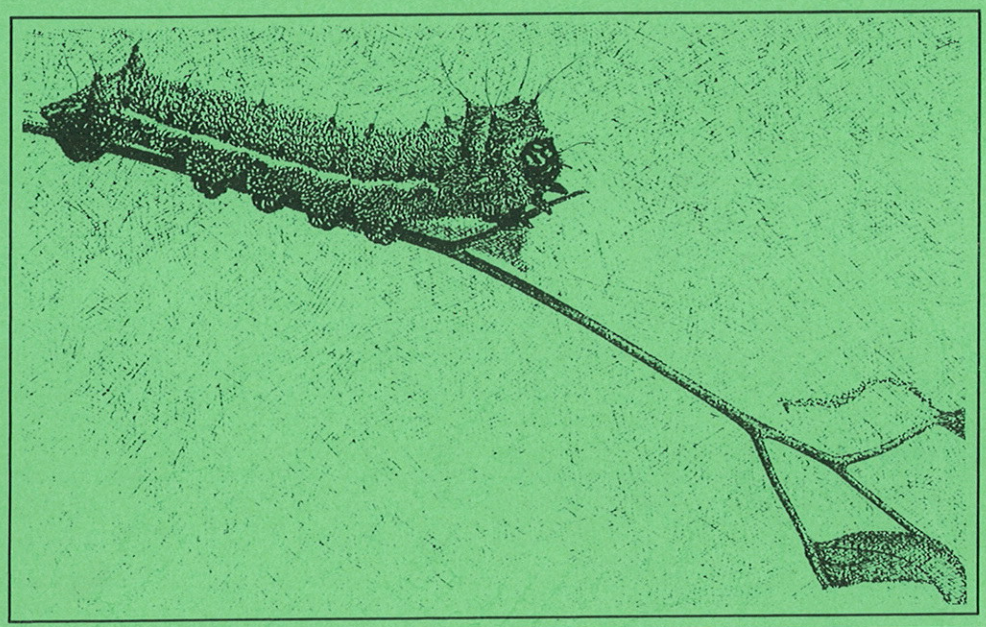
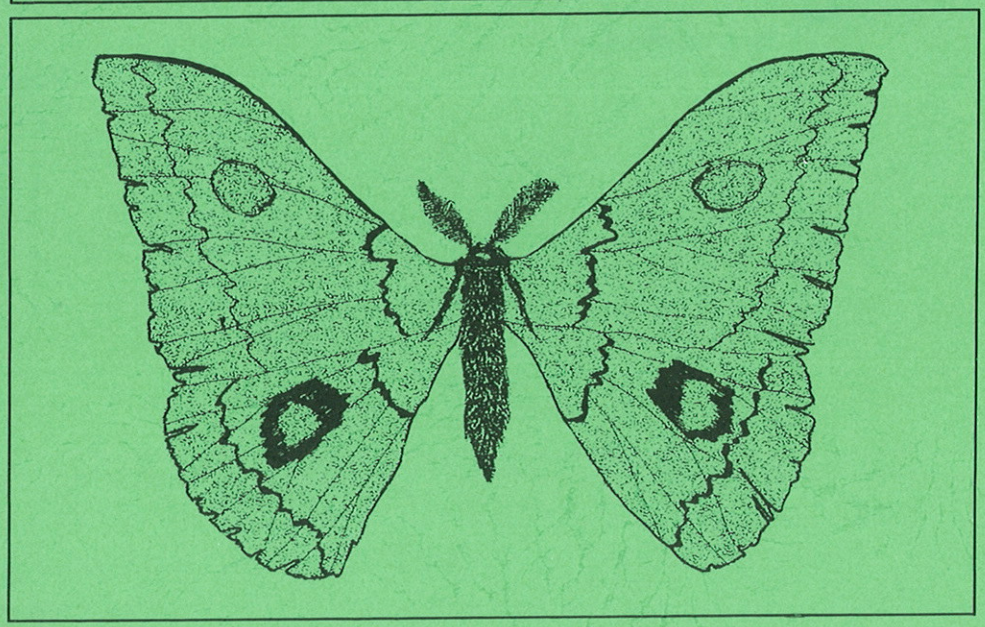
Annotated Bibliography of Forest Entomology in Western Australia to 1985

by I. Abbott, J.D. Majer, and Z. Mazanec





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Department of Conservation and Land Management W.A.

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by I. Abbott
Department of Conservation and Land Management,
Hayman Road, Como, Western Australia.

J.D. Majer
School of Biology, Western Australian Institute
of Technology, Kent Street, Bentley,
Western Australia

Z. Mazanec
CSIRO Division of Entomology, Underwood Avenue,
Floreat Park, Western Australia

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INTRODUCTION

At the sixth meeting of the Forest Research Working Group (No. 8 - Entomology) in 1984, delegates resolved to prepare an annotated bibliography of Australian forest entomology. This report represents the efforts of the three delegates from Western Australia.

This bibliography contains, to the best of our knowledge, all papers (up to and including 1985) that embrace biological studies of the insect fauna of the forests in Western Australia. No relevant papers published before the 1890s were found, but this was expected because a government entomologist was not appointed in Western Australia until 1895. Nearly all of the references cited have been published in refereed journals. We have also referred to a small number of theses and unpublished papers, and several papers based on research carried out in woodland adjacent to the forest.

Three-quarters of the papers were produced in the last two decades (1966-1985). About half of these were written by three entomologists, so it is perhaps uncertain whether such spectacular growth in numbers of papers (Table 1) will continue. Before 1965, the study of forest insects in Western Australia had ceased several times (Abbott 1985).

Excluded from this bibliography are taxonomic papers that refer solely to the presence of insect species in Western Australian forests without otherwise contributing knowledge on the biology of these species (e.g. their host plants, life history). The bibliography includes insects only, even though many excellent papers on other forest invertebrates were found. Papers delivered at conferences, for which only an abstract is available, have not been cited.

We would appreciate notification of any omissions or mistakes.

TABLE 1 Decennial production of papers in W.A. forest entomology

Decade	No. papers
1896-1905	2
1906-1915	0
1916-1925	7
1926-1935	6
1936-1945	4
1946-1955	6
1956-1965	11
1966-1975	19
1976-1985	79
Total	134

ANNOTATED BIBLIOGRAPHY, ARRANGED ALPHABETICALLY BY AUTHORS

ABBOTT, I. (1984). 'Changes in the abundance and activity of certain soil and litter fauna in the jarrah forest of Western Australia after a moderate intensity fire.' *Australian Journal of Soil Research* 22: 463-469.

Soil coring and pitfall trapping in high quality jarrah forest from December 1979 until November 1982 evaluated the effect of a moderate intensity fire on the abundance and activity of the larger invertebrates inhabiting soil and litter. A burnt plot subject to a moderate intensity fire (780 kW/m) in January 1980 was compared with an adjacent unburned control plot. Differences between the plots in the invertebrate fauna collected on 17 sampling dates after the fire were assessed by the Wilcoxon non-parametric test.

Ten taxa in the soil cores showed no significant difference in density between plots from February 1980 to November 1982: Megascolecidae (earthworms), Araneae (spiders), Isopoda (slaters), Isoptera (termites), Dermaptera (earwigs), Orthoptera part (crickets), Coleoptera (beetle) larvae, Coleoptera adults, Diptera (fly) larvae and Formicidae (ants). Diplopoda (millipedes) occurred at significantly greater densities in the burnt plot, and Chilopoda (centipedes), Thysanura (silverfish) and Blattodea (cockroaches) at significantly lower densities in the burnt plot. The total number of taxa and the density and biomass of that part of the invertebrate fauna studied did not differ significantly between plots.

Similar numbers of 12 taxa were captured in pitfall traps in both plots: earthworms, spiders, Pseudoscorpionida (pseudoscorpions), centipedes, termites, cockroaches, earwigs, adult beetles, fly larvae, Hemiptera (bugs), Lepidoptera larvae (caterpillars) and Orthoptera part (grasshoppers). Crickets,

beetle larvae and ants were captured in greater numbers in the unburnt plot. Similar numbers of taxa and of individuals (of all taxa combined) were captured in the plots.

Therefore, all but three taxa recovered in density within three years of a moderate intensity fire in the jarrah forest. The relative abundance and/or activity of three other taxa remained depressed on the burnt plot during the same period.

ABBOTT, I. (1985). Forest entomology research in Western Australia. Technical Report 2, Department of Conservation and Land Management, Western Australia, (76 pp).

Author's Summary:
'Both published and unpublished information on insects harmful to trees in Western Australia is reviewed, omitting consideration of soil and litter invertebrates. A preliminary checklist of 87 such species has been compiled from insects collected by S.J. Curry from 1965 to 1983. Host tree species and the type of damage inflicted are given when available.

Over 80% of these species are beetles. However, most extensive chronic damage to trees is inflicted by caterpillars of jarrah leafminer (*Perthida glyphopa*). The caterpillars of gumleaf skeletonizer (*Uraba lugens*) and the larvae of various longicorn (Cerambycidae) beetles have the greatest potential to inflict economic damage.

A combined experimental-observational approach is advocated for the future study of forest insects in Western Australia. Useful projects are outlined and ranked according to current research priorities. Emphasis is placed initially on studying the impact of insect populations on tree mortality, health, reproduction and growth, rather than studying the dynamics of the insect populations.'

ABBOTT, I., VAN HEURCK, P. and WONG, L. (1984). 'Responses to long-term fire exclusion: physical, chemical and faunal features of litter and soil in a Western Australian forest.' *Australian Forestry* 47: 237-242.

Authors' Summary:
'Physical and chemical properties of litter and soil of two adjacent stands of high quality jarrah forest, one unburned since 1937, the other burned periodically during the past 40 years and last burned in Spring 1981, were compared in 1982 and 1983. Sampling of the larger elements of the invertebrate fauna was by litter and soil coring and pitfall-trapping three times during 1983.

Most of the soil properties studied had higher values in the burned stand, suggesting that repeated low intensity fires do not deplete jarrah forest soils of nutrients. Periodic low intensity fires had little impact on the frequency of occurrence or capture of the invertebrate fauna studied.'

ABBOTT, I. and VAN HEURCK, P. (1985). 'Tree species preferences of foraging birds in jarrah forest in Western Australia.' *Australian Wildlife Research* 12: 461-466.

Invertebrate biomass in sapling crowns of the five commonest tree species in the jarrah forest did not differ significantly among tree species. There were marked differences in taxonomic composition and the numbers of arthropods captured.

BARNACLE, J.E. (1959). 'A pole test against *Mastotermes darwiniensis*.' CSIRO Forests Products Newsletter No. 254 (3pp).

This leaflet reports a pole test designed to compare the efficacy of nine preservatives in minimizing termite damage.

BATINI, F.E. (n.d. = 1972, reprinted 1977). The jarrah leaf miner. Information Sheet No. 8, Forests Department, Western Australia, (2pp).

Larvae of the small, native moth *Perthida glyphopa* (Lepidoptera: Incurvariidae), cause severe damage to leaves of jarrah, *Eucalyptus marginata*, in Western Australia. They feed in winter and spend summer buried in the soil. The damage reduces the tree's vigour and wood increment. A limited control of the feeding larvae can be achieved by injecting systemic insecticide into the tree's trunk.

BENJAMIN, K. (1984). A survey of wood borer damage in *Eucalyptus resinifera* planted in rehabilitated bauxite mines and jarrah dieback areas in Western Australia. Unpublished report for Alcoa of Australia Ltd (22pp).

The aim of this study was to determine the extent and range of borer damage in *E. resinifera* stands at Del Park, Jarrahdale and dieback sites in the Dwellingup area. The correlation of several factors (proximity of stand to other rehabilitated areas, spacing of trees, tree age, tree health, density of understorey) with infestation was examined. Trees aged seven years were most attacked. Cerambycids collected were *Phoracantha semipunctata*, *Dioclides prionoides* and *Aphanasium australi*.

BROWN, K. (1983). A preliminary survey of wood borer damage of eucalyptus species planted in rehabilitated bauxite mines in Western Australia. Unpublished report for Alcoa of Australia Ltd (29pp).

Author's summary:
'*Eucalyptus* spp. surveyed during October and November 1983 varied in their level of susceptibility to wood borer damage. Damage was observed to be at a high frequency in *E. saligna* and *E. resinifera* but was negligible or absent in *E. calophylla*,

E. maculata, E. microcorys and *E. wandoo*. The larvae of two wood borer species were isolated; *Tryphocaria solida* Blackburn was isolated from *E. saligna* at Jarrahdale and Del Park, whilst *T. acanthocera* (Macleay) was isolated from *E. resinifera* at both locations and from *E. calophylla* at Jarrahdale only. The highest incidences of borer attack at any sites were 48% of the *E. resinifera* surveyed at site 10 Jarrahdale, and 36% for *E. saligna* at site 1, Del Park.

Up to 6 *T. acanthocera* larvae were recovered from individual *E. resinifera* with a total of 9.72 m of channels at the cambium and in the wood. These channels extended over nearly 6 metres of trunk. *E. saligna* had both adults and larvae of *T. solida* present. The damage caused by this borer is less extensive than that caused by *T. acanthocera*. Both species are believed to have invaded the sites in the last 2-3 years.'

BUNN, S.E. (1983). 'Termite (Isoptera) fauna of jarrah forest in the Wagerup-Willowdale region, Western Australia: relevance to the rehabilitation of bauxite minesites.' *Forest Ecology and Management* 6: 169-177.

Author's summary:
'Fourteen species of termites are recorded from the Wagerup-Willowdale region, Western Australia. Nine species known to occur in the northern jarrah forest, which were rare or absent in this study, occur more commonly on the coastal sand plain or further inland.

Of those species of termites which are widespread in this region, two are considered to be of particular importance to the rehabilitation of bauxite mined areas. These are *Amitermes obeuntis* Silvestri and *Coptotermes acinaciformis raffrayi* Wasmann. Both of these species have been found in rehabilitated areas.

No obvious associations of termite species with either upland or lowland jarrah forest were found.'

BUNN, S. and NICHOLS, O.G. (1980). Termite utilisation of rehabilitated bauxite mined areas. Alcoa Environmental Research Bulletin No. 9 (8pp).

Authors' summary:
'Almost all termite species found in the native jarrah forest return to rehabilitated mined areas. This return is crucial in terms of nutrient recycling since along with fungi, termites serve a vital function in the breakdown and recycling of wood and plant material.

The reintroduction of termites into rehabilitated areas at an early stage would also be expected to facilitate vertebrate and particularly reptilian fauna return.'

CALABY, J.H. (1956a). 'The distribution and biology of the genus *Ahamitermes* (Isoptera).' *Australian Journal of Zoology* 4: 111-124.

Ahamitermes hillii is recorded from forests of Western Australia. Nests of this species are found only in nests of *Coptotermes acinaciformis*, where it eats the carton of the inner nest section.

CALABY, J.H. (1956b). 'The food habits of the frog, *Myobatrachus gouldii* (Gray).' *Western Australian Naturalist* 5: 93-96.

Thirteen species of termites were eaten by this species of frog. *Coptotermes acinaciformis* was present in 38% of the guts sampled.

CALABY, J.H. and GAY, F.J. (1956). 'The distribution and biology of the genus *Coptotermes* (Isoptera) in Western Australia.' *Australian Journal of Zoology* 4: 19-39.

Authors' summary:
'Knowledge of the distribution and biology in Western Australia of species of *Coptotermes* has been very incomplete and in some respect erroneous, due partly to a lack of collecting and partly to the fact that the genus is notoriously difficult taxonomically.

This genus, which includes the most destructive Australian termites, is represented in the State by four species and one subspecies. The form *raffrayi* previously thought to be a good species occurring sympatrically with *acinaciformis* is shown to be a subspecies of the latter form intergrading with it through a wide zone of intermediate forms and replacing it geographically in the wetter south-western corner of the State. *C. michaelseni* is restricted to south-western Australia and previous records from South Australia, Victoria, and Queensland are shown or considered to be misidentifications of *C. frenchi*. *C. frenchi* is definitely recorded from Western Australia for the first time. The separation of these two species by microscopical measurements is discussed. The fourth species is the recently discovered and described *C. brunneus*.

The known Western Australian distribution of all species except *C. brunneus* are given. New biological data for all species are recorded, particularly on tree species attacked, dispersal of alates, and construction of mounds. *C. acinaciformis* builds symmetrical domed mounds in parts of southern Western Australia. Mound nests had not previously been recorded in the State and they differ considerably in construction from those recorded from the Northern Territory and north Queensland. *C. frenchi* is here definitely recorded as a mound builder. The mound-building habit erroneously attributed in the literature to *C. michaelseni* is shown to be due to the confusion of this species with *frenchi*.

Photographs of mounds of *C. acinaciformis raffrayi*, *C. frenchi*, and *C. brunneus* are published for the first time.'

CLARK, J. (1921). 'Forest entomology in Western Australia.' *Australian Forestry Journal* 4: 142-144.

This paper begins with a discussion of the major early collectors of insects in Western Australia. It then considers how the study of forest entomology is best approached. Clark was forest entomologist in Western Australia from 1920 to 1926.

CLARK, J. (1925a). 'Forest pests. The Pin-hole borer (*Atractocerus kreuslerae*, Pasc.)' *Journal of Agriculture*, Western Australia 2 (ser. 2): 138-142.

This paper describes in detail original observations made on the life history of *Atractocerus kreuslerae*.

CLARK, J. (1925b). 'Forest insects. The Karri borer (*Tryphocaria hamata*).' *Journal of Agriculture*, Western Australia 2 (2): 513-517.

This paper describes in detail original observations made on the life history of *Tryphocaria hamata*.

COMMON, I.F.B. (1969). A new genus *Perthida* for the Western Australian jarrah leaf miner *P. glyphopa* sp. n. and *Tinea phoenicopa* Meyrick (Lepidoptera: Incurvariidae). *Journal of the Australian Entomological Society* 8: 126-130.

Author's summary:
'The jarrah leaf miner, a pest of *Eucalyptus marginata* Sm. in south-western australia, is assigned to a new genus and species, *Perthida glyphopa*. *Tinea phoenicopa* Meyrick from eastern Australia is shown to be congeneric.

CUMMINS, J.E. (1937). 'Included sapwood' in Karri (*E. diversicolor*).' *Journal of the Council for Scientific and Industrial Research* (Australia) 10: 29-32.

Included sapwood (i.e. sapwood included by, and in, the truewood) is frequent in karri, and is associated with borer damage in the living tree.

CUMMINS, J.E. and WILSON, H.B. (1934). 'The pore size (vessel diameter) of some Australian timbers and their susceptibility to attack by the Power Post Borer (*Lyctus brunneus* Stephens).' *Journal of the Council for Scientific and Industrial Research* (Australia) 7: 225-233.

The vessel diameters of four Western Australian timbers (*Eucalyptus calophylla, E. diversicolor, E. gomphocephala* and *E. patens*) infested with *Lyctus* are given. Such infestation is discussed in relation to the diameter of the ovipositor and dimensions of the egg of *Lyctus brunneus*.

CURRIE, G.A. (1937). 'Galls on Eucalyptus trees. A new type of association between flies and nematodes.' *Proceedings of the Linnean Society of New South Wales* 62: 147-174.

Details are given about the larva of *Fergusonina lockharti* in galls on *Eucalyptus rudis*.

CURRY, S.J. (1969). 'The assessment of insect damage to tall forest trees in Western Australia.' Paper presented at the Australian Applied Entomological Research Conference, Newport, NSW 1969 (2pp).

This paper discusses the sampling of eucalypt foliage, buds and fruit using firearms.

CURRY, S.J. (n.d. = 1970, reprinted 1977). Ips bark beetles. Pests of pines. Information Sheet No. 34, Forests Department, Western Australia, (2pp).

This is a leaflet summarizing the salient features of the life history of, and damage done to pines by, *Ips grandicollis*.

CURRY, S.J. (1972). Report to the second meeting of the Research Working Group on Forest Entomology (No. 8) (2pp).

This is a brief synopsis of research on *Ips grandicollis* in pines; chemical control of *Perthida glyphopa* on jarrah; cerambycid species damaging trees, and the pinhole borer attacking jarrah.

CURRY, S.J. (1976). Report to the third meeting of the Australian Forestry Council Working Group on Forest Entomology (No. 8) (2pp).

This paper reports very briefly on the occurrence of *Xyloborus saxeseni* in the jarrah forest; the insect fauna of karri forest after clearing; damage to the lower bole of karri trees by *Tryphocaria hamata* and *Xyleutes* sp.; weevil predators of karri seed; and chemical control of tuart trees from *Phoracantha impavida*.

CURRY, S.J. (1981a). 'Native wasps hit introduced tree pest.' *Journal of Agriculture*, Western Australia 22 (ser. 4): 61-62.

Author's summary:
'The first leaf blister sawfly damage in Western Australia was noticed in the Perth metropolitan area in the spring of 1978. Young eucalypts planted in carparks, recreation areas and street verges were mainly affected. The pest spread through the metropolitan area during 1979, when it attacked larger trees up

to 10 m high. By 1980 young trees were under attack in several country towns including Albany, Bunbury, Busselton, Katanning and Geraldton. In some of these towns at least, the trees were found to have originated in Perth tree nurseries.

The sawfly species is identified as *Phylacteophaga froggatti* which is not native to Western Australia but is common in Victoria, New South Wales and Queensland. A native Western Australian species, *P. occidens*, is of infrequent occurrence and has caused no widespread damage. Fortunately, Western Australia has native parasites which attack the pest. They are 'moving in' already.'

CURRY, S. (1981b). 'Insect pests of eucalypts,' in *Entomology for Advisers. Inservice Training Course in Entomology*. 2nd edn. Western Australian Department of Agriculture, pp 77-81

This includes general discussion of leaf-eating beetles, leaf-eating caterpillars, sawflies, leafminers, sucking insects, wood borers, and gall formers, insects associated with eucalypt die-back in Western Australia, and chemical control.

CURRY, S.J. (1981c). 'The association of insects with eucalypt dieback in South-western Australia.' In Old, K.M., Kile, G.A. and Ohmart, C.P. (eds.) *Eucalypt Dieback in Forests and Woodlands*. CSIRO, Melbourne, pp. 130-133.

This paper considers insect species that cause major damage to eucalypts in south-western Australia. These are *Poracantha impavida* in Tuart forest, *Phoracantha semipunctata* and *Xyleborus saxeseni* in jarrah forest, and *Creiis periculosa, Eriococcus coriaceus, Oxyops* sp., *Uraba lugens, Mnesampela privata* and *Perga* sp. in Wandoo woodland. Also mentioned are

Creiis periculosa and *Perthida glyphopa* damaging *Eucalyptus rudis*, general defoliation by spring beetles, scarab beetles of the genus *Liparetrus* and *Microthopus*, and damage by eurymelid bugs.

CURRY, S.J. (n.d. = 1984). Various contributions in *Insect Pests of Broadacre Farming*. Western Australian Department of Agriculture, Perth.

Relevant to forest entomology are concise descriptions of life history, damage and control for *Uraba lugens; Perga* sp.; leaf beetles; *Catasarcus* weevils; spring (scarab) beetles; *Perthida glyphopa, Phylacteophaga froggatti*, lerps and coccids on farm trees of south-western Australia.

CURRY, S.J. and MOULDEN, J. (1981). Insect pests of eucalypts and other native plants. Western Australian Department of Agriculture *Farmnote* 4/81 (4pp) (re-issued as 116/84).

This pamphlet describes the leaf-eating beetles, leaf-eating caterpillars, leaf miners, sucking insects, wood borers, gall-forming insects, mites and webbing caterpillars commonly found associated with native plants in Western Australia. Recommendations for their chemical control are given.

DOLVA, J.M. and SCOTT, J.K. (1982). 'The association between the mealybug, *Pseudococcus macrozamiae*, ants and the cycad *Macrozamia reidlei* in a fire-prone environment.' *Journal of the Royal Society of Western Australia* 65: 33-36.

Authors' summary:
'The mealybug, *Pseudococcus macrozamiae*, was found on the cycad, *Macrozamia reidlei*, near Jandakot, Western Australia. In 1979, *M. reidlei* plants which had not been burnt for at least 10

years had fewer leaves, fewer distortions to leaflets and less mealybugs when compared with plants that had regenerated from burns in 1977 and 1978. Where present, the mealybugs were found at the base of leaves or where leaflets were forced together or were distorted by fire. Ants were found with all colonies of mealybugs. The exclusion of ants did not affect the abundance of mealybugs, nor were ants necessary for the establishment of mealybug colonies. We suggest that ants are incidental in this mealybug/plant association and both the mealybug and the plant respond favourably to increased fire frequency.'

DOUGLAS, A. (1953). 'Early appearance of jewel beetle.' *Western Australian Naturalist* 4: 45-46.

Stigmodera gratiosa occurs in the northern jarrah forest of Western Australia. In 1953 it was first collected in July, well before the usual emergence in September-October.

ERICKSON, R. and RAYMENT, T. (1951). 'Simple social bees of Western Australia.' *Western Australian Naturalist* 3: 45-58.

This paper provides data on the life history of three species of social bees occurring in the jarrah forest.

FAITHFULL, M.J., MAJER, J.D. and POSTLE, A.C. (1985). 'Some notes on the occurrence and seasonality of *Austromerope poultoni* Killington (Mecoptera) in Western Australia.' *Australian Entomological Magazine* 12: 57-60.

Authors' summary:
'Forty-five individuals of the primitive mecopteran, *Austromerope poultoni*, have recently been collected during systematic sampling near Boddington and Worsley in south-west Western Australia.

The data indicate that the species is probably univoltine with a peak of adult activity in winter and extending into spring. It shows no apparent preference for vegetation association and occurs throughout a wide rainfall range in south-west Western Australia. The sampling programme suggests that the adult spends most of its time on the ground.

FOX, J.E.D. and CURRY, S.J. (1980). 'Notes on the Tuart tree (*Eucalyptus gomphocephala*) in the Perth area.' *Western Australian Naturalist* 14: 174-186.

Pages 181-4 deal with insects damaging the flowers (*Haplonyx tibialis*, *Catasarcus* sp.), insects damaging wood (*Poracantha impavida*, *Bethelium* sp., *Coptocercus unipunctata*, *Culama* sp. and *Atractocerus kreuslerae*), and insects damaging leaves (*Ciampa* sp, *Nepticula* sp., *Phylacteophaga froggatti*, *Perga* sp., *Paropsis* spp., Psyllidae, Eurymelidae, Membracidae and Pentatomidae). Notes on natural history are given for some of these insects.

FRASER, D. and DAVISON, E.M. (1985). 'Stem cankers of *Eucalyptus saligna* in Western Australia.' *Australian Forestry* 48: 220-226.

All perennial cankers on the lower bole of *Eucalyptus saligna* were found to be associated with insect galleries. Larvae of the cerambycid beetle *Tryphocaria solida* were isolated from some of these cankers.

FROGGATT, W.W. (1931). 'A classification of the gall-making coccids of the genus *Apiomorpha*.' *Proceedings of the Linnean Society of New South Wales* 56: 431-454.

Apiomorpha maliformis is recorded on *Eucalyptus patens* in the forested part of south-west Western Australia.

FULLER, C. (1897). 'Some Coccidae of Western Australia.' *The Journal of the Bureau of Agriculture, Western Australia* 4: 1344-1346.

This is a list of 'over one hundred species and varieties of coccids', seldom including an identifiable host plant species.

FULLER, C. (1899). 'Notes and descriptions of some species of Western Australian Coccidae.' *Transactions of the Entomological Society of London* 1899: 435-473.

The species recorded on a definitely named host tree or within the forested area of south-west Western Australia are:

Eriococcus agonis (on *Agonis flexuosa*), *E. simplex (Eucalyptus gomphocephala)*, *Ceronema dryandrae (Dryandra nivea)*, *Parlatoria proteus (Pinus radiata)* and *Chionaspis agonis (Agonis flexuosa)*.

GALLOWAY, R. (1985). Investigations of wood boring beetles (Coleoptera: Cerambycidae) in rehabilitated mine pits in the south-west of Western Australia. Report for Alcoa (Australia) (44pp).

Author's summary:
'The biology and distribution of cerambycid beetles found in rehabilitated bauxite mines of Alcoa of Australia in the Darling Range of Western Australia were considered. *Tryphocaria acanthocera* and *Tryphocaria solida* were isolated as the primary pests of live trees. Adult emergence was restricted to the summer period from December to February.

Infestation between mine sites was significantly different, with results showing that eucalypts differ in the degree of

susceptibility to wood borers. *Eucalyptus diversicolor*, *Eucalyptus patens*, *Eucalyptus resinifera* and *Eucalyptus saligna* showed the highest incidence of attack.

Factors such as locality, age, fertilizer application, water stress and whether or not trees were planted in mono or polycultures appeared to influence infestation, whereas wood hardness, bark condition and seed provenance did not appear significant. The importance of such factors and possible methods of control are discussed.'

GREENSLADE, P. and MAJER, J.D. (1980). 'Collembola of rehabilitated mine-sites in Western Australia.' Proceedings of the 7th International Colloquium of Soil Zoology, New York, 397-407.

The Collembola which have reinvaded three bauxite mines rehabilitated by different methods are described. Species identified were *Aneuempodialis cinereus* and *Corynephoria cassida* (Sminthuridae), *Lepidocyrtoides australicus*, *L. coerulea*, *Drepanura cinquelineata*, *Entomobrya unostrigata* and *E. atrocincta* (Entomobryidae), *Folsomides exiguus*, *Proisotoma minuta*, *P. ripicola*, *Cryptopygus thermophilus* and *C. antarcticus* (Isotomidae) and *Tullbergia krausbaueri* (Onychiuridae).

GREENSLADE, P. and MAJER, J.D. (eds.) (1985). Soil and litter invertebrates of some Australian Mediterranean-type ecosystems. Bulletin No. 12, Western Australian Institute of Technology, School of Biology, (93pp).

This publication includes brief summaries of the composition, density, species richness, and phenology of dung beetles, geotrupine beetles, ants and other soil and litter invertebrates. Most of this information has been published previously.

GULLAN, P.J. (1984). 'A revision of the gall-forming coccoid genus *Apiomorpha* Rübsaamen (Homoptera: Eriococcidae: Apiomorphinae).' *Australian Journal of Zoology* Supplementary Series No. 97 (203pp).

Species recorded from forests of Western Australia include *Apiomorpha malleeacola, A. munita, A. ovicoloides, A. maliformis, A. strombylosa, A. karschi, A. helmsii, A. regularis* and *A. subconica*. Their host eucalypt species are also given.

HAWKESWOOD, T.J. and PETERSON, M. (1982). 'A review of larval host records for Australian jewel beetles (Coleoptera: Buprestidae).' *Victorian Naturalist* 99: 241-251.

The Western Australian larval host records are for *Pseudotaemia spilota, Julodimorpha bakewelli, Melobasis sexplagiata, Astraeus prothoracicus, Curis intercribrata, Stigmodera cancellata, S. gratiosa, S. roei, S. imperialis* and *S. verdiceps*. The only Western Australian record for a forest tree involves *Melobasis sexplagiata* in *Eucalyptus rudis*.

HINDMARSH, R. and MAJER, J.D. (1977). Food requirements of Mardo (*Antechinus flavipes* (Waterhouse)) and the effect of fire on Mardo abundance. Research Paper 31 Forests Department, Western Australia, (13pp).

This paper compares (to Order) the insects obtained from the jarrah forest floor and the stomachs of the Mardo. Data on the abundance of soil and litter invertebrates in relation to fire are also presented.

HOUSTON, T.F. (1984). 'Bionomics of a pollen-collecting wasp, *Paragia tricolor* (Hymenoptera: Vespidae: Masarinae), in Western Australia.' *Records of the Western Australian Museum* 11: 141-151.

Nesting ecology of *Paragia tricolor* is described from a population in the northern jarrah forest of Western Australia.

JENKINS, C.F.H. (1962a). 'Insect pests of forests (1) Wood boring beetles.' *Journal of Agriculture*, Western Australia 3 (ser. 4): 556-558.

This paper provides a brief review of borers, particularly Cerambycidae, Buprestidae and Bostrychidae. Their control by chemicals is described.

JENKINS, C.F.H. (1962b). 'Insect pests of forests. (2) Tussock moths and Bag-shelter moths.' *Journal of Agriculture*, Western Australia 3 (ser. 4): 866-868.

This paper briefly summarizes the life history of *Orgyia anartoides* and *Ochrogaster contraria*.

JENKINS, C.F.H. (1963). 'Insect pests of forests. (3) The Tuart bud weevil and the Gregarious gall weevil.' *Journal of Agriculture*, Western Australia 4 (ser. 4): 787-789.

This paper briefly summarizes the life cycle of, and damage caused by, *Haplonyx tibialis* and *Strongylorrhinus ochraceus*.

JENKINS. C.F.H. and CURRY, S.J. (1971). 'Insect pests of forests.' In *Forestry in Western Australia*, 3rd edn. Forests Department of Western Australia, pp. 122-129.

This report reviews briefly leaf-eating, bud-destroying, sap-sucking and wood-boring insects of the forests of Western Australia.

KESSELL, S.L. (1925). 'Destruction of Pinus insignis seed - depredation by ants.' *Australian Forestry Journal* 8: 178.

This paper discusses the possible significance of ants in removing pine and eucalypt seed.

KOCH, L.E. (1971). 'The Wanderer Butterfly in Western Australia.' *Western Australian Naturalist* 12: 25-27.

Danaus plexippus occurs in the forest of south-west Western Australia, having been first recorded in 1898. Notes on its occurrence since then are provided.

KOCH, L.E. (1973). 'Wanderer Butterfly sightings in Western Australia (September 1971 to May 1972).' *Western Australian Naturalist* 12: 115.

Further records of *Danaus plexippus*, including some within the forest zone of the south-west, are listed.

KOCH, L.E., DELL, B. and KEIGHERY, G.J. (1977). 'The Wanderer Butterfly at Bunbury and other parts of the south-west, and a new food plant.' *Western Australian Naturalist* 13: 183-184.

Further records within the forested part of the south-west are provided. The distribution of food plants is discussed.

LANE-POOLE, C.E. (1921). 'Forest entomology in Western Australia.' In *Notes on the Forests and Forest Products and Industries of Western Australia* 2nd edn. Government Printer, Perth, pp. 231-4.

This paper stresses the seriousness of insect problems in Western Australian forests. It mentions Curculionidae, Buprestidae, Cerambycidae, Scolytidae, Bostrychidae, Hepialidae and Cossidae. Particular reference is made to a number of species in these families. Damage is discussed very generally.

MAHON, R.J., MIETHKE, P.M. and MAHON, J.A. (1982). 'The evolutionary relationships of three forms of the jarrah leaf miner, *Perthida glyphopa* (Common) (Lepidoptera: Incurvariidae).' *Australian Journal of Zoology* 30: 243-249.

Authors' summary:
'Isoenzymes from larvae of the leaf miner *Perthida glyphopa* Common from two host trees, *Eucalyptus marginata* and *E. rudis*, were examined. Significant differences in the frequencies of alleles at four gene loci were found in larvae collected from adjacent *E. marginata* and *E. rudis* trees. The most reasonable explanation of the data is that there is little or no gene flow between the leaf miner populations on the two host species, and thus, as *P. glyphopa* was described from *E. marginata*, the leaf miner that attacks *E. rudis* is a new species. Evidence is presented that suggests the leaf miner from a third host, *E. todtiana*, may be conspecific with *P. glyphopa*.'

MAJER, J.D. (1977). 'A preliminary survey of the epigaeic invertebrate fauna with particular reference to ants, in areas of different land use at Dwellingup, Western Australia.' *Forest Ecology and Management* 1: 321-334.

Author's summary:
'A pilot pitfall trap sampling programme was performed at Dwellingup, Western Australia in order to compare the epigaeic fauna in unburnt jarrah (*Eucalyptus marginata*), burnt jarrah, dieback-infested jarrah, pine plantations, and urban, farmed and mined areas.

Analysis of similarity of the ant fauna produced a broad division into two groups. The first group consisted of a rich ant fauna of moderate equitability and was associated with only slightly modified native forest sites. The second group consisted of a less rich and, to some extent, less equitable ant fauna and was associated with sites with highly modified vegetation.

The occurrence of individual species in each area is discussed in relation to forest succession and incidence of pioneer species.'

MAJER, J.D. (1978a). The importance of invertebrates in successful land reclamation with particular reference to bauxite mine rehabilitation. In Rehabilitation of mined lands in W.A., workshop proceedings, Perth, 11/10/78, pp. 47-61.

Author's summary:
'The need to monitor invertebrates during attempts at land reclamation is discussed. This is considered in relation to the sheer abundance of invertebrates, the paucity of ecological and taxonomic information on the group, the possibility of habitat instability, pest outbreaks and seed theft (in direct seeded areas), and their role in soil drainage, aeration, nutrient cycling and as sources of food for vertebrates. The possibility of using invertebrates as indicators of the success of rehabilitation is also explored.

These factors are illustrated using the result of a two year continuous monitoring programme of invertebrates in bauxite mine pits which have been rehabilitated by planting *Eucalyptus* spp., by direct seeding of native plants or which have not been

subject to any form of revegetation. These results are then related to the world literature on invertebrates in reclaimed lands.'

MAJER, J.D. (1978b). Studies on invertebrates in relation to bauxite mining activities in the Darling Range. A review of the first eighteen months research. Alcoa Environmental Research Bulletin, No. 3 (19pp).

Author's summary:
'This report is a review of the initial work performed by the author on minesite invertebrates. It is divided into the investigation of seed theft in rehabilitated areas and the invertebrate succession in unplanted, planted and seeded areas.

Seed theft by ants and birds is considered not to be significant in seeded mine pits although two ant species and one bird may have an extremely limited effect on seed survival along forest edges.

The succession of invertebrates, particularly of ants, is followed in an area planted with marri (*Eucalyptus calophylla*), an area seeded with mixed forest species and one where no revegetation attempts have been made. Lack of primary production in the latter plot resulted in the inability of new ant colonies to be sustained while a few species established small colonies in the planted area. The seeded area was colonized by considerably more ant species which reached moderately high numbers. The results suggest that seeding leads to the formation of an ecologically more satisfactory ant community. The implications of this for soil vitality and ecosystem stability are discussed.

A one-year replanted mine pit is compared with other land use types at Dwellingup for similarity of its ant fauna. The minesite fauna was found to be more closely allied with that of other artificial ecosystems, such as pine plantations, farmland and

townsite vegetation than with that of the jarrah forest. It was characterised by a low species richness and equitability. The possibility of using ant faunas as indicators of the invertebrate communities present is discussed.'

MAJER, J.D. (1980a). A preliminary ecological survey of the Wagerup ant fauna. Alcoa Environmental Research Bulletin, No. 7 (16pp).

Author's summary:
'A survey of the Wagerup ant fauna is reported. Seventy three species of ants were obtained after a preliminary sampling programme. The total number of species present in the vicinity of the initial bauxite mining area could be much higher.

Ecological information on some of the species is presented and the occurrence of Wagerup species is compared with other localities in the south-west of Western Australia.

Although a few species showed preferences for different site vegetation segments, the majority of species were unaffected in their distribution by such factors. The overall ant community composition showed little consistent trend along a swamp to plateau forest transect. Swamps contained an ant community which was different from the forest sites in terms of species composition and species richness. A granite outcrop supported the highest diversity of ants.

The low diversity and equitability of the ant community found in a mature arboretum at Willowdale suggests that replanting of bauxite mined areas without due consideration to understorey would not produce an ant fauna as diverse as that in the original forest. This lends support to the current rehabilitation objective of establishing a more diverse understorey on mined areas.'

MAJER, J.D. (1980b). Report on a study of invertebrates in relation to the Kojonup fire management plan. Bulletin No. 2, Western Australian Institute of Technology, Biology Department (22pp).

Author's summary:
'The influence of a cool spring burn on the density and abundance of soil, litter and surface-living invertebrates, and the activity of the latter group was investigated in a Kojonup nature reserve for which a fire management programme had been proposed.

During the pre-fire sampling period, decomposers were active primarily in winter and to a lesser extent in spring and autumn. Predators were generally less tied to seasons though activity of Araneae, Acarina and Formicidae, groups in which most sampled members are predators, did peak in summer.

The fire initially reduced the catch of most surface-living invertebrates although it did not eliminate any of the broad taxonomic groups present. Most taxa commenced numerical recovery after four months.

Density of soil and litter invertebrates was not altered appreciably by the burn.

This particular cool spring burn did not have as dramatic a negative effect on invertebrate density as has been reported for other fires in Western Australia. It is argued that autumn burns would depress invertebrate levels less than spring burns. A separate survey showed the five largest Kojonup reserves to be rather similar as to type and diversity of ant fauna, least so for reserve 8617. This reserve is considered the appropriate site for a duplicate study if one were to be carried out.'

MAJER, J.D. (1980c). 'The influence of ants on broadcast and naturally spread seed in rehabilitated bauxite mined areas.' *Reclamation Review*, 3: 3-9.

Author's summary:
'One method of rehabilitating areas mined for bauxite in Western Australia involves broadcast seeding with native plant species following return of the topsoil. Experiments were performed to see if there was the potential for seed theft by ants in mined areas which were about to be seeded. Data on seed removal by ants in the newly rehabilitated areas suggested that this would not be a problem in parts of the rehabilitated areas remote from forest margins. Additional experiments suggested that seed theft by ants occurred in the rehabilitated areas up to 25 m from the adjacent forest. When given a choice, ants took *Acacia extensa* Lindl. seeds more frequently than those of *Eucalyptus marginata* Sm. indicating that the relative density of seedling species might be altered by activities of seed-taking ants along the margins of rehabilitated areas.

Other workers have suggested that certain ant/seed-taking relationships are mutualistic and that seeds benefit by being buried in ant nests. Additional experiments were performed on rehabilitated areas which had been seeded three years previously. These indicated that the normal ant/seed-taking relationship had been partially restored. This is probably desirable for the long-term survival of seeds.'

MAJER, J.D. (1980d). Soil and litter invertebrates of the jarrah forest and woodland regions. In Proceedings of Workshop on Managing nitrogen economies of natural and man made forest ecosystems, Mandurah, Oct., pp. 47-61.

Author's summary:
'This paper confines itself to those invertebrates which occur in soil and litter layers of the region which was, or still is, vegetated by jarrah (*Eucalyptus marginata*). Invertebrates from

other strata of the forest such as the canopy defoliators, although also important in nutrient cycling, are not considered here.

The aim of this paper is threefold. It commences with a discussion of the ways in which soil and litter invertebrates may influence the decomposition process in terrestrial ecosystems. The published work on soil and litter invertebrates from the jarrah forest or woodland region is then reviewed in chronological order and certain points of interest are discussed. Finally, the relevant projects which are currently in progress in this region are outlined. Most work is in its early stages, so the findings will not be mentioned in detail here. It is hoped, however, that its description here will alert interested persons to its existence and enable them to contact the relevant workers if so required.'

MAJER, J.D. (1981). The role of invertebrates in bauxite mine rehabilitation. Bulletin 93, Forests Department, Western Australia (29pp).

Author's summary:
'The desirability of monitoring invertebrates during attempts at land reclamation following bauxite mining in the Darling Range is discussed. This is considered in relation to the sheer abundance of invertebrates, the paucity of ecological and taxonomic information on the group, their role in stabilising habitats, soil drainage, soil aeration, nutrient cycling, seed taking, limiting pest outbreaks and the fact that invertebrates comprise the diet of many vertebrates. The value of invertebrates as indicators of rehabilitation is also explored.

A continuous monitoring pitfall trap programme was performed over a two-year period in a forest control plot, and in mine pits which had been rehabilitated by planting marri (*Eucalyptus calophylla*), by direct seeding with native plants and in one which had not been subject to any form of revegetation. Ants

were scored at the species level while other invertebrates were recorded at the level of Class, Order, Super-family, Family or Sub-family.

The study showed that a great variety of invertebrates occurred in the mine pits and that revegetation was not a pre-requisite for many taxa to be present. Of the mine plots, the unplanted plot supported the least variety, and lowest numbers of invertebrates. The variety of invertebrates was similar in the planted and seeded plots although invertebrate numbers were considerably higher in the latter.
There was an increase in total ants, ant biomass and ant species richness from the unplanted plot, through the planted plot to the seeded plot. Ant species richness did not attain the forest control plot values in any mine plots.

The inter-plot differences are discussed in relation to the different revegetation techniques and the implications of these findings are considered.'

MAJER, J.D. (1982a). 'Ant-plant interactions in the Darling Botanical District of Western Australia.' In Buckley, R., Ed. *Ant-plant interactions in Australia.* ANU Press, Canberra, pp. 45-61.

Author's summary:
'The relevant studies which have been performed in, or close to, the Darling Botanical District of the South-west Botanical Province are reviewed.

The first investigations consider the role of ants attending the flowering spike of certain *Banksia* species and the flowering parts of *Alyogyne hakeifolia.* Ants, in both cases, are considered to play a protective role against herbivores.

The interation of ants with the mealybug *Pseudococcus macrozamiae* on the cycad *Macrozamia reidlei*, and with the scale insect *Pulvinariella mesembryanthemi* on the succulent

Carpobrotus edulis are also discussed. Ants are considered to be of negligible importance to the survival, reproduction and colonization of the mealybug, but appear to enhance the survival and growth of scale insect populations by preventing the formation of sooty mould on honeydew.

Various aspects of ant seed interactions in the jarrah, *Eucalyptus marginata*, forests and woodlands are described. The ant species which are elaiosome collectors or general collectors or which utilize seeds in nest construction are described. The ant seed interactions of the two species which stand out as the most significant seed takers in the northern jarrah forest, *Rhytidoponera inornata* and *Melophorus* sp. 1 (A.N.I.C.) are considered in detail. Aspects described include dietary preferences, foraging and feeding phenology, vertical distribution of seeds in ant nests, influence of nest position on seed germination patterns and also the influence of shade on ant nest distribution. Some implications of these interactions for forest ecology are discussed.'

MAJER, J.D. (1982b). Distribution maps of Western Australian and Northern Territory ants which are represented in the W.A. Institute of Technology Collection. Western Australian Institute of Technology School of Biology Report (563pp).

Distribution maps of ants collected in Western Australia, including those from forested areas, are presented in this document. Most of the ants are identified to genus only.

MAJER, J.D. (1983a). Why should miners consider the animals? Australian Mining Industry Council, Environmental Workshop Papers, pp. 1-17.

Author's summary:
'By comparison with flora, the attention paid to fauna when rehabilitating mined lands is disturbingly small. The low

priority of fauna research and monitoring is reflected by the fact that mining companies tend to employ agronomists, to a lesser extent botanists, but seldom zoologists, as rehabilitation officers.

Reasons why fauna should be considered in the rehabilitation agenda are discussed in this paper. They include the fact that animals play an important role in nutrient cycling, enhancing soil structure, consumption of plant biomass, promoting plant diversity, pollination of plants, dispersal of seeds and, of course, the conservation aspect of the fauna should also be considered. The role of fauna in some of these activities is discussed, using examples gathered throughout Australia.'

MAJER, J.D. (1983b). Assessing and promoting invertebrates return in revegetated minesites. Australian Mining Industry Council, Environmental Workshop Papers, pp. 18-36.

Author's summary:
'The role of invertebrates in rehabilitated minesites is briefly reviewed. Reasons why invertebrates are seldom considered in rehabilitation monitoring programmes are discussed and a sampling scheme is presented which aims to circumvent the existing problems encountered during such studies.

A list of rehabilitation options is tabulated which highlights the variables which may be manipulated to encourage the return of particular invertebrate groups. The methods for assessing the efficacy of these options are then described. These are the natural history approach, the case study approach and the statistical approach.'

MAJER, J.D. (1983c). 'Zones of potential land rehabilitation rate for the Australian sub-continent.' *Landline* 8: 5-6.

The results of ant recolonization studies performed in mined areas throughout Australia are presented. They indicate a

gradation in speed of recovery of the ant community which may well be related to prevailing climatic patterns. Since the ant community reflects other components of the biota it may be possible to divide Australia into zones of attainable rehabilitation rates.

MAJER, J.D. (1983d). 'Ants: Bio-indicators of minesite rehabilitation, land-use and land-conservation.' *Environmental Management* 7: 375-383.

Author's summary:
'In terms of their numerical abundance, size, and species richness, ants are a prominent taxonomic group in many terrestrial ecosystems. This, and the fact that ants occupy higher trophic levels and often specialised niches, suggests that they may be good bio-indicators of various environmental parameters.

This paper develops the rationale for using ants as bio-indicators and reviews examples of their use. Parameters which are considered include: ant species richness, species density, Shannon's diversity index, evenness index, and Mountford's similarity index. The possible use of indicator species or groups is also discussed although, in Australia, this is still in its exploratory stage.

The examples given in this paper suggest that a consideration of ant species richness and evenness and also the Mountford's similarity index provides significant insight into the composition of a habitat and of the degree of disturbance.

Some applications of the ant bio-indicator concept include providing of base-line data in pre-development situations; monitoring ecosystem recovery following land rehabilitation, monitoring degree of ecosystem degradation; and the understanding of faunal composition and status of conservation areas.'

MAJER, J.D. (1984a). The role of fauna in mined land rehabilitation. Bulletin No. 7, Western Australian Institute of Technology, Biology Department, 40-55.

Author's summary:
'By comparison with flora, the attention paid to fauna when rehabilitating mined lands is disturbingly small. The low priority of fauna research and monitoring is reflected in the fact that mining companies tend to employ agronomists, to a lesser extent botanists, but seldom zoologists, as rehabilitation officers. Reasons why fauna should be considered in the rehabilitation agenda are discussed in this paper. They include the fact that animals play an important role in nutrient cycling, enhancing soil structure, consumption of plant biomass, promoting plant diversity, pollination of plants and dispersal of seeds. Of course, the conservation aspect of the fauna should also be considered.

The role of fauna in some of these activities is discussed, using examples gathered throughout Australia, and some ways in which rehabilitation may be designed to promote various animal groups are outlined.

Studies performed on ants suggest that the rate of return of fauna, and probably development of the plant biota, are directly related to prevailing climatic factors. A model is proposed which divides Australia into zones of differing potential rehabilitation rates. This model should assist rehabilitation officers, and government agencies overseeing rehabilitation, to realistically gear their expectations to what is theoretically attainable in a particular climatic zone.'

MAJER, J.D. (1984b). Ant return in rehabilitated mines - an indicator of ecosystem resilience. In: B. Dell, ed. Proceedings of the Fourth International Conference on Mediterranean Ecosystems, pp. 105-106.

The results of ant recolonization studies performed in mined areas throughout Australia are presented. They indicate a gradation in speed of recovery of the ant community which may be related to prevailing climatic patterns. Since the ant community reflects other components of the biota it may be possible to divide Australia into zones of attainable rehabilitation rates.

MAJER, J.D. (1984c). 'Short-term responses of soil and litter invertebrates to a cool autumn burn in jarrah (*Eucalyptus marginata*) forest in Western Australia.' *Pedobiologia* 26: 229-247.

Author's summary:
'Soil and litter fauna densities, litter biomass, and certain microclimatic parameters were monitored monthly for 1 month prior to, and 13 months after, a cool autumn burn in eucalyptus forest. Samples were taken simultaneously from a similar, but unburnt, plot.

Litter biomass dropped considerably following the fire and had built up to 66% of the unburnt plot level after 13 months. Burning resulted in a generally increased soil and air temperature and a reduced relative humidity at ground level.

The soil and litter invertebrates, when considered at the broad taxonomic level, exhibited a range of responses to fire. These included immediate density reduction, delayed density reduction, temporary absence following fire, density stimulation or unaffected by fire.

The behaviour of the soil fauna and litter fauna were both assessed using simple binomial signs tests and by principal components analysis. The analyses demonstrated that fire affects the density of both soil and litter fauna and that the

effects of fire were still apparent in the litter fauna, and to a lesser extent the soil fauna, 13 months after the fire.'

MAJER, J.D. (1985a). 'Invertebrates.' In *Worsley Alumina Project. Flora and Fauna Studies Phase Two.* Worsley Alumina Pty Ltd, pp. 133-175.

This is a report on a base-line survey of ants, soil and litter associated invertebrates in areas of vegetation which are within bauxite mining or refining areas.

MAJER, J.D. (1985b). Invertebrate studies in disturbed and pristine habitats of Dryandra State Forest. Research Paper 80, Forests Department, Western Australia, (11pp).

Author's summary:
'Two surveys of invertebrates were performed in Dryandra State Forest during 1982 and 1983. In 1982 the influence of differing land-uses on the composition of the ant community was investigated, and in 1983 the effect of fire on litter arthropods and ground-surface arthropods was examined.

The number of ants and the variety of species was influenced by past farming practices, and to a lesser extent, the type of native vegetation. The composition and abundance of ground and litter-fauna in general was influenced by site factors such as moisture availability, and also by the length of time since the area was burnt. The influence of fire on litter-fauna still seemed evident four years after the burn.

MAJER, J.D. (1985c). 'Restoration of pre-mining ecosystems in forested and agricultural areas.' *Landline* 11: 4.

The return of invertebrates to mined land is compared in agricultural land restored after mining to agriculture and forested land restored after mining to forest. Within six years the recovery of fauna in the former type of land is much more rapid than that restored to the more complex forested ecosystem.

MAJER, J.D. and CHIA, J. (1980). An inventory of information on terrestrial invertebrates occurring in Western Australia. Bulletin No. 1, Western Australian Institute of Technology, Biology Department (211pp).

This is a bibliography of current and published work which has been performed in Western Australia on terrestrial invertebrates.

MAJER, J.D., DAY, J.E., KABAY, E.D. and PERRIMAN, W.S. (1984). 'Recolonization by ants in bauxite mines rehabilitated by a number of different methods.' *Journal of Applied Ecology* 21: 355-375.

Authors' summary:

'(1) The ant fauna of thirty bauxite mines rehabilitated by a range of different methods and three forest controls was surveyed in the summer of 1978-79. Physical and botanical parameters were also measured.

(2) Forty-two species of ants were found in the rehabilitated areas although many of the original forest species were not yet present.

(3) Eight ant community parameters were initially screened by canonical analysis. Ant species diversity (H') and ant species richness were found to be the most useful measures for relating to mined area parameters.

(4) Multiple regression analysis using ant species richness and species diversity as dependent variables revealed that ant return was positively associated with plant species richness and diversity, time since rehabilitation, percentage plant cover and

percentage litter cover. Presence of large logs was also an important factor.
(5) Principal components oridination analysis of the data suggests that plant species richness, and diversity, rehabilitation age and percentage litter cover also influence the species composition of the ant community in rehabilitated areas.
(6) The relevance of the findings to the improvement of rehabilitation practices is discussed.'

MAJER, J.D. and KOCH, L.E. (1982). Seasonal activity of hexapods in woodland and forest leaf litter in the south-west of Western Australia.' *Journal of the Royal Society of Western Australia* 65: 37-45.

Authors' summary:
'Invertebrates were collected in pitfall traps monthly between March 1976 and February 1977 at 3 localities in the south-west of Western Australia, namely Perth (Reabold Hill), Dwellingup and Manjimup. The Collembola and Insecta are treated here.

Herbivore diversity was high in spring, summer and early autumn at Perth, and in summer and early autumn at Manjimup; although diversity fluctuated less with season at Dwellingup it was lower in the winter. Predator and parasite diversity was highest in late autumn and early spring at Perth and Manjimup, but seasonal trends again were less obvious at Dwellingup. The numbers of individuals and species of ant were low in winter, increased in spring and summer, and decreased again towards the end of autumn at Perth and Dwellingup. At Manjimup, the seasonal activity of ants was less marked although more species were active in summer. Most Collembola species were trapped in Perth in winter, and in autumn, winter and spring at Dwellingup; but the Manjimup data are insufficient for interpreting.

The data from this paper are combined with those of Koch and Majer (1980) on non-hexapod groups collected at the same time. The 3 sites had different phenological patterns and this was particularly marked at Manjimup where temperatures are lower and relative humidities higher.'

MATTHIESSEN, J. (1983). 'The seasonal distribution and characteristics of bush fly *Musca ventustissima* Walker populations in south-western Australia.' *Australian Journal of Ecology* 8: 383-394.

Author's summary:
'In the agricultural region of south-western Australia the bush fly *Musca ventustissima* Walker was found to occur permanently in the north-eastern half but it died out during winter in the south-west. The abundance of bush flies increased rapidly throughout the overwintering zone in early spring as a result of local breeding. Flies then dispersed south-westwards, completely repopulating the region during October. Immigrant flies were large and therefore highly fecund, and of advanced reproductive maturity. Local breeding then rapidly increased the population. Maximum abundance occurred in mid-spring in the north and east and in early summer in the south and west. Abundance was greatest in the north where large overwintering populations occurred, and in the far south where repopulation occurred early in the seasonal cycle of pasture growth so that more favourable cattle dung produced flies that were more fecund than their immigrant parents. The abundance of bush flies declined throughout the region in sommer, to negligible levels near the south-west coast but, paradoxically, higher levels occurred inland where there were fewer cattle. On average, flies were smaller and reproductively younger in summer. In areas where irrigated pastures produce more favourable dung in summer, the patterns of abundance and other characteristics of flies did not differ substantially from those in comparable non-irrigated areas. The abundance and other characteristics of a bush fly population 10 km from a

cattle-grazing breeding site were similar to those at the site, indicating that constant dispersal is the basis of the bush fly's ubiquity.'

One of the study areas is located in the northern jarrah forest and several others are near forest.

MAZANEC, Z. (1974). 'Influence of jarrah leaf miner on the growth of jarrah.' *Australian Forestry* 37: 32-42.

Author's summary:
'Outbreaks of the leaf miner *Perthida glyphopa* in the jarrah forest of Western Australia have been occurring over an ever-increasing area since the early 1950s. Approximately 0.4 M ha of forest and 1.0 M ha of partly cleared farm land were infested in 1971. In addition, jarrah in scattered groves on the coastal plain has been infested by the leaf miner for at least 60 years.

Some 23 per cent of trees are resistant to the leaf miner's attack. The effect of infestation on girth increment was determined by comparing the growth of resistant and susceptible trees. Over the four years of measurement (1968-71), the annual losses for girth increment in the susceptible trees were 71, 83, 75 and 64 per cent in the forest, and 47, 41, 46 and 33 per cent at a site on the coastal plain. The magnitude of losses was influenced by the density of the insects.'

MAZANEC, Z. (1978). 'A sampling scheme for estimating population density of the jarrah leaf miner *Perthida glyphopa* (Lepidoptera: Incurvariidae).' *Journal of the Australian Entomological Society* 17: 275-285.

Author's summary:
'Densities of eggs, feeding and mature larvae of the jarrah leaf miner were estimated from samples of leaves, of larval cells from catches in cone traps placed under trees, of diapausing larvae from soil samples, and of moths from catches in emergence traps. Within the samples, homogeneity of variance and improved normality of numbers were achieved by transforming the original counts to ln (x + 1).

In general percentage standard error of the mean increased as the population mean decreased and ranged from 4-33% of the mean for eggs and larvae in leaves, and from 7-41% of the mean for live larvae diapausing in soil and months in emergence traps. To maintain precision of the estimated mean, more sample trees were needed when population density became low.

The total population of the leaf miner per unit area of forest canopy and floor was estimated only in areas of high density. At low population densities, where only a few feeding larvae could be found and examined, estimates of total population could not be made. Such samples were used to identify the factors of larval mortality.'

MAZANEC, Z. (1980). The jarrah leaf miner, *Perthida glyphopa* (Lepidoptera: Incurvariidae) (Common), a pest of jarrah forest in Western Australia. M.Sc. thesis, Department of Zoology, University of Western Australia (119pp).

Author's summary:
'The mining larvae of the native jarrah leaf miner, *Perthida glyphopa* Common (Lepidoptera: Incurvarridae), have been causing annual damage to jarrah, *Eucalyptus marginata* Smith, in the coastal and some inland forest and partly cleared land in the south west of Western Australia.

Certain trees of jarrah are resistant to the attack. The effect of damage on the girth increment was determined by comparing

the growth of resistant and susceptible trees over four years in 1968-71. The magnitude of losses was influenced by the density of the leaf miner.

The leaf miner is univoltine, its eggs are deposited in April-May and the larvae feed within the leaves until September-October. Each mature larva then constructs an eliptical cell in which it transfers to the ground and buries in the soil to diapause during summer.

Densities of eggs, feeding and mature larvae were estimated from samples of leaves and of larval cells from catches in cone traps placed under trees. Densities of the diapausing larvae were assessed from soil samples collected under the trees and of moths from catches in emergence traps.

The male moths are more numerous than the females. At emergence the female contain mature eggs which they deposit singly in day time, preferably into young leaves in clearings or sparse forest canopy.'

MAZANEC, Z. (1981). 'Environmental conditions influencing the population density of the jarrah leaf miner.' In: Old, K.M., Kile, G.A. and Ohmart, C.P. (eds). *Eucalypt dieback in forests and woodlands*. CSIRO. pp. 140-146.

Author's summary:
'Changes in the population density of the native jarrah leaf miner, *Perthida glyphopa* Common (Lepidoptera: Incurvariidae), damaging jarrah (*Eucalyptus marginata* Sm.) in Western Australia, are attributed to the changes in fecundity and the ability of female moths to deposit eggs. The mean potential fecundity of gravid females estimated at seven sites over four generations ranged from 133-165 eggs, whereas the numbers deposited ranged from 35-308 eggs per female.

The variations were related to the condition of the forest and to weather. Droughts limited the availability of oviposition sites on a large scale by restricting the production of jarrah leaves, while cold and windy days inhibited the diurnal activities of female moths. Conditions promoting oviposition on a local scale included the increased quantity of new leaves in the canopy in relation to the surrounds.'

MAZANEC, Z. (1983). 'The immature stages and life history of the jarrah leafminer, *Perthida glyphopa* Common (Lepidoptera: Incurvariidae).' *Journal of the Australian Entomological Society* 22: 101-108.

Author's summary:
'The morphology of egg, 4 larval instars, chaetotaxy of mature larva and pupa of the univoltine jarrah leafminer moth *Perthida glyphopa*, are figured and behaviour described. Barrel shaped eggs become flattened when deposited under the epidermis of a leaf of jarrah (*Eucalyptus marginata* Smith). Apodous larva with long setae on the anterior of partly retracted head and sides of body segments, excavates a mine, avoiding thick veins and oil glands. On maturing it constructs a cell, enters the soil, aestivates and pupates. Wriggling of pupa's abdomen equipped with spines and setae forces it to the soil surface, where ecdysis occurs.'

MAZANEC, Z. (1984). 'The use of gonads in larval sexing of the jarrah leafminer, *Perthida glyphopa* Common (Lepidoptera: Incurvariidae).' *Journal of the Australian Entomological Society* 23: 11-12.

Author's summary:
'The gonads of the larva of the jarrah leafminer *Perthida glyphopa* are embedded in a dorsal fat body within the abdomen. In both sexes they are pear-shaped in instars 1-3, but are 4

lobed in instar 4. The ducts of the gonads terminate within abdominal segment 7 of females and in segment 10 of males in all instars. The sexes were most readily determined by examining internal organs released from sections of larvae comprising abdominal segments 3-7; gonads were released only if the larvae were males.'

MAZANEC, Z. (1984b). 'Studies on the sex ratio in the jarrah leafminer *Perthida glyphopa* (Lepidoptera: Incurvariidae).' *Journal of the Australian Entomological Society* 23: 69-74.

Author's summary:
'The sex ratio of the jarrah leafminer *Perthida glyphopa* Common was studied in the larvae, pupae and adults. Female larvae predominated at the feeding stage in leaves during June-September, the sex ratio (male:female) being 0.74:1.00. Diapausing larvae in the soil at the end of September had sex ratio 1.47:1.00, pupae in March 1.30:1.00, and emerging adults in April-May 1.56:1.00. The reversal of the sex ratio at the diapausing stage suggests a biased mortality of female larvae in the soil.'

MAZANEC, Z. (1985). 'Resistance of *Eucalyptus marginata* to *Perthida glyphopa* (Lepidoptera: Incurvariidae).' *Journal of the Australian Entomological Society* 24: 209-221.

Author's summary:
'Anatomy of leaves of jarrah, *Eucalyptus marginata* Donn ex Smith, and their response to the presence of the jarrah leafminer *Perthida glyphopa* Common, are described. Depending on the reaction to its eggs and larvae, 4 types of trees were recognised: (a) susceptible to oviposition, egg development and larval feeding; (b) resistant to egg development; (c) resistant to larval feeding; (d) resistant to oviposition and egg development. Leaves of types a, b and c had identical anatomy, whereas those

of the only known tree of type d had a different structure of the mesophyll and lacked tannin in the palisade tissue.'

McCAW, W.L. (1983). 'Wood defect associated with fire scars on jarrah (*Eucalyptus marginata* Sm.).' *Australian Forest Research* 13: 261-266.

Author's summary:
'Thirteen jarrah trees (*Eucalyptus marginata* Sm.) with bole scars caused by a wildfire in 1950 were felled and dissected to assess the amount and type of fire-associated defect in the wood. The zone of sapwood behind the area of cambium killed by the fire had been affected and was susceptible to decay and termite attack. There was a significant positive correlation between the height of affected wood in the stem and the vertical and lateral extent of the original injury. These characteristics can be used as indicators of the extent of defect in a standing tree. Decay was generally confined to the wood present at the time of injury. Much of the wood present at the time of injury was free of decay and would be acceptable for saw-milling. Localized kino deposits were present beneath tissue which had grown over the wound.'

McMILLAN, R.P. (1952). 'Western Australian Stigmodera.' *Western Australian Naturalist* 3: 145-147.

Stigmodera gratiosa occurs in the forested part of south-west Western Australia. Notes on its life history are provided.

McMILLAN, P. (1977). 'Swarming ants.' *Western Australian Naturalist* 13: 204.

Aphaenogaster barbigula occurs in the northern jarrah forest. Notes on its life history are given.

McNAMARA, P.J. (1955). A preliminary investigation of the fauna of humus layers in the jarrah forest of Western Australia. Forestry and Timber Bureau, Leaflet No. 71 (16 pp.).

Author's summary:
'To determine possible relationships between the nature and abundance of the soil micro-fauna and forest humus types, populations were sampled in -

1. The surface layer of a protected compartment and an annually burnt fire break.
2. A protected compartment and an annually burnt fire break at various depths below the ground.
3. An area suffering from crown deterioration, giving rise to four distinct cover types.

In all cases the micro-fauna was found to be more abundant in numbers and types in zones of accumulated organic matter.

The populations found in the jarrah forest are compared with those found in similar types of humus overseas (pH 5.8-6.2), and found to be comparable where similar extraction methods were used, i.e., 41.40-64.40 millions per acre. Faunistic composition was found to be fairly constant (87-90 per cent, mites and sprintails) despite these variations in total population.

Factors governing population fluctuations and the role of the micro-fauna in the maintenance of forest fertility, by the annual destruction of 10-15 per cent of the annual leaf fall, are briefly discussed.

MOORE, K.M. (1970). 'Observations on some Australian forest insects. 23. A revision of the genus *Glycaspis* (Homoptera: Psyllidae) with descriptions of seventy-three new species.' *Australian Zoologist* 15: 248-376.

Glycaspis icterica (on jarrah), *G. occidentalis* (on wandoo), *G. subita* (on yate), *G. confinis* (on *Eucalyptus rudis*) and *G. deirada* (on karri and other eucalypt species) are recorded within the forested area of Western Australia.

MOORE, K.M. (1971). 'Observations on some Australian forest insects. 31. The *Glycaspis* spp. (Hemiptera: Psyllidae) - *Eucalyptus camaldulensis* associations.' *Journal of the Entomological Society of Australia* (N.S.W) 7: 3-7.

Glycaspis confinis occurs on *Eucalyptus rudis* in south-west Western Australia.

NEWMAN, L.J. (1928). 'Shot-hole borer (*Xylion gibbicollis*).' *Journal of Agriculture*, Western Australia 5 (ser. 2): 132-136.

This paper provides an account of the life cycle, method of attack, and control of this borer, with emphasis on grapevines. This beetle was also recorded infesting *Eucalyptus loxophleba*, *Acacia microbotrya*, *A. acuminata*, and *Hakea glabella*, native plant species surrounding the vineyards.

NEWMAN, L.J. (1935). 'Thrips census.' *Journal of the Royal Society of Western Australia* 21: 93-100.

Thrips imaginis, *T. tabaci*, *Isoneurothrips australis*, *Odomtothripella australis*, *Taeniothrips breviocornis*, *T. seticollis*, *Scholothrips sexmaculatus*, *Pseudonaphotrips achaetus* and *Australothrips bicolor* (Thripidae), *Desmothrips australis*, *D. mendozai*, *Rhipidothrips aureus*, *Liothrips atratus*, *Haplothrips victoriensis* and *Phaulothrips fuscus* (Aeolothripidae) occur in the forested part of south-west Western Australia. Host plant species are listed.

NEWMAN, L.J. and CLARK, J. (1924). 'The Tuart bud weevil (*Haplonyx tibialis*).' *Journal of Agriculture*, Western Australia 2 (ser. 1): 357-60 (reprinted in *Australian Forestry Journal* 9: 191-195, 1926).

This paper describes in detail original observations made on the life history of *Haplonyx tibialis*.

NEWMAN, L.J., and CLARK, J. (1925). 'The jarrah leaf miner.' *Journal of Agriculture*, Western Australia 2 (ser. 2): 372-8 (reprinted in *Australian Forestry Journal* 9: 95-9, 1926).

Larvae of an undescribed moth *Tinea* sp. mine the leaves of jarrah (*Eucalyptus marginata*) and flooded gum (*E. rudis*) in the coastal area in the south-west of Western Australia. Serious damage has been occurring since 1920 and casual outbreaks within the Perth area were observed as far back as 1914. Damaged leaves appear as if scorched by fire, but then trees recover.

Larvae feed in the leaves from June to September and they bury themselves in the soil. Effective application of poisons to control the pest in leaves is not possible, but burning with slow fires in non-commercial forests would kill larvae in the soil.

NICHOLS, O.G. and BURROWS, R. (1985). 'Recolonisation of revegetated bauxite mine sites by predatory invertebrates.' *Forest Ecology and Management* 10: 49-64.

Authors' summary:
'Alcoa of Australia Limited has a programme of re-afforestation of mined areas in the southwest of Western Australia. One of the aims of the programme is to promote the return of fauna species which inhabited forest areas prior to mining.

A survey on predatory invertebrates was undertaken because of the important ecological roles performed by this group, and in order to supplement extensive studies on vertebrates, ants, termites and collembola. It was found that utilisation of revegetated areas varied depending on the ecological requirements of the group concerned. Species requiring logs and dense leaf litter were less common than in surrounding unmined forest, whilst those utilising small bushes, open spaces or small amounts of cover were equally or more common than in the unmined forest.

Predatory invertebrate population parameters were estimated in surrounding jarrah (*Eucalyptus marginata*) forest, and in dieback affected jarrah forest. The sites were then compared with revegetated minesites. The results showed that better rehabilitated areas compare favourably with healthy forest. Areas rehabilitated using outdated techniques possess lower species richness and diversity than healthy or dieback affected forest. The introduction of logs, a leaf litter substitute (in the form of chipped wood waste) and the elimination of any roads around pits should further promote the development of a predatory invertebrate community similar to that found in unmined forest. These techniques are currently being investigated on a field trial basis.'

PENNIKET, J.G. (1977). 'The primitive Protomecopteran *Austromerope poultoni*.' Proceedings of the Western Australian Entomology Workshop, Perth, December 2, pp. 20-21.

Author's summary:
'*Austromerope poultoni* Killington 1933 from West Australia was until recently known from only two specimens: the ♂ holotype presently in Britain, and a ♀ now in America. One ♂ and two ♀♀, taken by the author in 1974 near Manjimup, were shown at the Workshop. On two occasions in 1976, other adults were taken east of Busselton and at Dwellingup by the Entomology

Section, Agriculture Department W.A.; some of this material was sent to the Entomology Division, C.S.I.R.O., Canberra. The only other members of the suborder, Protomecoptera, are two North American species of *Merope*. Apparently the larvae are unknown. The group is important because of the presumed mecopteran ancestry of Trichoptera, Lepidoptera, Diptera and Siphonptera (Fig. 1).

An immediate search for the larvae of *Austromerope poultoni* will be made, which if successful, will be followed by an investigation of the life history. The present and any further material will eventually be deposited with the West Australian Museum and the Australian National Insect Collection.

PERRY, D.H. (1979). Protection of timber in contact with the ground from the termite *Mastotermes darwiniensis* in the Pilbara region of Western Australia. Research Paper No. 56, Forests Department, Western Australia (10pp.).

Author's summary:
'A trial was installed in 1972 near Port Hedland, Western Australia, to test the possibility of protecting wooden sleepers from destruction by the termite *Mastotermes darwiniensis* Froggatt by treating them with termiticides. Results indicated that to protect the timber, near-complete penetration of the preservative is essential. *Mastotermes* repeatedly breached barriers of dieldrin, arsenic and creosote of various depths, and even excavated exploratory galleries into sleepers fully impregnated with creosote but always abandoned them.

It has proved difficult to protect Australian hardwood sleepers because complete penetration of preservative is not possible using currently available techniques of application.'

PERRY, D.H., LENZ, M. and WATSON, J.A.L. (1985). 'Relationships between fire, fungal rots and termite damage in Australian forest trees.' *Australian Forestry* 48: 46-53.

Authors' summary:
' The relationships between termites and fungal rots are complex and, in living trees, very poorly understood. However, termite attack on the heartwood of living jarrah (*Eucalyptus marginata*), karri (*E. diversicolor*) and maritime- or cluster pine (*Pinus pinaster*) in south-western Australia is secondary to fungal attack which, in turn, depends substantially on fire scaring. A review of the available data suggests that this generalisation applies equally in south-eastern Australian forests, and that the dependence of fungal and termite damage on fire or mechanical damage has important practical implications for forest management.'

RATCLIFFE, F.N., GAY, F.J. and GREAVES, T. (1952). *Australian termites. The biology, recognition, and economic importance of the common species.* CSIRO, Melbourne (124 pp.).

Six species of termite likely to damage timber structures are listed for south-western Australia. Methods of control and eradication are discussed.

RIDSDILL SMITH, T.J., WEIR, T.A. and PECK, S.B. (1983). 'Dung beetles (Scarabaeidae: Scarabaeinae and Aphodiinae) active in forest habitats in South-western Australia during winter.' *Journal of the Australian Entomological Society* 22: 307-309.

Authors' summary:
'The abundance of dung beetles (Scarabaeidae: Scarabaeinae and Aphodiinae) during winter was estimated from captures at dung and carrion baited pitfall traps at 40 sites in mature heath and forest habitats in the south of south-western Australia. Beetles

were attracted predominantly to dung baits. Of the 17 species trapped 16 occurred in heath, 10 in open forest (jarrah) and 10 in tall open forest (karri) habitats. Beetles of the tribes Onthophagini and Aphodiini were attracted predominantly to dung baits and were more abundant in heath and open forest than in tall open forest, while beetles of the tribe Scarabaeinae were attracted equally to dung and carrion baits, and their abundance did not differ significantly in the three habitat types.'

RIMES, G.D. (1959). 'The bark beetle in West Australian forests.' *Journal of Agriculture*, Western Australia 8 (ser. 3): 353-355.

Author's summary:

'1. In West Australian pine forests *Ips grandicollis* has not been found attacking healthy pine trees.
2. The main breeding habitat is fresh slash material and recently felled logs.
3. There is continuous activity from September until May, the life-cycle occupying four to five weeks, there being approximately six generations per year.
4. Removal of the logs within 48 hours of felling will provide uninfested logs.
5. Chemical protection of logs for a period of two months can be obtained by spraying with a 0.3 per cent water emulsion of lindane.'

ROSSBACH, M.H. and MAJER, J.D. (1983). 'A preliminary survey of the ant fauna of the Darling Plateau and Swan Coastal Plain near Perth.' *Journal of the Royal Society of Western Australia* 66:85-90.

Authors' summary:

'Sixty-eight ant species in 22 genera were collected by pitfall traps and hand sampling made along 2 transects, one north and one south of Perth, running across the Coastal Plain transect.

There were no trends in species richness, diversity or evenness across the transects although overall species composition differed between certain vegetation associations. These differences are discussed in terms of soil type and vegetation association and the results are compared with those from a similar study in the Queensland sub-tropics.'

RUSSELL, M.C. (1953). 'Notes on insects associated with sundews (*Drosera*) at Lesmurdie.' *Western Australian Naturalist* 4: 9-12.

Harpabittacus australis (Mecoptera) and *Cyrtopeltis* sp. (Biridae) occur on *Drosera* in the forest of Western Australia.

SCOTT, J. (1974). The regeneration of bauxite mining sites. Honours thesis, Department of Zoology, University of Western Australia (42pp).

Author's summary:
'Three areas on the earliest (1966) reforested sites of bauxite mining in the Darling ranges, were examined to assess their development towards the forest ecosystem. The reforested species were *Eucalyptus saligna, E. microcorys* and *Pinus pinaster,* the natural forest being dominated by *E. marginata.*

Twenty-four species of ants were compared in their abundance and distribution by pit-trapping and/or honey traps. The greater diversity of the reforested sites being due to the absence of competition by plants for the soil and insufficient litter inhibiting the establishing of competing fauna species. The ants, being the only major fauna group probably form an early stage in the development of the reforested sites.

The understorey flora was considerably more diverse in the natural forest, the reforested sites being similar. The probable factors causing this are the non-availability of nutrients due to competition by the established plantation species, leaching and soil structure.

The soils from the sites were compared for total Na, Ca, Mg, and K salts. The differences in this preliminary soils analysis are discussed and suggestions are made for future experiments.

Various considerations on how to improve the reforestation programme are discussed.'

SHEA, S.R., McCORMICK, J. and PORTLOCK, C.C. (1979). 'The effect of fires on regeneration of leguminous species in the northern jarrah (*Eucalyptus marginatus* Sm.) forest of Western Australia.' *Australian Journal of Ecology* 4: 195-205.

Authors' summary:
'In the northern dry sclerophyll jarrah (*Eucalyptus marginata* Sm.) forests of south-west of Western Australia abundant germination of soil-stored seed of leguminous species commonly occurs following wildfire. Broad scale regeneration of legumes does not occur following normal low to moderate intensity prescription burning. Regeneration of leguminous species has been achieved on several sites by high intensity prescription burning without significant damage to the boles of crop trees.

Leguminous seed is redistributed both vertically and horizontally by ants following seed-fall. The bulk of the seed occurs at depths at which there is no heat pre-treatment during normal prescription burns.

Promotion of native legume species by modification of prescription burning techniques could be used to improve the health of the forest.'

SHORT, J.R.T. (1946). 'Description and life history of a new Western Australian coccid.' *Proceedings of the Linnean Society of New South Wales* 71: 257-269.

Apiomorpha egeria occurs on the Tuart, *Eucalyptus gomphocephala*, in Western Australia.

SLATER, J.A. (1975). 'On the biology and zoogeography of Australian Lygaeidae (Hemiptera: Heteroptera) with special reference to the south-west fauna.' *Journal of the Australian Entomological Society* 14: 47-64.

Author's summary:
'Bassian, Eyrean, relict, and recent Oriental elements of the Lygaeid fauna of southwest Western Australia are discussed. Host plant relationships of Lygaeidae of this area are summarised. An account is given of wing polymorphism in Australian Lygaeids, and a classification of the major types of fore wings is proposed.'

SLATER, J.A. (1976a). 'The immature stages of Lygaeidae (Hemiptera: Heteroptera) of south-west Australia.' *Journal of the Australian Entomological Society* 15: 101-126.

Author's summary:
'Descriptions are given of the nymphs of 20 species (75 nymphal instars) of south-west Australian Lygaeidae together with descriptions of the eggs of 8 species. A key is given to separate the 5th instar nymphs and a discussion of characters that should prove valuable in the recognition of nymphs from the area that are not yet associated with adults. Dorsal views are given of the nymphs of 8 species.'

SLATER, J.A. (1976b). 'The biology, distribution and taxonomy of some Lygaeidae of south-west Australia (Hemiptera: Heteroptera).' *Journal of the Australian Entomological Society* 15: 129-151.

Author's summary:

'Biological, ecological and distributional data are presented for 25 species of south-west Australian Lygaeidae. Numerous host plant associations are discussed. These species are segregated in 19 genera and 6 subfamilies. Attention is drawn to the association of terrestrial litter inhabiting assemblages with particular soil types, particularly white sand areas. The position of the 7th abdominal spiracle in *Lepionysius* Ashlock, previously used for tribal position, is shown to be variable. A seasonal differential between 2 species of Cyminae occurring on the same host is discussed. The first description is given of the macropter of *Darwinocoris australicus* Slater. A key is presented to the south-west Australian species of *Udeocoris* Bergroth, and a discussion of the significance of wing polymorphism in species of the genus. Geographic variation in *Colescoris ocellatus* Gross is treated, with a discussion of the adaptive value of the 'coleopteroid' wing for insects living in xeric habitats.'

SMITHERS, C.N. (1974). 'A migration of *Vanessa kershawi* (McCoy) (Lepidoptera: Nymphalidae) in Western Australia.' *Western Australian Naturalist* 13: 16.

Vanessa kershawi occurs in the forests of south-west Western Australia. Notes on its distribution in and around the forest are provided.

SOLOMON, M.E. (1936). 'Description and life-history of a new Western Australian Psyllid.' *Journal of the Royal Society of Western Australia* 22: 41-48.

Spondyliaspis occidentalis occurs on *Eucalyptus gomphocephala* near Perth.

SPENCER, K.A. (1977). A revision of the Australian Agromyzidae (Diptera). Special Publication of the Western Australian Museum No. 8 (255pp.).

Host plant species are given for four Agromyzid species occurring in the forested part of south-west Western Australia.

SPRINGETT, B.P. (1978). 'On the ecological role of insects in Australian eucalypt forests.' *Australian Journal of Ecology* 3: 129-139.

The author states that an average of 20% of the photosynthetic area of the one-year-old leaves of *Eucalyptus marginata* is consumed by insects. The upper limit recorded is 39%.

SPRINGETT, J.A. (1976a). 'The effect of prescribed burning on the soil fauna and on litter decomposition in Western Australian forests.' *Australian Journal of Ecology* 1: 77-82.

Author's summary:
'The effect of mild fires on the south fauna was examined in a *Pinus pinaster* plantation and in jarrah (*Eucalyptus marginata*) and karri (*E. diversicolor*) forests. In the pine plantation, litter decomposition ceases until four years after burning. In both native forests, species diversity and density are reduced after burning and do not recover their pre-burning values during a normal prescribed burning rotation. Prescribed burning on a five to seven year rotation is likely to permanently simplify the litter fauna and flora, with far-reaching effects on forest and hygiene.'

SPRINGETT, J.A. (1976b). 'The effect of planting *Pinus pinaster* Ait. on populations of soil microarthropods and on litter decomposition at Gnangara, Western Australia.' *Australian Journal of Ecology* 1: 83-87.

Author's summary:
'Litter decomposition rates and the population densities of soil microarthropods were measured in three *Pinus pinaster* stands thirty-one, twenty-three and eighteen years old, and on an area of native vegetation on sandy soil at Gnangara, W.A. Litter decomposition was faster in the soil than within the litter layer and was slowest at the litter surface. Decomposition was rapid in cool wet seasons and slow in hot, dry summers. Microarthropod population densities were similar on all sites (77-100 x 10^3 gm/m^2) but species diversity was greatest under native vegetation and least under the youngest pine stand. The impoverished soil microfauna of the pine stands is unable to decompose pine or sclerophyll litter as fast as the full complement of soil microfauna in native vegetation.'

SPRINGETT, J.A. (1979). 'The effects of a simple hot summer fire on soil fauna and on litter decomposition in jarrah (*Eucalyptus marginata*) forest in Western Australia.' *Australian Journal of Ecology* 4: 279-291.

Author's summary:
'An area of jarrah (*Eucalyptus marginata* Sm) forest was burnt with a hot fire (ca 600 kw/ha) in March 1975. The meso- and microarthropod faunas were sampled in May, June and July 1976 and the decomposer activity of the soil and litter was estimated using buried cotton strips. The growth of jarrah seedlings in pots was measured under different litter and nutrient regimes. Feeding experiments with *Eucalyptus*, *Banksia* and *Bossiaea* litter were carried out on *Podykipus* sp., a litter millipede common at the site of the fire.

Burning reduced the numbers of arthropods, the proportion of juveniles and the proportion of fungal feeders in the microarthropod population. The rate of decomposition was also reduced. The seedlings grew most under leaf litter and

millipede faeces and least under leaf ash. *Podykipus* sp. preferred *Bossiaea* litter (high nutrient content) to either *Eucalyptus* or *Banksia* litter (low nutrient content).'

STOATE, T.N. (1953). Report on research activities of the Forests Department to December 1953. Part 2, pp 51-54. Unpublished Report, Department of Conservation and Land management Library, Woodvale, W.A.

This report provides a brief history of forest insect studies in Western Australia, and considers the recent importation of *Ips* and *Hylastes* bark beetles and *Sirex* wood wasp. Other insects discussed include *Ernobius mollis*, *Anobium*, *Lyctus*, 'cockchafer grub in nurseries' and *Perthida glyphopa*.

TAMBLYN, N. (1945). 'Service tests of fluarized karri rail sleepers in Western Australia.' *Journal of Commonwealth Scientific and Industrial Research (Australia)* 18: 254-262.

Author's summary:
'In 1929 service tests were commenced in Western Australia to determine the preservative value of the fluarizing process for the treatment of green karri (*Eucalyptus diversicolor* F.v.M.) rail sleepers. The tests were a co-operative project between the Division of Forest Products, the Western Australian Government Railways, and the Western Australian Forests Department.

The fluarizing process was a hot diffusion treatment developed and patented by the Western Australian Forests Department during the period 1924-26 as an alternative to the previously used powellizing process. Treatment consisted of boiling the green sleepers in the preservative for ten hours followed by a cooling period of 36 hours before removal from the solution. The preservative was an aqueous solution of sodium fluoride, arsenious oxide, and sodium dinitrophenate.

In the test approximately 3 000 fluarized karri sleepers were installed in 22 test sections in the Western Australian Government Railways system. The average service life of all fluarized karri sleepers in the test is now estimated at 13.0 years, ranging from 10.1-17.8 years in the 22 test sections. Untreated karri sleepers installed as controls in one test section only, gave an average service life of 6.3 years compared with an estimated life in excess of twenty years for untreated jarrah controls in the same section.

Treated sleepers failed principally from decay associated occasionally with termite attack. In some sections where decay hazard was low, mechanical failure also assumed importance in the later years of test. It is considered that the weakness of the treatment lay in the shallow penetration of the preservative and the susceptibility of the treated sleepers to end-splitting, thus exposing the inner untreated wood to fungal or termite attack.'

TAYLOR, K.L. (1964). 'A note on *Creeis periculosa* (Olliff) (Homoptera: Psyllidae).' *Proceedings of the Linnean Society of New South Wales* 89: 250-253.

Creeis periculosa occurs on *Eucalyptus rudis* in forest areas of south-west Western Australia.

TAYLOR, K.L. (1985). 'Australian Psyllids: a new genus of Ctenarytainini (Homoptera: Psylloidea) on *Eucalyptus* with nine new species.' *Journal of the Australian Entomological Society* 24: 17-30.

Blastopsylla occidentalis is recorded on *Eucalyptus rudis* and *E. gomphocephala* near Perth, and *B. nigricollaris* on *E. platypus*.

TWIGG, L., MAJER, J.D., and KOTULA, R. (1983). 'The influence of fluoroacetate producing plants upon seed selection by seed harvesting ants.' *Mulga Research Centre of the Western Australian Institute of Technology, Annual Report* No. 6: 75-80.

This paper compares the rate of seed removal by ants of seeds which do, or do not, contain fluoroacetate.

VAN DIDDEN, G.W. (1967). Aerial spraying of jarrah leaf miner in W.A. Forest Notes 5, Forests Department, Western Australia, 21-24.

This paper describes experimental aerial spraying of jarrah forest east of Manjimup with six concentrations of dimethoate insecticide. No treatment killed more than 70 per cent of larvae. The cost of killing 50 per cent of larvae was found to be uneconomic.

VEVERS STEELE, H. (1935). Thrips investigation: some common Thysanoptera in Australia. CSIR Australia Pamphlet No. 54 (59pp.).

Desmothrips australis and *Isoneurothrips australis* are recorded on the flowers of *Eucalyptus calophylla*.

WALLACE, M.M.H. (1966). 'Trunk implantation of Dimethoate to control jarrah leaf miner and psyllids in eucalypts.' *Australian Forestry* 30: 131-133.

Author's summary:
'Dimethoate injected into the tree trunk as a 30 per cent emulsifiable concentrate (Rogor 40) successfully controlled the jarrah leaf miner in *Eucalyptus marginata* Sm. and in *E. rudis* Endl. Good control of psyllids on *E. rudis* was also achieved.

The dosage required for trees of 8 in. dbh was 8 g active ingredient. For smaller and larger trees, dosages should be calculated on the assumption that they will be proportional to the breast-high cross-sectional areas, that is, 2 g for a tree of 4 in. dbh, and 32 g for a tree of 16 in. dbh.

Technical crystalline dimethoate placed in holes drilled into the tree trunk achieved satisfactory control of both pests, but the results were not as consistent as with the emulsifiable concentrate.

WALLACE, M.M.H. (1970). 'The biology of the jarrah leaf miner, *Perthida glyphopa* Common (Lepidoptera: Incurvariidae).' *Australian Journal of Zoology* 18: 91-104.

Author's summary:
'The jarrah leaf miner *P. glyphopa* causes conspicuous damage to both jarrah (*Eucalyptus marginata*) and to flooded gum (*E. rudis*) in Western Australia. It may also attack other *Eucalyptus* species but rarely reaches high densities in them.

Details of the life history and distribution are presented and processes influencing numbers in the field are discussed. These include larval parasitism (Hymenoptera); possible predation by birds; tree or understorey density or both; surface soil type; and innate resistance of certain trees to attack.

A theory of outbreak initiation and subsequent decline is outlined.'

WATSON, J.A.L. (1956). 'Notes on the arthropod fauna of the Mundaring Weir area.' *Western Australian Naturalist* 5: 60-62.

This paper is a crude survey of the occurrence of certain arthropods in 'native bush' and adjacent pine forest. The only

insects identified to species were *Anax papuensis* (Odonata) and *Pyrameis cardui* (Lepidoptera).

WATSON, J.A.L. (1962). *The dragonflies (Odonata) of South-western Australia.* Western Australian Naturalists' Club, Perth (72pp.).

This booklet provides original data on phenology, distribution, zoogeography and life history of the dragonflies present in the south-west of Western Australia.

WATSON, J.A.L. (1967). 'The larva of *Synthemis leachi* Selys, with a key to the larvae of Western Australian Synthemidae (Western Australia).' Western Australian Naturalist 10: 86-91.

Symthemis leachi occurs in the forest of south-west Western Australia. This paper records notes on its ecology and provides a key to the larvae of Western Australian Synthemidae.

WATSON, J.A.L. (1971). 'The development of 'workers' and reproductives in *Mastoterms darwiniensis* Froggat (Isoptera).' *Insectes Sociaux* 18: 173-176.

Author's summary:
'The five larval stages of *Mastotermes darwiniensis* Froggat lead to the pseudergate 'worker' stages, which can undergo stationary moults. The reproductives and soldiers develop from the pseudergates.'

WHELAN, R.J., LANGEDYK, W. and PASHBY, A.S. (1980). 'The effects of wildfire on arthropod populations in jarrah-banksia woodland.' *Western Australian Naturalist* 14: 214-220.

Authors' summary:

' This study investigates the response of arthropods to fire within the fortnight immediately following burning. Arthropods were sampled in pitfall traps and by hand-searching in potential refuges in both burnt and unburnt areas. There were more individuals representing more species in pitfall traps from the burnt area, suggesting that many former foliage-inhabiting species survived and were restricted to ground level. The natural histories of some of these species supported this view and several species found in unburnt *Banksia* canopies were also sampled in pitfall traps in the burnt area. The dense crowns of *Macrozamia riedlei* and *Xanthorrhoea preissii* provided refuges after fire for several arthropod species not usually found there. The ability of arthropods to survive predation and starvation until vegetation regeneration occurs is discussed.'

WHELAN, R.J., and MAIN, A.R. (1979). 'Insect grazing and post fire plant succession in S.W. Australian woodland.' *Australian Journal of Ecology* 4: 387-398.

Authors' summary:

'This study investigates the impact of insect grazing on the establishment of plant populations from seed after bushfires in coastal plain woodland near Perth, Western Australia. Seedling germination was measured and individual seedlings were observed frequently to estimate survivorship and causes of mortality. Invasion rates of acridid grasshoppers into both small and large burnt areas were measured and palatabilities of seedlings to the most abundant grasshopper species were estimated. Escape of seedlings from insect grazing was influenced by both seedling palatability and area of burning. Grasshoppers were absent from large burnt areas for one to two years. In small burnt patches of vegetation, the patterns of grazing on seedlings were related to seedling palatabilities. These results are discussed in the light of current models of plant succession and the main conclusion is that fire is not a succession-initiating disturbance

in this ecosystem because the long association with fire has allowed the evolution of specific survival and recruitment strategies.'

WOODROFF, S. and MAJER, J.D. (1981). 'Colonisation of ants on the exposed banks of the Canning Dam reservoir.' *Australian Entomological Magazine* 8: 41-46.

Authors' summary:
'The plants, ants and certain epigaeic invertebrates were sampled on the banks of the Canning Dam reservoir which had become exposed as a result of several years drought. At least 26 plant and 17 ant species had colonised the reservoir banks within 67 months of exposure. All but three ants present were also residents of the adjacent forest. Most were generalist feeders which nested in soil or subterranean dead wood. The ant species present took between about 1.5 and 67 months to colonise the banks. The species composition of this was very similar to those recolonising nearby bauxite mined areas.'

INDEX OF KEYWORDS

Keyword	Reference
Cossidae	Abbott 1985; Curry 1976; Curry and Moulden 1981; Jenkins and Curry 1971; Lane-Poole 1921.
Curculionidae	Abbott 1985; Curry 1969, 1976, 1981b, 1981c; Curry and Moulden 1981; Fox and Curry 1980; Jenkins and Curry 1971; Jenkins 1963; Lane-Poole 1921; Newman and Clark 1924.
Damage	Abbott 1985; Barnacle 1959; Batini 1972; Benjamin 1984; Brown 1983; Clark 1925a, 1925b; Cummins 1937; Curry 1970, 1972, 1976, 1981a, 1981c, 1984; Curry and Moulden 1981; Fox and Curry 1980; Galloway 1985; Jenkins 1962a, 1962b, 1963; Lane-Poole 1921; Mazanec 1974, 1980; McCaw 1983; Newman 1928; Newman and Clark 1924, 1925; Perry; 1979; Perry; Lenz and Watson 1985; Rimes 1959; Springett 1978; Tamblyn 1945.
Distribution	Abbott 1985; Calaby and Gay 1956; Faithfull, Majer and Postle 1985; Koch 1971, 1973; Koch et al. 1977; Majer 1982b; Mazanec 1974; Rossbach and Majer 1983; Slater 1976b; Smithers 1974; Wallace 1970; Watson 1962.
Eriococcidae	Curry 1981b, 1981c, 1984; Froggatt 1931; Fuller 1897, 1899; Gullan 1984; Jenkins and Curry 1971; Short 1946.
Eucalypt plantation	Benjamin 1984; Brown 1983; Fraser and Davison 1985; Galloway 1985; Majer 1978a.
Eurymelidae	Curry 1981c.
Extra-floral nectary	Majer 1982a.
Fire	Abbott 1984; Abbott, Van Heurck and Wong 1984; Dolva and Scott 1982; Greenslade and Majer 1985; Hindmarsh and Majer 1977; Majer 1980b, 1984c, 1985b; McCaw 1983; McNamara 1955; Perry, Lenz and Watson 1985; Shea, McCormick and Portlock 1979; Springett 1976a, 1979; Whelan, Langedyk and Pashby 1980; Whelan and Main 1979.
Foliage fauna	Abbott and Van Heurck 1985; Curry 1969; Springett 1978.

Keyword	Reference
Formicidae	Abbott 1984; Dolva and Scott 1982; Greenslade and Majer 1985; Kessell 1925; Majer 1980a, 1980b, 1980c, 1981, 1982a, 1982b, 1983c, 1983d, 1984b; Majer, Day, Kabay and Perriman 1984; McMillan 1977; Rossbach and Majer 1983; Scott 1974; Shea, McCormick and Portlock 1979; Twigg, Majer and Kotula 1983; Woodroff and Majer 1981.
Fungus	Fraser and Davison 1985; Perry, Lenz and Watson 1985.
Genetics	Mahon, Miethke and Mahon 1982.
Geometridae	Curry 1981b; Curry and Moulden 1981.
Hepialidae	Lane-Poole 1921.
Historical	Abbott 1985; Clark 1921; Lane-Poole 1921; Stoate 1953.
Host plant species	Abbott 1985; Benjamin 1984; Brown 1983; Clark 1925a, 1925b; Cummins and Wilson 1934; Currie 1937; Curry 1981b, 1981c, 1984; Curry and Moulden 1981; Dolva and Scott 1982; Fox and Curry 1980; Froggatt 1931; Fuller 1897, 1899; Galloway 1985; Gullan 1984; Hawkeswood and Peterson 1982; Moore 1970, 1971; Newman 1928, 1935; Newman and Clark 1924, 1925; Rimes 1959; Russell 1953; Short 1946; Slater 1975, 1976b; Smithers 1974; Solomon 1936; Spencer 1977; Taylor 1964, 1985; Vevers Steele 1935.
Included sapwood	Cummins 1937.
Incurvariidae	Abbott 1985; Batini 1972; Common 1969; Curry 1969, 1972, 1981b, 1981c, 1984; Curry and Moulden 1981; Jenkins and Curry 1971; Mahon, Miethke and Mahon 1982; Mazanec 1974, 1978, 1980, 1981, 1983, 1984a, 1984b, 1985; Newman and Clark 1925; Stoate 1953; Van Didden 1967; Wallace 1966, 1970.
Introduced species	Curry 1969, 1970, 1972, 1976, 1981a, 1981b, 1981c; Fox and Curry 1980; Jenkins and Curry 1971; Koch 1971, 1973; Koch, Dell and Keighery 1977; Rimes 1959; Stoate 1953.

Keyword	Reference
Invertebrate	Majer 1983a, 1983b, 1984a; Majer and Chia 1980; Nichols and Burrows 1985; Watson 1956.
Isoptera	Abbott 1984, 1985; Barnacle 1959; Bunn 1983; Calaby 1956a, 1956b; Calaby and Gay 1956; Jenkins and Curry 1971; McCaw 1983; Nichols and Bunn 1980; Perry 1979; Perry, Lenz and Watson 1985; Ratcliffe, Gay and Greaves 1952; Watson 1971; Tamblyn 1945.
Lagriidae	Abbott 1985.
Land use	Majer 1977, 1978b, 1980a, 1985b, 1985c; Scott 1974; Springett 1976b; Watson 1956.
Life history	Abbott 1985; Clark 1925a, 1925b; Curry 1970, 1984; Erickson and Rayment 1951; Galloway 1985; Jenkins 1962a, 1962b, 1963; Matthiessen 1983; Mazanec 1980, 1983; McMillan 1952; Newman 1928; Newman and Clark 1925; Rimes 1959; Short 1946; Solomon 1936; Wallace 1970; Watson 1962, 1967, 1971.
Limacodidae	Curry 1981b; Curry and Moulden 1981.
Lyctidae	Abbott 1985; Cummins and Wilson 1934; Stoate 1953.
Lygaeidae	Slater 1975, 1976a, 1976b.
Lymantriidae	Abbott 1985; Jenkins 1962b; Jenkins and Curry 1971.
Lymexylidae	Abbott 1985; Clark 1925a; Curry 1972; Fox and Curry 1980; Jenkins and Curry 1971.
Mammalia	Hindmarsh and Majer 1977.
Margarodidae	Dolva and Scott 1982.
Mecoptera	Faithfull and Majer 1985; Penniket 1977; Russell 1953.
Megachilidae	Erickson and Rayment 1951.

Keyword	Reference
Mining	Benjamin 1984; Brown 1983; Bunn 1983; Galloway 1985; Greenslade and Majer 1980, 1985; Majer 1978a, 1978b, 1980c, 1981, 1983a, 1983b, 1983c, 1983d, 1984a, 1984b, 1985a, 1985c; Majer, Day, Kabay and Perriman 1984; Nichols and Bunn 1980; Nichols and Burrows 1985; Scott 1974.
Morphology	Common 1969; Cummins and Wilson 1934; Mazanec 1983; Slater 1975, 1976a, 1976b; Watson 1967.
Muscidae	Matthiessen 1983.
Nematoda	Currie 1937.
Nesting biology	Calaby 1956a; Calaby and Gay 1956; Houston 1984.
Noctuidae	Abbott 1985.
Nolidae	Abbott 1985; Curry 1981b, 1981c, 1984; Curry and Moulden 1981; Jenkins and Curry 1971.
Notodontidae	Abbott 1985; Jenkins 1962b; Jenkins and Curry 1971.
Nutrient cycling	Majer 1980d.
Nymphalidae	Koch 1971, 1973; Koch et al. 1977; Smithers 1974.
Odonata	Watson 1962, 1967.
Pentatomidae	Fox and Curry 1980.
Pergidae	Abbott 1985; Curry 1981a, 1981b, 1981c, 1984; Curry and Moulden 1981; Fox and Curry 1980; Jenkins and Curry 1971.
Phenology	Douglas 1953; Greenslade and Majer 1985; Majer 1980b; Majer and Koch 1982; McMillan 1977; Watson 1962.
Pine plantation	Springett 1976b.
Population biology	Matthiessen 1983; Mazanec 1978, 1980, 1981, 1984b.

Keyword	Reference
Psyllidae	Abbott 1985; Curry 1981b, 1981c, 1984; Fox and Curry 1980; Jenkins and Curry 1971; Moore 1970, 1971; Solomon 1936; Taylor 1964; 1985; Wallace 1966.
Psychidae	Jenkins and Curry 1971.
Reclamation	Benjamin 1984; Brown 1983; Bunn 1983; Galloway 1985; Greenslade and Majer 1980; 1985; Majer 1978a, 1978b, 1980c, 1981, 1983a, 1983b, 1983c, 1983d, 1984a, 1984b; Majer, Day, Kabay and Perriman 1984; Nichols and Bunn 1980; Nichols and Burrows 1985; Scott 1974; Woodroff and Majer 1981.
Reinvasion	Greenslade and Majer 1980; Majer 1978a, 1978b, 1983a, 1983b, 1983c, 1983d, 1984a, 1984b, 1984c, 1985c; Majer et al. 1984; Matthiessen 1983; Nichols and Burrows 1985; Scott 1974; Springett 1976a, 1976b, 1979; Whelan and Main 1979; Woodroff and Majer 1981.
Reproductive system	Mazanec 1984a.
Scarabaeidae	Abbott 1985; Curry 1981b, 1981c; Curry and Moulden 1981; Greenslade and Majer 1985; Ridsdill Smith et al. 1983; Stoate 1953.
Scolytidae	Abbott 1985; Curry 1970, 1972, 1976, 1981c; Jenkins and Curry 1971; Lane-Poole 1921; Rimes 1959; Stoate 1953.
Seed removal	Kessell 1925; Majer 1980c, 1982a; Shea, McCormick and Portlock 1979; Twigg, Majer and Kotula 1983.
Siricidae	Abbott 1985; Jenkins and Curry 1971; Stoate 1953.
Sleepers	Perry 1979; Tamblyn 1945.
Soil and litter fauna	Abbott 1984; Abbott, Van Heurck and Wong 1984; Greenslade and Majer 1985; Hindmarsh and Majer 1977; Majer 1977, 1978a, 1978b, 1980b, 1980d, 1981, 1984c, 1985a, 1985b, 1985c; Majer and Koch 1982; McNamara 1955; Springett 1976a, 1976b, 1979; Whelan, Langedyk and Pashby 1980.

Keyword	Reference
Thysanoptera	Newman 1935; Vevers Steele 1935.
Trogrositidae	Abbott 1985.
Vegetation type	Bunn 1983; Majer 1980a; Majer 1985a; Rossbach and Majer 1983.
Vespidae	Houston 1984.

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