Apocrita	62	T>03f	Various guilds	Many endemic genera in moist temperate forests
		T>03=8		
Apocrita	58	T<09bf	Various guilds	Many endemic genera in moist temperate forests
Megaspilidae	56	T<09bf	Parasitoids of Diptera and hyperparasitoids of Braconids	40 species in Australia associated with primitive diptera families
		T<09bf=2		

Wasp Taxa:	Morpho Species Code:	Forest Type	Larval Trophic Guild:	Biogeographic Affinities:
Apocrita	80	TC=09b	Various guilds	Many endemic genera in moist temperate forests
Braconidae	82	TC=09f	Parasitoids of most insect larvae	Four sub-families endemic with only 10 described species
Apocrita	74	TR=09b	Various guilds	Many endemic genera in moist temperate forests
Chrysididae	76	TR=09b	Parasitise eggs of Phasmatodea and nests of Vespidae	76 Australian species with cosmopolitan and oriental affinities
Apocrita	77	TR=09f	Various guilds	Many endemic genera in moist temperate forests
Thyninae*	78	TR=09f	Parasitise subterranean Coleoptera and Orthoptera	Subfamily largely in Australia and South America with many endemic genera
Thyninae	79	TR=09f	Parasitise subterranean Coleoptera and Orthoptera	Subfamily largely in Australia and South America with many endemic genera
		T=09=7		
Apocrita	75	T>09b	Various guilds	Many endemic genera in moist temperate forests
Apocrita	81	TC>09f	Various guilds	Many endemic genera in moist temperate forests
		T>09=2		
Apocrita	91	TC=61b	Various guilds	Many endemic genera in moist temperate forests
Apocrita	93	TC=61b	Various guilds	Many endemic genera in moist temperate forests
Apocrita	100	TC=61b	Various guilds	Many endemic genera in moist temperate forests
Braconidae	90	TC=61b	Parasitoids of most insect larvae	Four sub-families endemic with only 10 described species
Megaspilidae	92	TC=61b	Parasitoids of Diptera and hyperparasitoids of Braconids	40 species in Australia associated with primitive diptera families
Apocrita	3	TC=61f	Various guilds	Many endemic genera in moist temperate forests
Apocrita	94	TC=61f	Various guilds	Many endemic genera in moist temperate forests
Apocrita	95	TC=61f	Various guilds	Many endemic genera in moist temperate forests
Apocrita	96	TC=61f	Various guilds	Many endemic genera in moist temperate forests
Apocrita	102	TC=61f	Various guilds	Many endemic genera in moist temperate forests
Apocrita	103	TC=61f	Various guilds	Many endemic genera in moist temperate forests
Apocrita	104	TC=61f	Various guilds	Many endemic genera in moist temperate forests
Apocrita	109	TC=61f	Various guilds	Many endemic genera in moist temperate forests
Scelionidae	101	TC=61f	Parasitoids of the eggs of Orthoptera, Heteroptera, Coleoptera and spiders.	Cosmopolitan, endemic genera Crama, Jarabambius, Neoscelio, Mirobaeoides.
Evaniidae*	84	TR=61	Solitary parasitoids of oothecae of blattid and blattelid cockroaches	Cosmopolitan family more diverse in warmer regions
Apocrita	83	TR=61b	Various guilds	Many endemic genera in moist temperate forests
Apocrita	97	TR=61b	Various guilds	Many endemic genera in moist temperate forests
Diapriidae	98	TR=61bf	Most endoparasitic in prepupal or pupal Diptera.	Ambostrinae have a Gondwanan distribution, several undescribed endemic genera
Scelionidae	89	TR=61bf	Parasitoids of the eggs of Orthoptera, Heteroptera, Coleoptera and spiders.	Cosmopolitan, endemic genera Crama, Jarabambius, Neoscelio, Mirobaeoides.
Apocrita	86	TR=61f	Various guilds	Many endemic genera in moist temperate forests
Apocrita	88	TR=61f	Various guilds	Many endemic genera in moist temperate forests
Cynipoidea	87	TR=61f	Parasitoids of insects or in plant galls.	Cosmopolitan, endemic genera Thrasorus.
Cynipoidea	99	TR=61f	Parasitoids of insects or in plant galls.	Cosmopolitan, endemic genera Thrasorus.
Scelionidae	85	TR=61f	Parasitoids of the eggs of Orthoptera, Heteroptera, Coleoptera and spiders.	Cosmopolitan, endemic genera Crama, Jarabambius, Neoscelio, Mirobaeoides.
		T=61=24		
		T=57		
	Total	105		

Table 7: Spider (Araneae) morphospecies trapped from 12 sites in the forests of the Nornalup-Walpole National Park in November 1996. J = jarrah sites, K = karri, T = tingle sites; Time since fire = 0.2 year, = 03 years, = 09 years, =11 years, = 30 years and = 61 years. R = ridge sites and C = creek sites. Tree butt = b and forest floor = f.
Families trapped only at this forest type = **.

Taxa	Species Code	Forest Type	Trophic Guild	Biogeographic Affinities
Lycosidae	4	TJK>0.2bf	Medium nomadic predators	Cosmopolitan, many undescribed species.
Micropholcommatidae	8	TJK>0.2bf	Very small web predators	Cool temperate forests of southern Australia, in damp litter and moss on tree trunks, Gondwanan, many undescribed species.
Ctenidae	5	TJK>3bf	Medium nomadic predators	Cosmopolitan, many undescribed species.
Stiphidiidae	3	TJK>9bf	Medium web predators	Southern Australia, restricted Biami species in SW.
Ctenidae	10	TJK>9bf	Medium nomadic predators	Cosmopolitan, many undescribed species.
		TJK >0.2 - 9 =5		
Micropholcommatidae	7	TJ>0.2b	Very small web predators	Cool temperate forests of southern Australia
Salticidae	34	TJ>0.2bf	Aboreal nomadic predators	Cosmopolitan, many undescribed species
Zodariidae	37	TJ>0.2bf	Nomadic & burrowing predators	Widespread arid species and restricted species in wet forests.
Zoridae	60	TJ>0.2bf	Medium nomadic predators	Coastal Australia wide & Tasmania.
Salticidae	94	TJ>0.2bf	Aboreal nomadic predators	Cosmopolitan, many undescribed species
Gnaphosidae	28	TJ>9bf	Medium to small nomadic predators	Cosmopolitan, many undescribed species.
Araneae	22	TK>11bf	Araneae	Araneae
		TJ >0.2 - 11 =7		
Gnaphosidae	2	TK>3bf	Medium to small nomadic predators	Cosmopolitan, many undescribed species.
Araneae	25	TK>3bf	Araneae	Araneae
Stiphidiidae	31	TK>3bf	Medium web predators	Southern Australia, restricted species in SW.
Salticidae	12	TK>9bf	Aboreal nomadic predators	Cosmopolitan, many undescribed species
Pararchaeidae	39	TK>9bf	Very small nomadic predator	Species of Pararchaea in SW & SE cool temperate forests & at high altitudes in NE Australia
		TK >3 - 9 =5		
Orsolobidae	48	TK>30bf	Medium nomadic predators	Southern forests in moss, litter & logs, *Tasmanoonops australis*
		TK>30 =1		

Taxa	Species Code	Forest Type	Trophic Guild	Biogeographic Affinities
Salticidae	67	J=0.2b	Aboreal nomadic predators	Cosmopolitan, many undescribed species
Zodariidae	73	J=0.2b	Nomadic & burrowing predators	Widespread arid species and restricted species in wet forests.
Araneae	75	J=0.2b	Araneae	Araneae
Araneae	76	J=0.2b	Araneae	Araneae
Zodariidae	91	J=0.2b	Nomadic & burrowing predators	Widespread arid species and restricted species in wet forests.
Lycosidae	92	J=0.2b	Medium nomadic predators	Cosmopolitan, many undescribed species.
Salticidae	93	J=0.2b	Aboreal nomadic predators	Cosmopolitan, many undescribed species
Salticidae	95	J=0.2b	Aboreal nomadic predators	Cosmopolitan, many undescribed species
Gnaphosidae	96	J=0.2b	Medium to small nomadic predators	Cosmopolitan, many undescribed species.
Gnaphosidae	68	J=0.2bf	Medium to small nomadic predators	Cosmopolitan, many undescribed species.
		J=0.2 =10		
Corinnidae	64	J=30b	Medium nomadic predators	Widespread, many undescribed species.
Salticidae	65	J=30b	Aboreal nomadic predators	Cosmopolitan, many undescribed species
Araneae	69	J=30b	Araneae	Araneae
Gnaphosidae	70	J=30b	Medium to small nomadic predators	Cosmopolitan, many undescribed species.
Corinnidae	86	J=30f	Medium nomadic predators	Widespread, many undescribed species.
Miturgidae	87	J=30f	Medium nomadic predators	Widespread, many undescribed species.
Lycosidae	88	J=30f	Medium nomadic predators	Cosmopolitan, many undescribed species.
Gnaphosidae	89	J=30f	Medium to small nomadic predators	Cosmopolitan, many undescribed species.
Micropholcommatidae	90	J=30f	Very small web predators	Cool temperate forests of southern Australia
		J=30 =9		
Theridiosomatidae	78	K=30b	Very small sedentary web predators	Cosmopolitan, coastal Australia.
Araneae	80	K=30b	Araneae	Araneae
		K=30=2		
Anapidae**	56	T=3bf	Very Small web predators	Southern Australia, relict species in SW, in logs and tree hollows.
		T=3 =1		
Stiphidiidae	11	T>3b	Medium web predators	Southern Australia, restricted species in SW.
Gnaphosidae	32	T>3b	Medium to small nomadic predators	Cosmopolitan, many undescribed species.
Nemesiidae	1	T>3bf	Large open burrow predators	Undescribed endemic species of Chenistonia, Aname, Stanwellia and Teyl possible in damp shaded gullies.
Linyphiidae	13	T>3bf	Medium sedentary web predators	Cosmopolitan, endemic species in caves and raparian vegetation.
Araneae	14	T>3bf	Araneae	Araneae
Araneae	17	T>3bf	Araneae	Araneae
		T>3bf =6		

Taxa	Species Code	Forest Type	Trophic Guild	Biogeographic Affinities
Trochanteriidae	19	T>9bf	Medium nomadic predators	Widespread in semi-arid areas, many undescribed species.
Thomisidae	21	T>9bf	Medium sedentary predators.	Australia wide, species possibly restricted to particular flower species.
Micropholcommatidae	24	T>9f	Very small web predators	Cool temperate forests of southern Australia
		T>3 - 9 =9		
Actinopodidae	51	TC≈3b	Large solitary burrowing predators	Gondwanan distribution, 1 well known genera Missulena.
Gnaphosidae	52	TC≈3b	Medium to small nomadic predators	Cosmopolitan, many undescribed species.
Trochanteriidae	53	TC≈3b	Medium nomadic predators	Widespread in semi-arid areas, many undescribed species.
Tetragnathidae**	54	TC≈3b	Medium sedentary web predators	Found in raparian vegetation.
Ctenidae	57	TC≈3b	Medium nomadic predators	Cosmopolitan, many undescribed species.
Salticidae	58	TC≈3b	Aboreal nomadic predators	Cosmopolitan, many undescribed species
Micropholcommatidae	55	TC≈3bf	Very small web predators	Cool temperate forests of southern Australia
Ctenidae	59	TC≈3f	Medium nomadic predators	Cosmopolitan, many undescribed species.
Stiphidiidae	46	TC>3f	Medium web predators	Southern Australia, restricted species in SW.
Ctenidae	6	TC≈9b	Medium nomadic predators	Cosmopolitan, many undescribed species.
Araneidae	15	TC≈9b	Medium sedentary web predators	Cosmopolitan, many undescribed species.
Araneidae	16	TC≈9b	Medium sedentary web predators	Cosmopolitan, many undescribed species.
Lycosidae	18	TC≈9f	Medium nomadic predators	Cosmopolitan, many undescribed species.
Araneae	23	TC≈9f	Araneae	Araneae
Ctenidae	26	TC≈9f	Medium nomadic predators	Cosmopolitan, many undescribed species.
Gnaphosidae	27	TC≈9f	Medium to small nomadic predators	Cosmopolitan, many undescribed species.
Zoridae	29	TC≈9f	Medium nomadic predators	Coastal Austraila wide & Tasmania.
Stiphidiidae	30	TC≈9f	Medium web predators	Southern Australia, restricted species in SW.
		TC≈3 - 9 =18		
Salticidae	40	TC≈60b	Aboreal nomadic predators	Cosmopolitan, many undescribed species
Micropholcommatidae	83	TC≈60b	Very small web predators	Cool temperate forests of southern Australia
Araneae	84	TC≈60b	Araneae	Araneae
Ctenidae	41	TC≈60f	Medium nomadic predators	Cosmopolitan, many undescribed species.
Lycosidae	42	TC≈60f	Medium nomadic predators	Cosmopolitan, many undescribed species.
Ctenidae	43	TC≈60f	Medium nomadic predators	Cosmopolitan, many undescribed species.
Nicodamidae	44	TC≈60f	Medium sedentary web predators	Australia wide, Nicodamus has many undescribed species.
Nicodamidae	45	TC≈60f	Medium sedentary web predators	Australia wide, Nicodamus has many undescribed species.
		TC≈60 =8		

Taxa	Species Code	Forest Type	Trophic Guild	Biogeographic Affinities
Linyphiidae	61	TR=3bf	Medium sedentary web predators	Cosmopolitan, endemic species in caves and raparian vegetation.
Araneae	62	TR=3f	Araneae	Araneae
Araneae	63	TR=3f	Araneae	Araneae
Araneae	33	TR>3bf	Araneae	Araneae
Theridiidae	38	TR>3f	Medium sedentary web predators	Widespread, many undescribed species
Nemesiidae	9	TR=9b	Large open burrowed predators	Undescribed species of Chenistonia, Aname, Stanwellia & Teyl restricted to damp habitats.
Lycosidae	20	TR=9f	Medium nomadic predators	Cosmopolitan, many undescribed species.
Micropholcommatidae	35	TR=9f	Very small web predators	Cool temperate forests of southern Australia
Theridiidae	36	TR>9f	Medium sedentary web predators	Cosmopolitan, restricted species in Hadrotarsine & Phoroncidia
		TR=3 - 9 =9		
Salticidae	47	TR=60b	Aboreal nomadic predators	Cosmopolitan, many undescribed species
Linyphiidae	82	TR=60b	Medium sedentary web predators	Cosmopolitan, endemic species in caves and raparian vegetation.
Nemesiidae	49	TR=60b	Large open burrowed predators	Undescribed species of Chenistonia, Aname, Stanwellia & Teyl restricted to damp habitats.
Ctenidae	50	TR=60f	Medium nomadic predators	Cosmopolitan, many undescribed species.
		TR=60 =4		
Total Families:		21		
TOTAL SPECIES:		88		

Table 8: Mean abundance of Collembola morphospecies trapped from specific sites in the forests of the Nornalup-Walpole National Park in November 1996. J = jarrah sites, K = karri, T = tingle sites; Time since fire = 0.2 year, = 03 years, = 09 years, =11 years, = 30 years and = 61 years. R = ridge and slope sites and C = creek sites. Tree butt = b and forest floor = f.

Morph oSpp	Habitat	Site:	10a	10b	11a	11b	1a	2a	3a	4a	7a	7b	8a	8b
			Mean Abundance.............................											
1	b		0	2	1	2	5	1	1	0	1	0	0	0
1	f	TJKbf	2	1	1	0	0	0	0	4	1	0	1	0
11	b		3	6	0	7	0	0	2	0	1	0	0	0
11	f	TJK>0.2 bf	0	0	0	5	11	6	0	0	0	0	4	0
12	b		4	4	1	5	0	0	0	4	4	3	1	0
12	f	TJK>0.2 bf	3	1	2	2	2	1	4	2	5	1	2	1
5	b		4	2	0	0	4	0	0	3	2	0	0	0
5	f	TJK>0.2	0	1	0	1	0	1	1	0	0	0	0	0
2	b		0	0	5	5	2	0	0	6	0	0	0	5
2	f	TJK>09bf	8	1	7	9	4	0	1	7	0	0	0	4
		TJK>0.2 =5												
25	b		0	1	0	0	0	0	0	1	0	4	0	0
25	f	TK>03bf	0	5	0	1	0	0	0	0	0	0	0	0
		TK>03 =1												
14	b	TJ>0.2b	0	0	0	0	0	1	0	0	0	0	0	2
10	b		0	0	0	0	0	1	0	0	2	0	3	0
10	f	TJ>0.2bf	0	0	0	0	2	2	0	0	0	0	0	0
17	f	TJ>0.2f	0	0	0	2	0	1	0	0	0	0	0	0
		TJ>0.2 =3												
6	b	TJ>30b	0	1	0	2	1	0	0	0	0	0	0	0
8	b		0	0	0	0	1	0	0	0	0	0	0	0
8	f	TJ>30bf	0	0	0	4	0	0	0	0	0	0	0	0
		TJ>30 =2												
		TJ=5												
18	b		0	0	0	0	0	0	2	2	0	0	0	0
18	f	JK>0.2bf	0	0	0	0	0	2	0	0	0	0	0	0
		JK>0.2 =1												

Table 8: From pg 1.

Morph oSpp	Habitat	Site:	10a	10b	11a	11b	1a	2a	3a	4a	7a	7b	8a	8b
16	f	J=0.2f	0	0	0	0	0	1	0	0	0	0	0	0
4	b		0	0	0	0	5	0	0	0	0	0	0	0
4	f	J>0.2bf	0	0	0	0	0	4	0	0	0	0	0	0
19	f	J>0.2f	0	0	0	0	0	2	0	0	0	0	0	0
		J>0.2 =3												
3	b	J=30b	0	0	0	0	1	0	0	0	0	0	0	0
7	b	J=30b	0	0	0	0	1	0	0	0	0	0	0	0
9	b	J=30b	0	0	0	0	1	0	0	0	0	0	0	0
13	f	J=30f	0	0	0	0	1	0	0	0	0	0	0	0
		J=30bf =4												
		J =7												
20	b	K=11b	0	0	0	0	0	0	2	0	0	0	0	0
21	b	K=11b	0	0	0	0	0	0	2	0	0	0	0	0
26	b		0	0	0	0	0	0	0	1	0	0	0	0
26	f	K=11bf	0	0	0	0	0	0	0	2	0	0	0	0
		K=11 =3												
22	f	K=30f	0	0	0	0	0	0	2	0	0	0	0	0
23	f	K=30f	0	0	0	0	0	0	1	0	0	0	0	0
24	f	K=30f	0	0	0	0	0	0	1	0	0	0	0	0
		K=30 =3												
		K=6												
35	b	TC=03b	0	0	0	0	0	0	0	0	0	2	0	0
27	b		0	0	0	0	0	0	0	0	17	1	0	0
27	f	T=03bf	0	0	0	0	0	0	0	0	18	0	0	0
30	b	TR=03b	0	0	0	0	0	0	0	0	1	0	0	0
31	b	TR=03b	0	0	0	0	0	0	0	0	1	0	0	0
32	b	TR=03b	0	0	0	0	0	0	0	0	1	0	0	0
34	f	TR=03f	0	0	0	0	0	0	0	0	1	0	0	0
		T=03 =6												
28	b		22	11	0	15	0	0	0	0	38	7	1	0
28	f	T>03bf	7	1	2	3	0	0	0	0	19	0	0	0
29	b		0	0	0	0	0	0	0	0	1	0	0	0
29	f	T>03bf	0	0	0	1	0	0	0	0	0	0	0	0
33	b		1	0	0	0	0	0	0	0	0	0	0	0
33	f	T>03bf	0	0	0	1	0	0	0	0	1	0	0	0
		T>03 =3	0	0	0	0	0	0	0	0	0	0	0	

Table 8: from page 2.

Morph oSpp	Habitat	Site:	10a	10b	11a	11b	1a	2a	3a	4a	7a	7b	8a	8b
38	f	TC=9f	0	0	0	0	0	0	0	0	0	0	0	1
36	b		0	0	0	0	0	0	0	0	0	0	1	0
36	f	T>9bf	0	0	0	1	0	0	0	0	0	0	0	0
		T=11												
37	b		4	1	0	0	0	0	0	0	0	0	0	0
37	f	T=61bf	0	0	0	1	0	0	0	0	0	0	2	0
39	b		5	1	1	4	0	0	0	0	0	0	0	0
39	f	T=61bf	1	0	2	1	0	0	0	0	0	0	0	0
41	b		1	0	4	6	0	0	0	0	0	0	0	0
41	f	T=61bf	4	0	0	0	0	0	0	0	0	0	0	0
		T=61 =3												
43	b	TC=61b	0	3	0	0	0	0	0	0	0	0	0	0
44	b	TC=61b	0	1	0	0	0	0	0	0	0	0	0	0
45	b	TC=61b	0	4	0	0	0	0	0	0	0	0	0	0
46	b	TC=61b	0	1	0	0	0	0	0	0	0	0	0	0
51	b	TC=61b	0	0	0	1	0	0	0	0	0	0	0	0
52	b	TC=61b	0	0	0	6	0	0	0	0	0	0	0	0
53	b	TC=61b	0	0	0	1	0	0	0	0	0	0	0	0
50	b		0	0	0	1	0	0	0	0	0	0	0	0
50	f	TC=61bf	0	0	0	1	0	0	0	0	0	0	0	0
54	f	TC=61f	0	0	0	3	0	0	0	0	0	0	0	0
55	f	TC=61f	0	0	0	2	0	0	0	0	0	0	0	0
		TC=10												
40	b	TR=61b	1	0	0	0	0	0	0	0	0	0	0	0
47	b	TR=61b	0	0	1	0	0	0	0	0	0	0	0	0
42	f	TR=61f	1	0	0	0	0	0	0	0	0	0	0	0
48	f	TR=61f	0	0	2	0	0	0	0	0	0	0	0	0
49	f	TR=61f	0	0	1	0	0	0	0	0	0	0	0	0
		TR=5												
		T61=18												
Total:		**=54**												

Table 9: Fly (Diptera) morphospecies trapped from 12 sites in the forests of the Nornalup-Walpole National Park in November 1996. J = jarrah sites, K = karri, T = tingle sites; Time since fire = 0.2 year, = 03 years, = 09 years, =11 years, = 30 years and = 61 years. R = ridge sites and C = creek sites. Tree butt = b and forest floor = f.
Families trapped only at this forest type = **.

Diptera Taxa:	Morpho Species Code:	Site:	Number of Species:	Larval Trophic Guild:	Biogeographic Affinities:
Empididae	22	Jb	1	Litter predators & aquatic	Cosmopolitan, 3 genera with Gondwanan affinities
Ceratopogonidae	31	J=0.2b	1	Aquatic & rotting litter	1 endemic genus
Ephydridae	20	J=30bf		Stem & shoot borers of aquatic & land plants.	Cosmopolitan, Cosmopolitan, found in or near water
Therevidae**	27	J=30f	2	Soil predators	All but 2 genera endemic, origins unclear.
Jarrah Sites Total:		J TOT=	4		
Cecidomyiidae	39	Kf		Plant gall herbivores	Cosmopolitan, 1 endemic genus
Perissommatidae**	40	Kf	2	Fungivores	*Perissomma* only known genus with 5 species, Gondwanan origin
Cecidomyiidae	45	K=11b		Plant gall herbivores	Cosmopolitan, 1 endemic genus
Mycetophilidae	47	K=11f		Fungivores	10 Endemic genera, including Panagean & Gondwanan groups.
Tipulidae	48	K=11f	3	Moist soil & rotting vegetation, possible decomposers	Cosmopolitan, 14 endemic genera some with Gondwanan affinities
Ceratopogonidae	34	K=30b		Moist & rotting litter	1 endemic genus
Ephydridae	41	K=30f		Stem & shoot herbivores	Cosmopolitan, found in or near water
Phoridae	142	K=30f	3	Decomposers, saprophages & ant parasitoids	Cosmopolitan
Karri Sites Totals:		K TOT	8		
Chironomidae	17	Tbf		Aquatic bottom feeders	Cosmopolitan, 12 endemic genera, *Archaeochlus* from W.A. and S. Africa
Phoridae	49	Tbf	2	Decomposers, saprophages & ant parasitoids	Cosmopolitan
Agromyzidae**	71	T= 03f		Leaf- or stem-miners & gall makers	Cosmopolitan, 13 genera present in Australia, 80% of species endemic
Phoridae	63	T= 03b		Decomposers, saprophages & ant parasitoids	Cosmopolitan
	64	T= 03bf			
	80	T= 03f			
	94	T= 03f			
Sciaridae	50	T= 03bf	6	Found in rotting vegetation, possible decomposers	Cosmopolitan, Australian fauna not well known
Chironomidae	68	T= 03Cb		Aquatic bottom feeders	Cosmopolitan, 12 endemic genera, *Archaeochlus* from W.A. and S. Africa
Dolichopodidae**	72	T= 03Cf		Mostly predators	Cosmopolitan, species of *Sympychus* with Gondwanan affinities.
Empididae	70	T= 03Cf		Litter predators	Cosmopolitan, 3 genera with Gondwanan affinities
Mycetophilidae	67	T= 03Cb		Fungivores	10 Endemic genera, including Panagean & Gondwanan groups

Table 9: continued from pg 1:

Diptera Taxa:	Morpho Species Code:	Site:	Number of Species:	Larval Trophic Guild:	Biogeographic Affinities:
Phoridae	57	T= 03Cb		Decomposers, saprophages & ant parasitoids	Cosmopolitan
	60	T= 03Cb			
	61	T= 03Cb			
	65	T= 03Cb			
	66	T= 03Cb			
	69	T= 03Cf			
Sciaridae	62	T= 03Cb		Found in rotting vegetation, possible decomposers	Cosmopolitan, Australian fauna not well known
Unident. Larva	73	T= 03Cf	12		
Cecidomyiidae	91	T= 03Rf		Plant gall herbivores	Cosmopolitan, 1 endemic genus
Phoridae	95	T= 03Rf		Decomposers, saprophages & ant parasitoids	Cosmopolitan
	96	T= 03Rf			
	97	T= 03Rf			
Sciaridae	90	T= 03Rf		Found in rotting vegetation, possible decomposers	Cosmopolitan, Australian fauna not well known
Tipulidae	92	T= 03Rf		Moist soil & rotting vegetation, possible decomposers	Cosmopolitan, 14 endemic genera some with Gondwanan affinities
Unident. Larva	93	T= 03Rf	7		
Ephydridae	81	T= 09f		Stem & shoot herbivores	Cosmopolitan, found in or near water
Mycetophilidae	9	T= 09f	2	Fungivores	10 Endemic genera, including Panagean & Gondwanan groups.
Sciaridae	85	T= 09Rb	1	Found in rotting vegetation, possible decomposers	Cosmopolitan, Australian fauna not well known
Sciaridae	74	T= 09C		Found in rotting vegetation, possible decomposers	Cosmopolitan, Australian fauna not well known
	10	T= 09Cf			
Unident. Larva	84	T= 09Cf		Unident. Larva	Unident. Larva
Cecidomyiidae	78	T= 09Cb		Plant gall herbivores	Cosmopolitan, 1 endemic genus
Ceratopogonidae	76	T= 09Cb		Moist & rotting litter	1 endemic genus
Chironomidae	82	T= 09Cf		Aquatic bottom feeders	Cosmopolitan, 12 endemic genera, Archaeochlus from W.A. and S. Africa
Phoridae	75	T= 09Cb		Decomposers, saprophages & ant parasitoids	Cosmopolitan
Sciaridae	77	T= 09Cb		Found in rotting vegetation, possible decomposers	Cosmopolitan, Australian fauna not well known
Unident. Larva	79	T= 09Cb	9	Unident. Larva	Unident. Larva
Mycetophilidae	83	T= 09Rf		Fungivores	10 Endemic genera, including Panagean & Gondwanan groups.
Phoridae	89	T= 09Rf		Decomposers, saprophages & ant parasitoids	Cosmopolitan
Sciaridae	87	T= 09Rf		Found in rotting vegetation, possible decomposers	Cosmopolitan, Australian fauna not well known
	88	T= 09Rf	4		
Tingle Sites: (< 9 years after fire)		T< 09	41		

Table 9: continued from pg 2.

Diptera Taxa:	Morpho Species Code:	Site:	Number of Species:	Larval Trophic Guild:	Biogeographic Affinities:
Cecidomyiidae	100	T=61		Plant gall herbivores	Cosmopolitan, 1 endemic genus
Phoridae	107	T=61		Decomposers, saprophages & ant parasitoids	Cosmopolitan
Syrphidae**	110	T=61f	3	Decomposers & predators	Cosmopolitan
Cecidomyiidae	44	T=61Cb		Plant gall herbivores	Cosmopolitan, 1 endemic genus
	130	T=61Cb			
Ceratopogonidae	111	T=61Cb		Moist & rotting litter	1 endemic genus
Empididae	124	T=61Cf		Litter predators	Cosmopolitan, 3 genera with Gondwanan affinities
Phoridae	118	T=61Cf		Decomposers, saprophages & ant parasitoids	Cosmopolitan
	119	T=61Cf			
	120	T=61Cf			
	121	T=61Cf			
	122	T=61Cf			
	123	T=61Cf			
Sciaridae	13	T=61Cb		Found in rotting vegetation, possible decomposers	Cosmopolitan, Australian fauna not well known
	51	T=61Cb			
	114	T=61Cf			
	116	T=61Cb			
	117	T=61Cf			
	131	T=61Cb			
	133	T=61Cb			
Unident. Larvae	134	T=61Cb			
	135	T=61Cb			
	136	T=61Cb			
	137	T=61Cb	21		

Table 9: continued from pg 3.

Diptera Taxa:	Morpho Species Code:	Site:	Number of Species:	Larval Trophic Guild:	Biogeographic Affinities:
Bibionidae**	128	T=61R		Decomposers in soil & rotting vegetation	Largely Gondwanan distribution, with some tropical genera.
Cecidomyiidae	105	T=61Rf		Plant gall herbivores	Cosmopolitan, 1 endemic genus
Chironomidae	125	T=61R		Aquatic bottom feeders	Cosmopolitan, 12 endemic genera, *Archaeochlus* from W.A. and S. Africa
	126	T=61R			
Ephydridae	108	T=61Rf		Stem & shoot herbivores	Cosmopolitan, found in or near water
	127	T=61R			
Phoridae	104	T=61Rf		Decomposers, saprophages & ant parasitoids	Cosmopolitan
	106	T=61Rf			
Scatopsidae**	102	T=61Rf		Found in dung & rotting vegetation	Cosmopolitan, *Austroclemina* & *Hawomersleya* endemic
Sciaridae	101	T=61Rb		Found in rotting vegetation, possible decomposers	Cosmopolitan, Australian fauna not well known
Stratiomyidae**	99	T=61Rb		Found in moist soil and rotting vegetation	Cosmopolitan, including Gondwanan group
Tipulidae	109	T=61Rf		Moist soil & rotting vegetation, possible decomposers	Cosmopolitan, 14 endemic genera some with Gondwanan affinities
Unident. Larvae	98	T=61Rb			
	129	T=61Rf	14		
Tingle Sites: (61 years after fire)		T=61	38		

Table 9: continued from pg 4.

Diptera Taxa:	Morpho Species Code:	Site:	Number of Species:	Larval Trophic Guild:	Biogeographic Affinities:
Chironomidae	14	TJK		Aquatic bottom feeders	Cosmopolitan, 12 endemic genera, *Archaeochlus* from W.A. and S. Africa
	25	TJK			
Ephydridae	19	TJK		Stem & shoot herbivores	Cosmopolitan, found in or near water
Phoridae	6	TJK		Decomposers, saprophages & ant parasitoids	Cosmopolitan
	21	TJK			
	53	TJK			
Psychodidae	11	TJK		Decomposers in dung & rotting vegetation	Cosmopolitan, rare genera *Nemopalpus*, *Sycorax* & *Trichomyia*
	23	TJK			
Sciaridae	1	TJK		Found in rotting vegetation, possible decomposers	Cosmopolitan, Australian fauna not well known
	8	TJK			
	16	TJK			
	24	TJK			
	30	TJK			
	37	TJKb			
	46	TJK			
Tachinidae	26	TJKf		Host specific endo-parasitoids of insect herbivores.	Cosmopolitan, may reflect uncommon host distributions
Tipulidae	32	TJK		Moist soil & rotting vegetation, possible decomposers	Cosmopolitan, 14 endemic genera some with Gondwanan affinities
	33	TJK			
Unident. Larva	38	TJKb			
	52	TJK			
	59	TJK			
	7	TJK			
Unident. Fly	3	TJK			
Tingle, Jarrah & Karri Sites:		TJK=	23		
Total Families at All Sites:			20		
Total Species at All Sites:			116		

Table 10: The mean abundance of Trichoptera morphospecies trapped from specific sites in the forests of the Nornalup-Walpole National Park in November 1996. J = jarrah sites, K = karri, T = tingle sites; Time since fire = 0.2 year, = 03 years, = 09 years, =11 years, = 30 years and = 61 years. r = ridge sites and c = creek sites. Tree butt = b and forest floor = f.

Forest Type:			Tr	Tc	Tr	Tc	J	J	K	K	T	T	Tr	Tc	
Post Fire Years:			61	61	61	61	30	.2	30	11	3	3	9	9	
Morpho Spp.	Habitat	Forest Type	10 a	10 b	11 a	11 b	1a	2a	3a	4a	7a	7b	8a	8b	Grand Total
1	1b			1			1				1				3
	1f							2							2
	2b						1					1			2
	2f					1									1
1 Total		**TJrcbf >0.2**		1		1	2	2			1	1			8
2	2b						1			1		1			3
2 Total		**TJKrcb>3**					1			1		1			3
3	1b		1					1			1				3
	1f					1		1			1		1		4
	2b									1		1			2
	2f										1		1		2
3 Total		TJKrc>3	1			1		2		1	3	1	2		**11**

Forest Type:			Tr	Tc	Tr	Tc	J	J	K	K	T	T	Tr	Tc	
Post Fire Years:			61	61	61	61	30	.2	30	11	3	3	9	9	
Morpho Spp.	Habitat	Forest Type	10 a	10 b	11 a	11 b	1a	2a	3a	4a	7a	7b	8a	8b	Grand Total
4	1b		1						1						2
	1f								1						1
	2b									1					1
4 Total		**TKrbf > 11**	1						2	1					4
5	1b		1												1
	1f								1						1
	2b									1					1
5 Total		**TKrbf > 11**	1						1	1					3
6	2b											1			1
6 Total		**Tcb = 3**										1			**1**
7	2f												1		1
7 Total		**Trf = 9**											1		**1**
8	1b										1				1
	2f												1		1
8 Total		**Trbf = 3 to 8**									1		1		2
9	2b		1												1
	2f			1											1
9 Total		**Trcbf = 61**	1	1											2
10	2b		1												1
10 Total		**Trb = 61**	1												1
Grand Total		**= 10spp.**	7	4	4	4	5	6	5	5	8	7	8	4	67

Table 11: Beetle (Coleoptera) morphospecies trapped from 12 sites in the forests of the Nornalup-Walpole National Park in November 1996. J = jarrah sites, K = karri, T = tingle sites; Time since fire = 0.2 year, = 03 years, = 09 years, =11 years, = 30 years and = 61 years. R = ridge sites and C = creek sites. Tree butt = b and forest floor = f. Families trapped only at this forest type = **. #adapted from Insects of Australia, CSIRO (1991).

Beetle Taxa:	Morphio Species Code:	Forest Type:	Larval Trophic Guild:#	Biogeographic Affinities:#
Pselaphidae	542	JKT=3-30bf	Most predators with afew fungal feeders	900 known Australian species, Tiracerus ant specialists
JKT<30 years		=1 species		
Carabidae	492	JKT=3-61bf	Mostly predatory	Migadopini rare in Australia with southern temperate affinities
Staphylinidae	377	JKT=2-61bf	Most predatory or fungal feeders	Oxypius peckorum flightless relict from south-west W.A..
JKT <61 years		=2 species		
Amycterine	575	J=.2f	Live in soil and feed on underground stems of Poaceae and Liliaceae	All species endemic to Australia
	581	J=.2b		
Carabidae	576	J=.2f	Mostly predatory	Migadopini rare in Australia with southern temperate affinities
	579	J=.2bf		
	582	J=.2b		
Chrysomelidae	577	J=.2f	All known species are plant feeders	About 3000 known Australian species, specialized Cryptocephalinae and Chrysomelinae species that feed on Nothofagus, Eucalyptus and Acacia leaves and flowers
	585	J=.2b		
	586	J=.2b		
Corylophidae	281	J=.2bf	Some species feed on fungal spores in leaf litter, dead grass and rotten logs	3 subfamilies in Australia containing about 60 known species
Curculionidae	578	J=.2f	Below ground or internal feeders on plant parts	6000 Australian species, many species specific to relic plant groups such as cycads, Araucaria and Xanthorrhoea
	580	J=.2f		
Scydmaenidae	195	J=0.2f	Predators which capture small litter organisms, such as mites, using an adhesive organ	Represented in Australia by about 300 known species. Scydmaenids found in leaf litter, rotten wood, moss, tree holes, sawdust piles and ant nests.
Staphylinidae	583	J=.2b	Most predatory or fungal feeders	Oxypius peckorum flightless relict from south-west W.A..
	584	J=.2b		
J=0.2bf years		=14 species		
Nitidulidae	402	J=.2-30bf	Both predators and plant feeders	About 300 species known for Australia, some found in cones of relic plants such as cycads and Araucaria, others found in leaf litter, rotten fruits and tree wounds. Cychramptodes and Cybocephalus prey on Australian scale insects (Coccoidea).
Staphylinidae	301	J=.2-30bf	Most predatory or fungal feeders	Oxypius peckorum flightless relict from south-west W.A..
J<30 years		=2 species		

Amycterine	513	J=30f	Live in soil and feed on underground stems of Poaceae and Liliaceae	All species endemic to Australia
	592	J=30f		
Chrysomelidae	588	J=30b	All known species are plant feeders	About 3000 known Australian species, specialized Cryptocephalinae and Chrysomelinae species that feed on Nothofagus, Eucalyptus and Acacia leaves and flowers
Curculionidae	587	J=30b	Below ground or internal feeders on plant parts	6000 Australian species, many species specific to relic plant groups such as cycads, Araucaria and Xanthorrhoea
	589	J=30b		
	593	J=30f		
	594	J=30f		
Mycteridae	590	J=30b	Occur under tree bark or in leaf axils and dead fronds of monocotyledonous plants	20 known species in Australia, species of Hemipeplinae breed in the axils of monocots such as Lomandra. Species of Lacconotinae have gondwanan affinities with species in Chile.
Staphylinidae	472	J=30b	Most predatory or fungal feeders	Oxypius peckorum flightless relict from south-west W.A..
J=30 years		**=9 species**		
J Total Species		**=28 species**		
Nitidulidae	572	JTR=.2-9f	Both predators and plant feeders	About 300 species known for Australia, some found in cones of relic plants such as cycads and Araucaria, others found in leaf litter, rotten fruits and tree wounds. Cychramptodes and Cybocephalus prey on Australian scale insects (Coccoidea).
JTR=.2-9 years		**=1 species**		
Carabidae	266	JTC=3-61b	Mostly predatory	Migadopini rare in Australia with southern temperate affinities
JT>3 years		**=1 species**		
Cryptocephalinae	528	JT=9-61bf	Unusual chrysomelid subfamily as larvae live in a portable case constructed of faeces and debris and feed on dead leaves in the litter layer	Extensive species radiation, possibly host plant specific, with 500 known Australian species, the adult beetles primarily feed on Eucalyptus and Acacia foliage
Elateridae	515	JT=9-61bf	Saprophagous species on rotten wood, phytophagous species on plant roots and predatious species on wood boring beetles	800 known Australian species, Crepidomenus is a large genera with a Bassian distribution
JT>9 years		**=2 species**		
Corylophidae	595	JTC=30-61bf	Some species feed on fungal spores in leaf litter, dead grass and rotten logs	3 subfamilies in Australia containing about 60 known species
Mycteridae	246	JTR=30-61bf	Occur under tree bark or in leaf axils and dead fronds of monocotyledonous plants	20 known species in Australia, species of Hemipeplinae breed in the axils of monocots such as Lomandra. Species of Lacconotinae have gondwanan affinities with species in Chile.
Nitidulidae	568	JTR=30-61bf	Both predators and plant feeders	About 300 species known for Australia, some found in cones of relic plants such as cycads and Araucaria, others found in leaf litter, rotten fruits and tree wounds. Cychramptodes and Cybocephalus prey on Australian scale insects (Coccoidea).
JT>30 years		**=3 species**		
Pselaphidae	250	JK=30bf	Most predators with afew fungal feeders	900 known Australian species, Tiracerus ant specialists
JK=30 years		**=1 species**		

Amycterine	607	K=11b	Live in soil and feed on underground stems of Poaceae and Liliaceae	All species endemic to Australia
Carabidae	520	K=11bf	Mostly predatory	Migadopini rare in Australia with southern temperate affinities
Curculionidae	606	K=11b	Below ground or internal feeders on plant parts	6000 Australian species, many species specific to relic plant groups such as cycads, Araucaria and Xanthorrhoea
Nitidulidae	609	K=11b	Both predators and plant feeders	About 300 species known for Australia, some found in cones of relic plants such as cycads and Araucaria, others found in leaf litter, rotten fruits and tree wounds. Cychramptodes and Cybocephalus prey on Australian scale insects (Coccoidea).
Pselaphidae	610	K=11b	Most predators with afew fungal feeders	900 known Australian species, Tiracerus ant specialists
Staphylinidae	608	K=11b	Most predatory or fungal feeders	Oxypius peckorum flightless relict from south-west W.A..
K=11 years		= 6 species		
Curculionidae	600	K=11-30bf	Below ground or internal feeders on plant parts	6000 Australian species, many species specific to relic plant groups such as cycads, Araucaria and Xanthorrhoea
	535	K=11-30f		
	601	K=11-30f		
K=11-30 years		= 3 species		
Chrysomelidae	602	K=30f	All known species are plant feeders	About 3000 known Australian species, specialized Cryptocephalinae and Chrysomelinae species that feed on Nothofagus, Eucalyptus and Acacia leaves and flowers
	603	K=30f		
Curculionidae	529	K=30b	Below ground or internal feeders on plant parts	6000 Australian species, many species specific to relic plant groups such as cycads, Araucaria and Xanthorrhoea
	597	K=30b		
	598	K=30f		
Pselaphidae	604	K=30f	Most predators with afew fungal feeders	900 known Australian species, Tiracerus ant specialists
Scarabaeidae	596	K=30b	Live in concealed habitats, feeding on roots, dung or decaying vegetable matter	3000 known Australian species, extensive radiation with habitat specific species on endemic plants, Marsupial dung and rotten wood
	599	K=30f		
Staphylinidae	141	K=30f	Most predatory or fungal feeders	Oxypius peckorum flightless relict from south-west W.A..
	481	K=30f		
K=30 years		= 10 species		
K Total Species		=19 species		
Leiodidae**	558	KTC=3-11f	Scavengers and fungal feeders, abundant in decaying organic matter, carrion, dung and fungal fruiting bodies	135 known Australian species
Mycetophagidae	498	KTR=3-11bf	Fungal feeders in rotten wood or fungal fruiting bodies	10 known Australian species, Litargus includes several endemic species
KT=3-11 years		=2 species		
Carabidae	560	KT=3-30f	Mostly predatory	Migadopini rare in Australia with southern temperate affinities
KT=3-30 years		= 1 species		

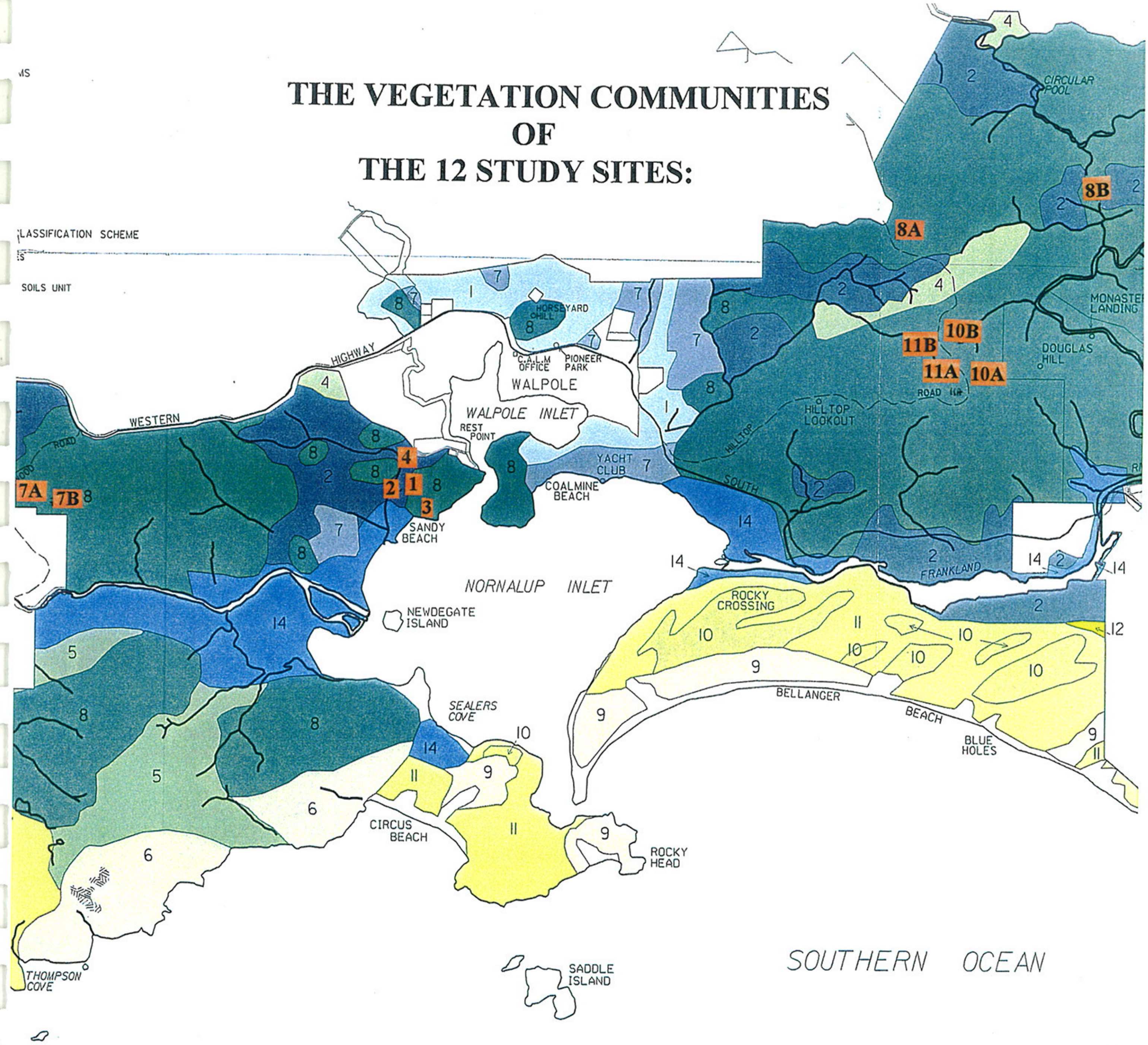
**Biphyllidae	499	KT=3-61bf	Found under fermenting bark or leaf bases and in fungal fruiting bodies	35 known Australian species
Cryptocephalinae	254	KT=3-61bf	Unusual chrysomelid subfamily as larvae live in a portable case constructed of faeces and debris and feed on dead leaves in the litter layer	Extensive species radiation, possibly host plant specific, with 500 known Australian species, the adult beetles primarily feed on Eucalyptus and Acacia foliage
Curculionidae	493	KT=3-61bf	Below ground or internal feeders on plant parts	6000 Australian species, many species specific to relic plant groups such as cycads, Araucaria and Xanthorrhoea
Melolonthinae	530	KT=3-61bf	Most species feed on plant roots and decaying matter. Adults have a synchronised emergence from the soil pupation cell following rain	Speciose subfamily of the Scarabaeidae, possibly as a result of extensive radiation due to synchronised adult emmergence and congregation on flowering trees to feed and mate
Nitidulidae	282	KT=3-61bf	Both predators and plant feeders	About 300 species known for Australia, some found in cones of relic plants such as cycads and Araucaria, others found in leaf litter, rotten fruits and tree wounds. Cychramptodes and Cybocephalus prey on Australian scale insects (Coccoidea).
KT=3-61 years		**= 5 species**		
Curculionidae	611	KTC=11-61f	Below ground or internal feeders on plant parts	6000 Australian species, many species specific to relic plant groups such as cycads, Araucaria and Xanthorrhoea
**Geotrupidae	521	KTC=11-61f	Live in burrow dug by adults and provisioned with hypogean fungi, decaying organic matter or dung	140 known Australian species
Staphylinidae	570	KTR=11-61f	Most predatory or fungal feeders	Oxypius peckorum flightless relict from south-west W.A..
KT=11-61 years		**= 3 species**		
Staphylinidae	605	KTC=30-61f	Most predatory or fungal feeders	Oxypius peckorum flightless relict from south-west W.A..
KT=30-61 years		**= 1 species**		

Carabidae	545	TR=3bf	Mostly predatory	Migadopini rare in Australia with southern temperate affinities
Chrysomelidae	548	TR=3f	All known species are plant feeders	About 3000 known Australian species, specialized Cryptocephalinae and Chrysomelinae species that feed on Nothofagus, Eucalyptus and Acacia leaves and flowers
	549	TR=3f		
Colydiidae**	555	TC=3f	Most species fungal feeders under bark, in rotten wood and in leaf litter	120 known Australian species, some associated with moss or lichens
Curculionidae	552	T=3b	Below ground or internal feeders on plant parts	6000 Australian species, many species specific to relic plant groups such as cycads, Araucaria and Xanthorrhoea
	557	TC=3f		
	561	TC=3b		
Languriidae**	551	TR=3f	Some species stem-bores, others pollen and spore feeders in leaf litter and decaying vegetation	30 known Australian species, some feed on the pollen of cycads
Melandryidae**	554	TR=3b	Possible fungal feeders	50 known Australian species, found in dead wood or durable fruiting bodies of Basidiomycetes
Nitidulidae	392	TC=3b	Both predators and plant feeders	About 300 species known for Australia, some found in cones of relic plants such as cycads and Araucaria, others found in leaf litter, rotten fruits and tree wounds. Cychramptodes and Cybocephalus prey on Australian scale insects (Coccoidea).
Phycosecidae**	559	TC=3f	Scavengers, along coastlines on carrion such as dead birds and fish	3 known Australian species, Phycosecis ammophila on west coast, P. littoralis along south and south-east coast and P. hilli north-east Queensland coast
Ptiliidae	553	TR=3b	Most species fungal feeders	75 known Australian species, found in decaying organic matter, seaweed, leaf litter, dung, rotten logs and tree holes
Scarabaeidae	550	TR=3f	Live in concealed habitats, feeding on roots, dung or decaying vegetable matter	3000 known Australian species, extensive radiation with habitat specific species on endemic plants, Marsupial dung and rotten wood
Staphylinidae	546	T=3bf	Most predatory or fungal feeders	Oxypius peckorum flightless relict from south-west W.A..
	547	T=3bf		
	562	TC=3b		
T=3 years		**=16 species**		
Sphindidae**	556	T=3-9f	Feed on the spores of slime moulds (Myxomycetes)	8 known Australian species, an undescribed genus occurs in Tasmania and Victoria
T=3-9 years		**=1 species**		
Hydrophilidae	252	T=3-61bf	Predacious in decaying vegeteable matter, dung, carrion and damp soil	175 known Australian species, the endemic genus Notocercyon includes species which are abundant in forest litter
T=3-61 years		**=1 species**		
Carabidae	500	TR=9b	Mostly predatory	Migadopini rare in Australia with southern temperate affinities
	500	TR=9b		
	537	TC=9b		
	543	TC=9b		
Chrysomelidae	541	TC=9b	All known species are plant feeders	About 3000 known Australian species, specialized Cryptocephalinae and Chrysomelinae species that feed on Nothofagus, Eucalyptus and Acacia leaves and flowers
Cryptorhynchinae	494	TR=9b	Many species feed on the seed pods of Acacia	A large subfamily of the Curculionidae, possible extensive species radiation with their hosts the Acacia
	494	TR=9b		
	495	TR=9b		
	495	TR=9b		
Curculionidae	538	TC=9b	Below ground or internal feeders on plant parts	6000 Australian species, many species specific to relic plant groups such as cycads, Araucaria and Xanthorrhoea

Hydrophilidae	479	TC=9b	Predacious in decaying vegeteable matter, dung, carrion and damp soil	175 known Australian species, the endemic genus Notocercyon includes species which are abundant in forest litter
	540	TC=9b		
Melyridae**	573	TR=9f	Scavengers or predators of insect eggs	300 known Australian species, possible habitat or host specificity due to Australia wide distribution and adult habit of feeding on pollen
	573	TR=9f		
Mycetophagidae	574	TR=9f	Fungal feeders in rotten wood or fungal fruiting bodies	10 known Australian species, Litargus includes several endemic species
	574	TR=9f		
Staphylinidae	31	TC=9b	Most predatory or fungal feeders	Oxypius peckorum flightless relict from south-west W.A..
	539	TC=9b		
T=9 years		= 19 species		
Carabidae	491	T=9-61bf	Mostly predatory	Migadopini rare in Australia with southern temperate affinities
	514	T=9-61bf		
Nitidulidae	375	TC=9-61bf	Both predators and plant feeders	About 300 species known for Australia, some found in cones of relic plants such as cycads and Araucaria, others found in leaf litter, rotten fruits and tree wounds. Cychramptodes and Cybocephalus prey on Australian scale insects (Coccoidea).
	496	T=9-61bf		
	497	T=9-61bf		
T>9 years		= 5 species		

Carabidae	364	TC=61f	Mostly predatory	Migadopini rare in Australia with southern temperate affinities
	563	TR=61b		
Cleridae**	613	TC=61f	Most species are predators of insects associated with bark or wood	350 known Australian species, little known of the biology of many species
Curculionidae	421	TR=61b	Below ground or internal feeders on plant parts	6000 Australian species, many species specific to relic plant groups such as cycads, Araucaria and Xanthorrhoea
	565	TR=61b		
	567	TR=61b		
	571	TC=61f		
	612	TC=61f		
	615	TC=61b		
	618	TR=61b		
Elateridae	279	TC=61b	Saprophagous species on rotten wood, phytophagous species on plant roots and predatious species on wood boring beetles	800 known Australian species, Crepidomenus is a large genera with a Bassian distribution
Mycetophagidae	369	TC=61f	Fungal feeders in rotten wood or fungal fruiting bodies	10 known Australian species, Litargus includes several endemic species
Nitidulidae	564	TR=61b	Both predators and plant feeders	About 300 species known for Australia, some found in cones of relic plants such as cycads and Araucaria, others found in leaf litter, rotten fruits and tree wounds. Cychramptodes and Cybocephalus prey on Australian scale insects (Coccoidea).
	569	TR=61f		
Pselaphidae	524	TC=61f	Most predators with afew fungal feeders	900 known Australian species, Tiracerus ant specialists
	616	T=61bf		
	617	TC=61b		
	621	TR=61bf		
Ptiliidae	566	TR=61b	Most species fungal feeders	75 known Australian species, found in decaying organic matter, seaweed, leaf litter, dung, rotten logs and tree holes
	620	TR=61b		
Staphylinidae	409	TC=61f	Most predatory or fungal feeders	Oxypius peckorum flightless relict from south-west W.A.
	619	TR=61b		
	622	TC=61b		
T=61 years		=23 species		
T Total		=65 species		
Total Richness		=135 species		

THE VEGETATION COMMUNITIES OF THE 12 STUDY SITES:



Site No.	Forest Type:	Time Since Fire:	Location:
1)	1x Jarrah	unburnt 30 yrs (65/66)	Sandy Beach Rd.(South)
2)	1x Jarrah	burnt Nov. 96 (84/85)	Sandy Beach Rd.(North)
3)	1x Karri	unburnt 30 yrs (65/66)	Sandy Beach Walk Track
4)	1x Karri	to be burnt (84/85)	Rest Point Rd.
7A)	1 xTingle(Upland)	3 years(93/94)	Delta Rd.
7B)	1 xTingle(Creek)	3 years(93/94)	Delta Rd.
8A)	1 x Tingle(Upland)	9 years(87WF)	Creek Rd.
8B)	1 x Tingle(Creek)	9 years(87WF)	Allen Rd.
10A)	1 x Tingle (Upland)	unburnt 60 yrs(37)	Douglas Hill.
10B)	1 x Tingle (Creek)	unburnt 60 yrs(37)	Douglas Hill.
11A)	1 x Tingle(Upland)	unburnt 60 yrs	Douglas Hill
11B)	1 x Tingle(Upland)	unburnt 60 yrs	Douglas Hill

Fig. 1: The vegetation communities and post-fire age of the 12 study sites in the Walpole-Nornalup National Park.

EARLY POST-FIRE VEGETATION STRUCTURE

Fig. 2: Site 7A, Hill top Tingle forest 3 years after a prescribed fire. Note the dense *Acacia* regeneration following the fire.

FIRE REFUGES AT EARLY POST-FIRE SITE

Fig. 3: Site 7A, Refuge microhabitat protected under decaying log, the scorched upper surfaces are extensively colonised by mosses 3 years after the prescribed fire.

MID POST-FIRE VEGETATION STRUCTURE

Fig. 4: Site 8B, Creek line Tingle forest 9 years after a wildfire. The understorey has reached maximum height, and competition appears to be causing death and thinning of the dense *Acacia* stems.

LATE POST-FIRE VEGETATION STRUCTURE

Fig. 5: Site 11A, Another hill top Tingle forest 60 years after a wildfire. A deep litter layer covers the forest floor, the understorey is very open with large clumps of sedges, while extensive moss swards are present on decaying logs and tree butts.

A DEEP LITTER PITFALL TRAP AT THE BUTT OF A TINGLE TREE

Figure 6. An operational pitfall trap with litter exclusion mesh tube, near the butt of a co-dominant tingle tree at site 7A approximately three years after a prescribed fire.

Fig.7: The Species Richness of Litter Invertebrates on the Forest Floor and around the Butts of Forest Trees occurring on Slopes and Hill Tops, Nov.96

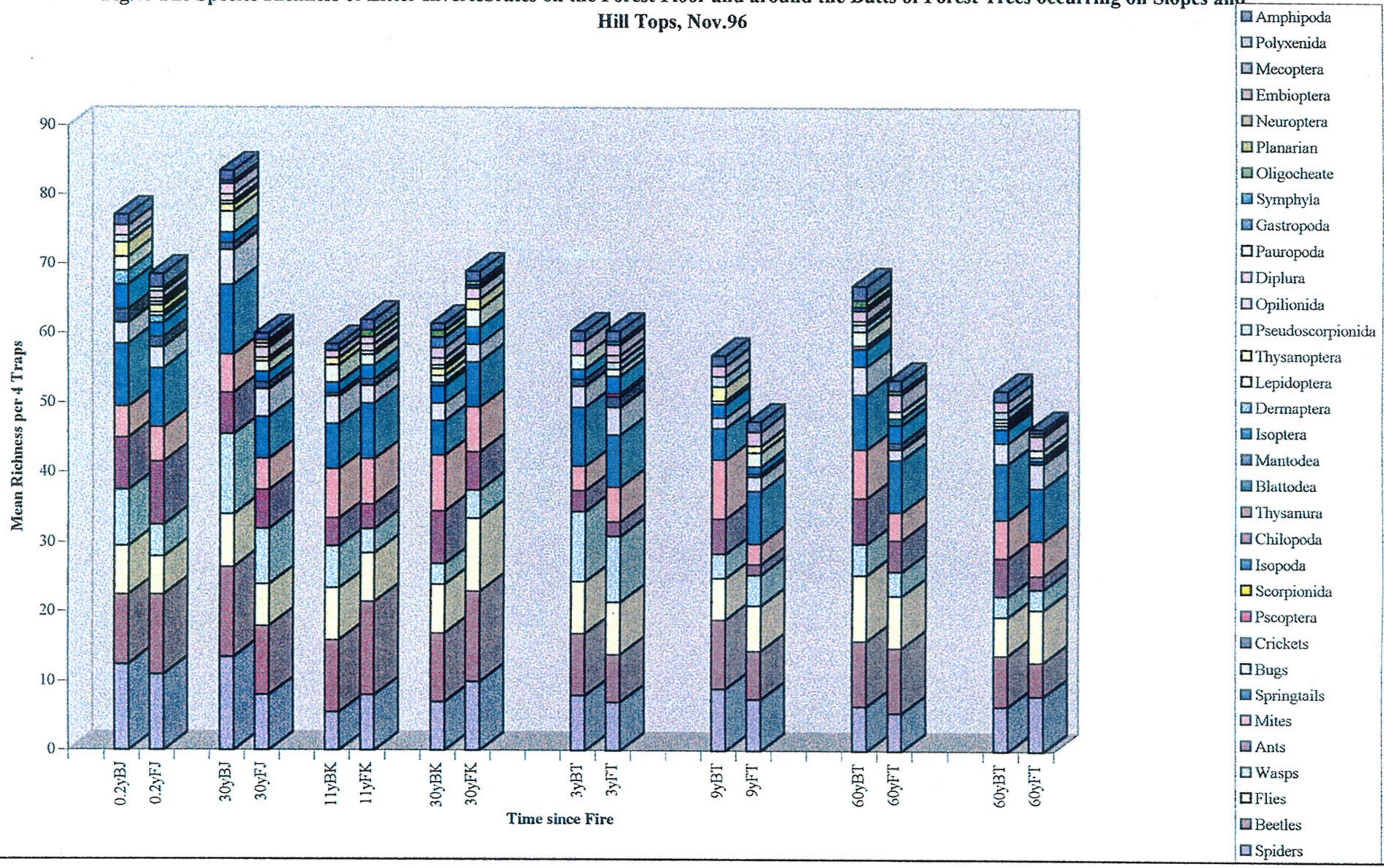


Fig.8: The Abundance of Litter Invertebrates on the Forest Floor (F) and around the Butts of Forest Trees occurring on Slopes or Hill Tops, Nov.96.

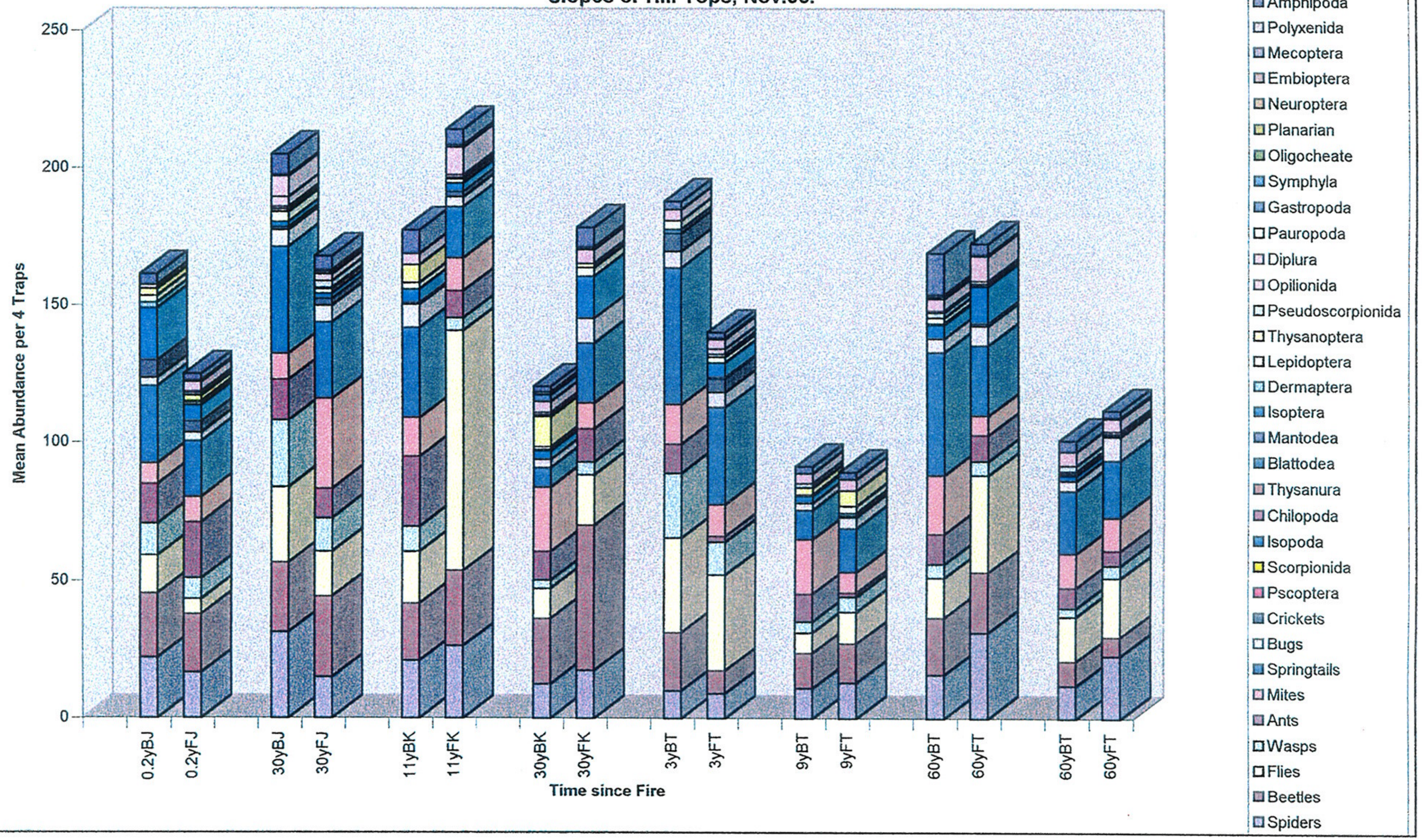


Fig.9: Richness of Litter Invertebrates on the Forest Floor and around the Butts of Tingle Trees occurring along Creeklines, Nov. 96.

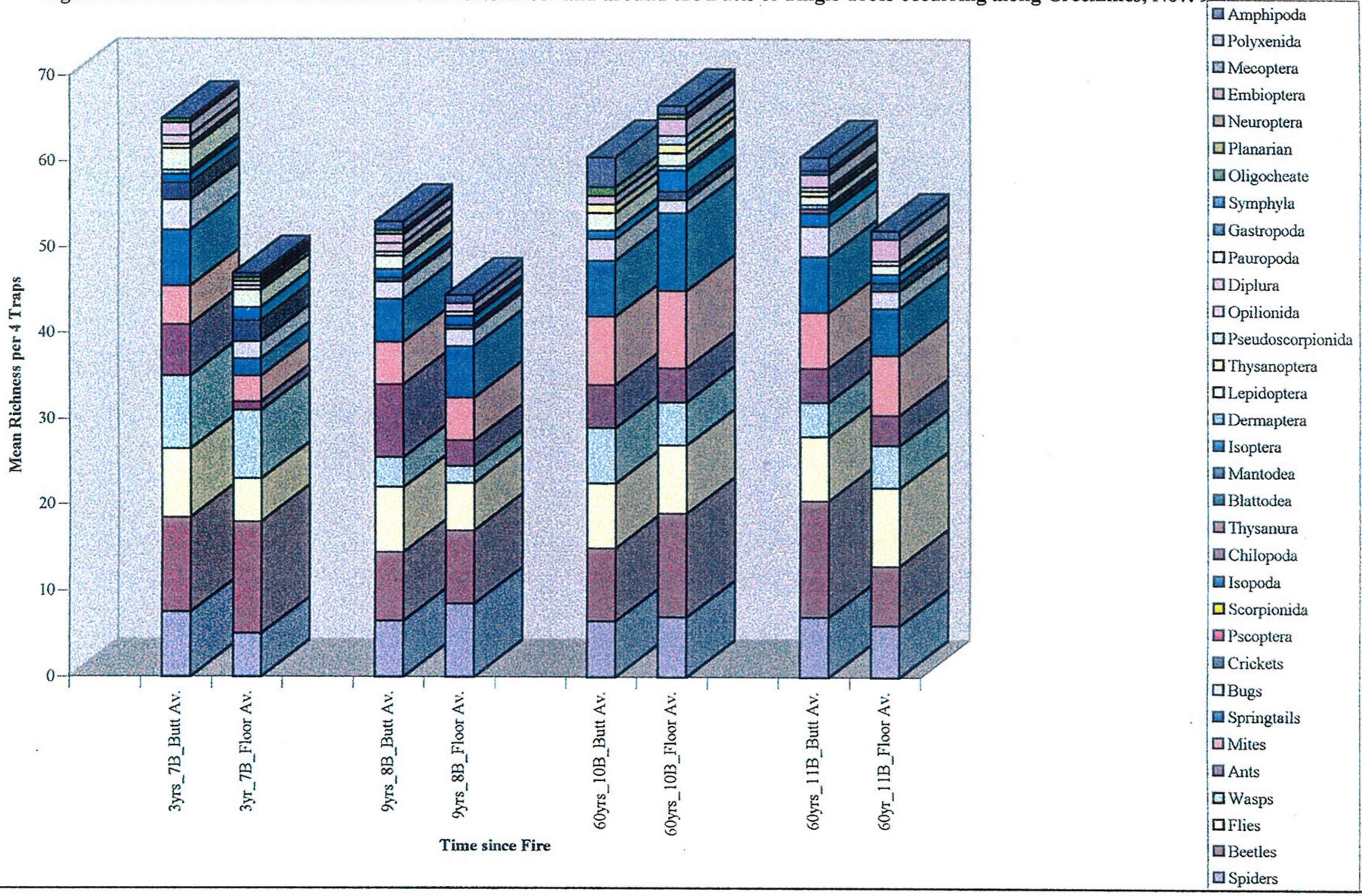


Fig.10: Abundance of Litter Invertebrates on the Forest Floor and around the Butts of Tingle Trees occurring along Creeklines, Nov.96.