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# Australian Insects for the Biological Control of the Paperbark Tree, *Melaleuca quinquenervia*, A Serious Pest of Florida, USA, Wetlands

***Joseph K. Balciunas,[1] Damien W. Burrows[2] and Matthew F. Purcell[3]***

***[1]United States Department of Agriculture, Australian Biological Control Laboratory, Kevin Stark Research Building, James Cook University of North Queensland, Townsville, Queensland 4811, Australia***
***[2]Australian Centre for Tropical Freshwater Research, Australian Biological Control Laboratory, Kevin Stark Research Building, James Cook University of North Queensland, Townsville, Queensland 4811, Australia***
***[3]Commonwealth Scientific and Industrial Research Organisation, Long Pocket Laboratories, P.M.B. 3, Indooroopilly, Queensland 4068, Australia***

Since 1987, surveys have been conducted in northern Queensland, south-eastern Queensland and northern New South Wales to detect potential agents for the biological control of *M. quinquenervia* in Florida, USA, where it has become a serious pest. A list of the 409 herbivorous insect species that we have found in Australia (through 1991), associated with this tree, and its close allies, is presented. Also included in this table is information on the habits, regional distribution and relative abundance of each insect species. The merits and biological control potential of some of the more promising candidates are discussed. We intend applying for permission to export our top 2 candidates, the defoliating sawfly, *Lophyrotoma zonalis*, and the young foliage feeding weevil, *Oxyops vitiosa*, to USA quarantine facilities in the near future.

## Introduction

The native Australian broad-leaved paperbark tree, *Melaleuca quinquenervia* (Cav.) S. T. Blake (Myrtaceae), was introduced into Florida as an ornamental at the beginning of this century. In the last 30-40 yrs this pest has greatly expanded its range in southern Florida, and now occurs in nearly half a million acres (approximately 200,000 ha) (Cost and Craver 1981), causing extensive environmental and economic damage.

In Florida, *M. quinquenervia* grows very rapidly, and many of the older trees are now over 20 m tall and still growing. This, combined with the dense, monotypic stands which these trees form, enable them to out-compete most native species for sunlight (Hofstetter 1991). *M. quinquenervia* forests use 4-5 times more water per acre than the sawgrass prairies that they have replaced (Exotic Pest Plant Council 1989). It is predicted that *M. quinquenervia* will infest over 50% of the Florida Everglades by the year 2000, thus greatly reducing the volume of the Biscayne Aquifer, which is already over-burdened as the major agricultural and urban water source in southern Florida (Exotic Pest Plant Council 1989).

There are 250 species in the genus *Melaleuca* in Australia (Barlow 1986), but most are shrubs with needle-like leaves, which do not resemble *M. quinquenervia*. Blake (1968) placed *M. quinquenervia* with 9 other closely related species in the *M. leucadendra* (L.) L. complex (see Table 1 for authors of *Melaleuca* spp.). *M. quinquenervia* is widespread along the

eastern coast of Australia, particularly in swamps and streams (Holliday 1989), but also as ornamental plantings. Its native range extends to eastern New Guinea and New Caledonia (Blomberg 1977) and south to Sydney (Debenham 1963).

Initial surveys to locate biological control agents for *Melaleuca* were undertaken in 1977 by Dr. Dale Habeck in south-eastern Queensland and New Caledonia (*see* Habeck 1981). In late 1986, further surveys for natural enemies of *M. quinquenervia* in Australia were initiated by the United States Department of Agriculture (USDA). These surveys indicated that over 150 species of herbivorous insects at least occasionally feed on *M. quinquenervia* (Balciunas and Center 1991). These initial surveys led to the establishment of the USDA Australian Biological Control Laboratory (ABCL), for which the current, primary focus is the development of biological control agents for *M. quinquenervia*. The ABCL utilises facilities at James Cook University, Townsville, northern Queensland, and also operates a satellite laboratory at the Commonwealth Scientific and Industrial Research Organisation's (CSIRO) Long Pocket Laboratories in Brisbane, south-eastern Queensland.

**Table 1. Numbers of quantitative collections (1987-91) from hosts within the *Melaleuca leucadendra* complex.**

| Host Species | Code | Region[1] | | |
|---|---|---|---|---|
| | | NQ | SQ | NSW |
| *M. quinquenervia* (Cav.) S.T. Blake | Mqn | 272 | 218 | 57 |
| *M. leucadendra* (L.) L. | Mlb | 178 | 4 | – |
| *M. dealbata* S.T. Blake | Mdl | 66 | – | – |
| *M. viridiflora* Sol. ex Gaertn. | Mvr | 21 | – | – |
| *M.* new sp. A | MspA | 23 | – | – |
| *M. nervosa* (Lindl.) Cheel | Mnv | 9 | – | – |
| *M. cajuputi* Powell | Mcj | 3 | – | – |
| *M. saligna* Schau. | Msl | 2 | – | – |

[1] See last page of appendix for region codes.

## Materials and Methods

Our field work in Australia is concentrated in two main regions along the eastern coast. In northern Queensland (NQ), we regularly sample at sites from the Daintree River (16°16'S), 85 km NNW of Cairns, to Townsville (19°20'S). In south-eastern Queensland (SQ) and northern New South Wales (NSW), we sample from Coolum (26°34'S), 100 km N of Brisbane, to Maclean (29°27'S), 45 km NE of Grafton. We have also collected from around Darwin (12°34'S) in the Northern Territory (NT).

Our field collections consisted of 2 main types, quantitative collections and field-search collections. Most were quantitative, and were designed to: 1) provide a list of herbivore species for our broad-leaved paperbark survey; and 2) detect and estimate relative population levels of potential biological control candidates.

For each quantitative sample, 1 kg of plant material was collected by cutting and breaking branches from the host tree, snipping off the twigs with their leaves, flowers and fruit, and placing them into a clear plastic bag. Each bag was assigned a unique collection number, and the tree height, sample height, trunk circumference, bark thickness, climatic conditions, abundances of fruits and flowers (if present), as well as observations of visible herbivore damage, were recorded on a field data sheet. The samples were brought back to the laboratory, where they were searched and all insect herbivores removed and counted. The fresh weights of all leaves, twigs, fruits and flowers examined were recorded. The fruits and flowers were placed into zip-lock bags and examined regularly over 1-2 months for additional emerged herbivores. Immature herbivores were provided with food and pupation material, and reared to adults in cages or in rearing cups and containers. Adult herbivores were either preserved or used in laboratory colonies and host-range testing.

Non-herbivorous insects were immediately preserved.

In our field-search collections, insects were collected directly from vegetation in the field. This type of collection is more superficial than quantitative collections, but far more plant material can be searched. It was effective in detecting low densities of particular insect herbivores, especially if that insect causes unique damage to the plant. Large numbers of a single insect species can also be collected, especially if it is the target of these field searches. These collections were an efficient and reliable method for obtaining insects for laboratory colonies and testing.

**Results and Discussion**

From 1987 through the end of 1991, we made 853 quantitative collections of melaleuca species (Table 1). We supplemented these with numerous field searches from natural and ornamental plantings as well as from trees outside of our 2 shadehouses. Thus far, we have recorded 409 insect species on *M. quinquenervia* and its allies (see list in Appendix). This list also provides the author for each species, their relative abundance, the regions and hosts (listed in order of abundance) from where it was collected, as well as their habit. However, this list does not include all of the insect species that we have encountered in our collections. Since we are uncertain as to the exact habits of the Blattodea, Psocoptera and many Heteroptera species that we have collected, these have not been included on the list. Also not included are Ephydroidea (Diptera) and Apoidea (Hymenoptera) nectar-feeders, Reduviidae (Hemiptera) predators and over 50 species of Coleoptera, from 7 families, that are predators, scavengers, detritivores, or spore, mould and other fungi feeders. Thirteen Lepidoptera species were left off the list because they were only collected as either adults or pupae. Also not included on the list are more than 40 species of parasitoids, belonging to 11 Hymenoptera and Diptera families, which we have reared from our herbivorous insects.

Among the 409 herbivorous insects on the list, 82% (336 spp.) were collected/reared on *M. quinquenervia*. Several are known polyphages or pests, and will not be considered further. These include Homoptera: *Ceroplastes rubens* Maskell, *C. sinensis* del Guercio (both Coccidae), *Icerya purchasi* Maskell (Margarodidae), *Philagra parva* (Donovan) (Aphrophoridae), *Planococcus citri* (Risso) and *Pseudococcus longispinus* (Targioni Tozzetti) (both Pseudococcidae); and Lepidoptera: *Anisozyga pieroides* (Walker), *Cleora repetita* Butler, *?Gymnoscelis lophopus Turner*, *Hyposidra janiaria* (Guenee) (all Geometridae), *Cryptoblabes adoceta* Turner (Pyralidae), *Doratifera vulnerans* (Levin) (Limacodidae), *Epiphyas postvittana* (Walker), *Isotenes miserana* (Walker), (both Tortricidae), *Nanaguna breviuscula* Walker, *Spodoptera litura* (Fabricius) and *S. mauritia* (Boisduval) (all Noctuidae) (Common 1990; Jones and Elliot 1986; Hill 1983; McFarland 1979; Swaine and Ironside 1983; Swaine *et al.* 1985). Many of the better biological control candidates are discussed briefly by their mode of feeding.

*Wood-borers*

Our collecting methods have not targeted wood-borers, although we have found Cerambycidae larvae boring within the branches of *M. quinquenervia*, causing the death of the branch distal from the feeding site. These larvae have proved very difficult to rear. We plan to test an artificial diet (Harley and Willson 1968), based on powdered *M. quinquenervia* branches.

The larvae of Xyloryctinae (Lepidoptera: Oecophoridae) moths, such as *Clerarcha poliochyta* Turner, bore short tunnels into the bases of branches, within which they spend the day, emerging at night to collect leaves which they later consume within their retreats. Their tunneling causes weakening of the branch bases, which are then easily broken. All members of this subfamily that we have collected, appear to have long life cycles, and rearing success has been limited.

*Gall-formers*

A variety of gall types are common on broad-leaved paperbark trees, but our dissections and rearings have primarily produced parasitic and

commensal insects. The majority of our true gall-formers belong to the dipteran families, Cecidomyiidae and Fergusoninidae. Cecidomyiidae are the causative agents of the commonly found pea-shaped galls. We have also frequently recovered Cecidomyiidae as secondary inhabitants of a variety of other gall types. We hope to further investigate these gall-formers in the laboratory, as well as in the field.

The fleshy-tip gall is formed by the larvae of *Fergusonina* sp. (Fergusoninidae). Members of this genus, in a symbiotic association with nematodes, are known to cause galls in *Eucalyptus*, which may reduce flowering and subsequent seed-set (Currie 1937). Recently, *Fergusonina* sp. flies reared from galls collected on *M. quinquenervia*, were released into cages containing *M. quinquenervia* saplings. New galls were readily formed on branch tips. *Fergusonina* sp. shows promise as a biological control agent, and we are currently attempting to colonize this species in our Brisbane laboratory for further study.

*Sapfeeders*

The Cicadellidae are well represented on our list with 15 species, of which 13 were found on *M. quinquenervia*. Of special interest is *Hishimonus melaleucae* (Kirkaldy), which has only been recorded from *Melaleuca* (Fletcher, M.J., personal communication, 1987). *Ipo conferta* Kirkaldy and *Ipoides melaleucae* Evans (both Eurymelidae) are found regularly on *M. quinquenervia* saplings, and in preliminary experiments undertaken in 1988 and 1989, appeared to retard sapling growth (unpublished data).

Of the Miridae species collected during our surveys, only one, *Eucerocoris suspectus* Distant, is commonly collected *on M. quinquenervia*. Thus far we have collected this species exclusively from *M. quinquenervia*, although Jones and Elliot (1986) report that it also feeds on *M. leucadendra*, *M. viridiflora* Sol. ex Gaertn., and some *Callistemon* species. At some of our field sites, many (sometimes all) *M. leucadendra* and *M. quinquenervia* trees showed extensive *E. suspectus* damage, but not a single mirid specimen was found. Jones and Elliot (1986, p. 50) consider *E. suspectus* to be "a serious and debilitating pest which causes damage out of all proportion to its size and abundance". Both the nymphs and adults feed on the sap of young leaves and shoots. Their highly toxic saliva kills patches of leaf around where they have fed (Jones and Elliot 1986) leaving a distinctive, brown, blotch scar. There may be many such scars on each leaf, and subsequent growth becomes distorted. If sufficient numbers can be collected, we will attempt to colonise *E. suspectus* in the laboratory to enable further detailed study of its life-history and host-specificity.

One of our most promising candidates is *Pomponatius typicus* Distant (Hemiptera: Coreidae). These coreids feed by inserting their stylet into the stems of growing tips, which then wilt and die within 24 h. On saplings, upper tips are preferred. While not common in quantitative collections, *P. typicus* is regularly observed on saplings outside of our Townsville shadehouse. Besides *Melaleuca* spp., we have found *P. typicus* on two species of *Callistemon* (also Myrtaceae). In our current herbivore exclusion experiment, *M. quinquenervia* saplings, treated with systemic insecticides to exclude herbivores, grew over 50% more in 6 months than untreated saplings. Much of this difference in height between the two groups appears to be due to damage by *P. typicus*. Even low numbers of *P. typicus* seem to greatly restrict the vertical growth rate of a sapling. This species is a high priority for our 1992 research efforts.

*Flower- and Fruit-feeders*

Flower-feeders might make excellent biological control agents in Florida, where *M. quinquenervia* flowers virtually year-round (Balciunas and Center 1991). This high reproductive rate limits the effectiveness of chemical controls, and enables *M. quinquenervia* to increase its range in Florida by 1000 ha/yr (DiStefano and Fisher 1983). In Australia, however, the flowering season for *M. quinquenervia* is as short as 2 months in NQ, but up to 7 months in SQ. The much shorter flowering period of *M. quinquenervia* in Australia doubtlessly limits the populations of some flower-feeders. Flowering is sporadic and unpredictable, with the trees at any one site

flowering at different times each year. There is also little synchronisation of flowering between nearby sites. This has made it difficult to maintain laboratory colonies of promising flower-feeders.

Among the commonly collected flower-feeding beetles are several species of "*Baris*" weevils (Coleoptera: Curculionidae), but these have proved difficult to maintain in the laboratory, and we have been unable to locate their larvae. The larvae of *Haplonyx* spp. (also Curculionidae) are flower-feeders that bore within the floral axis, destroying many (or even all) flowers of an inflorescence. Adults of the weevil, *Haplonyx* sp. B, feed on young leaves in a similar manner to the curculionid, *Oxyops vitiosa* Pascoe (see leaf-feeders), but leave smaller feeding scars. Some of our *Haplonyx* spp. larvae pupate within the floral axis, but are difficult to rear, and oviposition has not been elicited from adults.

Among the flower-feeding moths that we collected, are 6 species of Cosmopterigidae. Cosmopterigidae sp. A is common, has a wide geographical distribution (within the range of *M. quinquenervia*), and its host range in the field appears to be narrow. Unfortunately, identification of live Cosmopterigidae is frequently difficult, as their genitalia often have to be extracted. These 5 species are very similar as adults, and not easily distinguished as larvae. These taxonomic uncertainties have hindered our attempts to test these Cosmopterigidae.

Three of the 4 most common Tortricidae moths (*Dudua aprobola* [Meyrick], *Strepsicrates semicanella* [Walker] and *S.* nr. *semicanella*) are all flower or fruit feeders, but only destroy 2 or 3 flowers before pupating. The larger *Syntonarcha iriastis* Lucas larvae (Pyralidae) destroy many more flowers during their life cycle (Balciunas and Center 1991). Identification of these flower-feeding moths (particularly Tortricidae) is also very difficult. Our attempts to study these insects are further hampered by the fact that several species of Tortricidae, (as well as Pyralidae, Noctuidae and a variety of beetles), may be found within the one inflorescence, making it difficult to attribute damage to any one species.

The caterpillar of the flower-feeding and tip-binding moth, *Characoma vallata* (Meyrick) (Lepidoptera: Noctuidae), is common in collections of *M. quinquenervia* and *M. viridiflora*. Being relatively abundant, having a narrow host range, dual feeding habits, as well as a wide latitudinal distribution (from NQ to NSW), makes this moth a good potential biological control agent. We will attempt preliminary life-history and host-testing studies of this species in the second half of 1992.

*Leaf-feeders*

This guild of insects is favoured by our collecting methods, and is well represented, both in terms of numbers and diversity.

*Lepidoptera. Epipaschia sp. B* (Pyralidae) is frequently found on saplings outside of our Townsville shadehouse. The larva feeds on leaves from a hollow tube constructed of waste products. Several larvae may live together in adjacent, but separate tubes. This system of tubes can be 10 cm long, and is quite distinctive. The tubes are protected by webbing several small branches together around the system of tubes. These larvae can be particularly damaging as webbed branches are stripped of all leaves. If time and resources permit, we plan to further evaluate this candidate.

*Careades plana* Warren (syn. *Aiteta plana*; Noctuidae), is a voracious leaf-feeder, and an apparent *M. quinquenervia* specialist. The larvae are easily distinguished by their large, green, bulbous thorax. Larvae are commonly collected, but only in low numbers (maximum of 1 or 2 per collection), which greatly restricts our ability to study this candidate. Like *C. plana*, *Imma* sp. (Immidae) is frequently collected but only in low numbers. This species has only been collected from *M. quinquenervia* and the closely related *M. leucadendra*. We intend to further investigate the life-history, feeding habits and host-specificity of these 2 species.

The leaf-miner, ?*Acrocercops* sp. (Gracillariidae), is an occasional pest on *M. quinquenervia* trees at our Townsville shadehouse. This small moth completes its entire life cycle (about 4-5 wks) on just 1 leaf, thus making it amenable to laboratory study and colony establishment. These shadehouse pests

are rarely collected in the field, and then only in small numbers, suggesting that the natural enemies of this blister moth are being excluded or reduced in our shadehouse. If released in Florida, in the absence of its natural enemies, this blister moth could be very damaging to *M. quinquenervia*. If this insect reappears at our shadehouse, we will attempt to establish a laboratory colony for a more thorough evaluation of its biological control potential.

*Hymenoptera*. Some Pergidae (sawflies), are conspicuous defoliators of *Melaleuca* trees, and are common in our collections. The larvae of both *Acanthoperga cameronii* (Rohwer) and *Pergagrapta* sp. sawflies are gregarious, congregating on branches during the day, and disbanding at night to feed on young foliage at the top of the tree. Older leaves are ignored in the field, and untouched by larvae in the laboratory. We have found it difficult to elicit oviposition from either of these 2 species. Larval damage to *M. quinquenervia* trees at field sites, and in the laboratory, is not as extensive as for the 2 *Lophyrotoma* sawflies. *Lophyrotoma* sp. B is regularly collected on *M. quinquenervia* in NSW and SQ. This species has similar feeding habits and life-history as *Lophyrotoma zonalis* (Rohwer) (see below) from NQ, and is also a voracious foliage feeder, but does not reach outbreak levels, as does *L. zonalis*.

The sawfly, *L. zonalis*, is one of our top 2 biological control candidates. This species is regularly collected in large numbers, with densities of over 100 larvae/kg of leaves not uncommon. Despite being heavily parasitised by the wasps, *Australsecodes* sp. and *Chrysonotomyia* sp. (Eulophidae), this sawfly can rapidly defoliate mature trees. To determine the field host-range of *L. zonalis*, we have performed 2 intensive examinations of 161 trees, belonging to 31 species from 9 families, in the Geoscience carpark at James Cook University. During the first evaluation, *L. zonalis* was found only on 3 *M. quinquenervia* trees. Over 600 larvae and 60 egg cases were found on one 4 m tree alone. By the second evaluation 6 wks later, this tree had been completely defoliated and more than 200 larvae had moved to another *M. quinquenervia* tree, feeding voraciously upon it. Some larvae had moved onto nearby *Eucalyptus* and *Callistemon* trees, but damage to these trees was minor.

To date, we have performed 2,234 *L. zonalis* larval no-choice feeding tests on 46 plant species comprised of 25 myrtaceous species and 21 other species from 20 families. Minor feeding has only occurred on 10 of the 21 non-myrtaceous species. Double and triple-choice oviposition trials conducted thus far have induced oviposition from *L. zonalis* on *M. quinquenervia* and *M. leucadendra*, but not on 8 other myrtaceous species tested from 4 genera (*Callistemon*, *Eucalyptus*, *Eugenia* and *Myciaria*). Field oviposition by *L. zonalis* has also been observed on *M. dealbata* S.T. Blake, *M.* new sp. A, *M. leucadendra*, and *M. viridiflora*. In summary, starving *L. zonalis* larvae will feed on many of the Myrtaceae, but only lightly, if at all, on non- myrtaceous species. Oviposition, however, seems to be confined to a few closely related members of the *M. leucandendra* complex. Larvae pupate in chambers excavated in the soft, thick, papery bark of their hosts, which is likely to further restrict their host selection. This adaptation to swamps and wetlands, should allow this species to attack *M. quinquenervia* in similar habitats (e.g., Everglades) in Florida.

*Coleoptera*. Among the more promising foliage-feeding beetles are *Apion* spp. (Apionidae), the adults of which feed on young leaves and terminal leaf buds. These are commonly found in our current herbivore exclusion experiment. We believe that *Apion* sp. B, along with *P. typicus*, has contributed greatly to a reduced growth rate for untreated trees. Unfortunately, in spite of intensive searches, we have never found an *Apion* spp. larvae.

Among the Chrysomelidae, there are 20 candidate species belonging to the genera *Paropsis* and *Rhyparida*. *Paropsis* spp. have become pests on eucalypts, particularly in overseas plantations (Edwards and Whiteman 1984). Some *Paropsis* larvae that we have collected seem to prefer saplings. However, adults reared from larvae have all died without feeding. *Rhyparida* spp. adults have been observed causing considerable damage to the leaves of mature *Melaleuca* trees.

Unfortunately, *Rhyparida* spp. have also proven difficult to maintain in the laboratory.

Our most promising biological control candidate is the weevil, *O. vitiosa*. It occurs in NQ and SQ, and both the adults and larvae feed on the young foliage of *M. quinquenervia* trees, especially stunting and deforming saplings and suckers. Adults scar and perforate leaves, while the larvae feed along one surface of the leaf, consuming all leaf tissue through to the cuticle on the opposite side, thereby forming an elongate "window." Unlike leaves damaged by other herbivores, those scarred by *O. vitiosa* persist for many months.

The high degree of *O. vitiosa* damage in the field has led us to investigate the host-specificity of this weevil. Between 1988-91, field host-specificity surveys have been conducted at 5 sites in NQ and SQ. At the 4 SQ sites (involving up to 22 species of trees from 9 families), *O. vitiosa* was only ever found on *M. quinquenervia*. From 5 evaluations at the NQ site (involving 34 species from 9 families), *O. vitiosa* was only found on *M. quinquenervia* and 3 other species; *M. diosmatifolia* Dum. Cours. (1 adult), and 6 larvae each on *Eucalyptus robusta* Smith and *Callistemon viminalis* (Gaertner) G. Don (all Myrtaceae). In each case, these larvae, and the adult, appear to have crawled from adjacent *M. quinquenervia* trees which had been severely damaged by *O. vitiosa*.

In laboratory no-choice feeding trials, *O. vitiosa* larvae fed moderately to heavily on 4 *Melaleuca* species (*M. quinquenervia, M. dealbata, M. leucadendra and M. viridiflora)* and relatively lightly on 5 other Myrtaceae, *Eugenia uniflora* L., *Lophostemon grandiflorus* (Benth.) Peter G. Wilson & Waterhouse, *Psidium guajava* L., *Syzygium tierneyanum* (F. Muell.) T. Hartley & Perry and *Xanthostemon chrysanthus* (F. Muell.) Benth. However, in oviposition trials, eggs were oviposited only on 3 myrtaceous species–*M. quinquenervia*, *C. viminalis* and *L. confertus* (R. Br.) Peter G. Wilson & Waterhouse. The majority of eggs were laid on *M. quinquenervia*, and only on this species did any larvae successfully reach the adult stage, indicating that *O. vitiosa* can only complete its life cycle upon *M. quinquenervia*.

The damage that *O. vitiosa* inflicts upon *M. quinquenervia*, and its high degree of host-specificity, in both field and laboratory trials, has made this weevil our top biological control candidate. We currently maintain a laboratory colony of *O. vitiosa* which is now into its fifth generation. We hope to receive approval to ship this weevil to the quarantine facilities in Gainesville, Florida in 1992.

## Summary

From our extensive field surveys, we have detected many potential biological control agents from a variety of insect taxa. These insect species have a variety of habits, and feed on most parts of *M. quinquenervia* trees. The fitness and viability of *M. quinquenervia* trees can therefore be reduced through various means; decreasing flower production and seed set, inhibiting vertical and tip growth of saplings, destroying woody tissues, killing branches, or defoliating trees. Currently, we intend requesting permission to export 2 species, (*O. vitiosa* and *L. zonalis*) to USA quarantine facilities. With many more promising species currently being evaluated, the potential for the biological control of *M. quinquenervia* appears encouraging.

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**Appendix 1. Insects collected during surveys of melaleuca between 1987 and 1991. Taxonomic usage follows the *Insects of Australia* (2nd Edition) 1991 except Apionidae which follows Zimmerman (1991). See last page of list for explanation of codes for abundance, region, host and references.**

| Taxonomy | Abundance | Region | Host | Host Relationship/ Comments |
|---|---|---|---|---|
| ORTHOPTERA | | | | |
| Acrididae | | | | |
| Undet. Acrididae sp. A | R | SQ | Mqn | ?Leaf-feeder |
| Undet. Acrididae sp. B | R | SQ | Mqn | ?Leaf-feeder |
| Eumasticidae | | | | |
| Undet. Morabinae sp. | R | NQ | Mqn | ?Leaf-feeder |
| Gryllacrididae | | | | |
| Undet. Gryllacrididae sp. A | R | NQ | Mqn | ?Leaf-feeder |
| Undet. Gryllacrididae sp. B | R | NQ | Mlb, Mqn | ?Leaf-feeder |
| Gryllidae | | | | |
| Undet. Eneopterinae sp. | R | NQ | Mlb | ?Leaf-feeder |
| Undet. Gryllinae sp. | R | NQ | Mqn | ?Leaf-feeder |
| Undet. Oecanthinae sp. | R | NQ | Mqn | ?Leaf-feeder |
| Undet. Trigonidiinae sp. | U | NQ | Mqn, Mlb | ?Leaf-feeder |
| Tettigoniidae | | | | |
| *Caedicia ?simplex* (Walker) | R | NQ | MspA, Mqn | Leaf-feeder |
| Undet. Phaneropterinae sp. A | R | NQ, SQ | Mlb, Mqn | ?Leaf-feeder |
| Undet. Phaneropterinae sp. C | R | SQ | Mqn | ?Leaf-feeder |
| Undet. Phaneropterinae sp. D | R | SQ | Mqn | ?Leaf-feeder |
| Undet. Phaneropterinae sp. E | R | NQ | Mlb | ?Leaf-feeder |
| Undet. Phaneropterinae sp. F | R | NQ | Mqn | ?Leaf-feeder |
| Undet. Tettigoniidae sp. B | R | NSW, SQ | Mqn | ?Leaf-feeder |
| Undet. Tettigoniidae sp. C | R | SQ | Mqn | ?Leaf-feeder |
| PHASMATODEA | | | | |
| *Scionecia queenslandica* (Sjost) | R | NQ | Mnv | ?Leaf-feeder |
| Undet. Phasmatidae sp. A | U | NQ, SQ | Mlb, Mqn | Leaf-feeder |
| Undet. Phasmatidae sp. B | R | NQ | Mqn | ?Leaf-feeder |
| Undet. Phasmatidae sp. C | R | NQ | Mqn | ?Leaf-feeder |
| HEMIPTERA (STERNORRHYNCHA) | | | | |
| Coccoidea | | | | |
| Undet. Coccoidea sp. A | U | NSW, SQ | Mqn | Sapfeeder |
| Undet. Coccoidea sp. B | U | NSW, SQ | Mqn | Sapfeeder |
| Undet. Coccoidea sp. C | U | SQ | Mqn | Sapfeeder |
| Undet. Coccoidea sp. D | U | NSW, SQ | Mqn | Sapfeeder |
| Undet. Coccoidea sp. E | U | SQ | Mqn | Sapfeeder |
| Undet. Coccoidea sp. F | U | SQ | Mqn | Sapfeeder |
| Undet. Coccoidea sp. G | U | SQ | Mqn | Sapfeeder |
| Aleyrodidae | | | | |
| Undet. Aleyrodidae sp. | A | NQ, SQ | Mqn, Mdl | Sapfeeder |
| Aphididae | | | | |
| *Aphis gossypii* Glover | C | SQ | Mqn | Sapfeeder |
| Undet. Aphididae sp. | C | SQ | Mqn | Sapfeeder |
| Coccidae | | | | |
| *Ceroplastes floridensis* Comstock | C | SQ | Mqn | Sapfeeder |
| *C. rubens* Maskell | C | NQ, SQ | Mqn, Mvr, Mlb | Sapfeeder |
| *C. sinensis* del Guercio | U | SQ | Mqn | Sapfeeder |

**Appendix 1. Continued.**

| Taxonomy | Abundance | Region | Host | Host Relationship/ Comments |
|---|---|---|---|---|
| *Ceroplastes* sp. C | C | NQ, NSW, SQ | Mqn, Mvr, Mdl, Mlb | Sapfeeder |
| *Coccus* sp. | U | NQ, SQ | Mqn | Sapfeeder on leaves |
| *Eucalymnatus tessellatus* (Signoret) | C | NQ | Mqn | Sapfeeder on leaves |
| *Pulvaria* nr. *dodonaeae* Maskell | R | SQ | Mqn | Sapfeeder |
| Undet. Coccidae sp. | U | NQ | Mqn | Sapfeeder |
| Diaspididae | | | | |
| *Chrysomphalus aonidum* (L.) | U | NQ | Mqn | Sapfeeder |
| *Lindingaspis rossi* (Maskell) | U | NQ | Mqn | Sapfeeder |
| Undet. Diaspididae sp. | C | NT, SQ | Mqn, Mcj | Sapfeeder |
| Eriococcidae | | | | |
| *Eriococcus* nr. *leptospermi* Maskell | R | NQ | Mqn | Sapfeeder |
| *"Sphaerococcus" ferrugineus* Froggatt | R | NQ | Mqn | "Puff-ball" gall-former |
| Margarodidae | | | | |
| *Icerya purchasi* Maskell | R | NQ, SQ | Mqn, Mlb, Mdl, Mvr | Sapfeeder |
| Undet. Monophlebulini sp. | U | NQ, NSW, SQ | Mqn, Mvr | Sapfeeder |
| Undet. Margarodidae sp. | U | NQ | Mqn | Sapfeeder |
| Pseudococcidae | | | | |
| *Dysmicoccus queenslandianus* Williams | U | NQ | Mqn, Mdl | Sapfeeder |
| *Planococcus citri* (Risso) | U | NQ | Mqn | Sapfeeder, shadehouse pest |
| *Pseudococcus eucalypticus* Williams | R | NSW, SQ | Mqn | Sapfeeder |
| *Pseudococcus* nr. *eucalypticus* Williams | R | NSW, SQ | Mqn | Sapfeeder |
| *P. longispinus* (Targioni Tozzetti) | R | SQ | Mqn | Sapfeeder |
| *P. similans* (Lidgett) | R | SQ | Mqn | Sapfeeder |
| Undet. Pseudococcidae sp. | C | NQ | Mqn, Mdl, Mlb | Sapfeeder |
| Psyllidae | | | | |
| *Acizzia* sp. | R | SQ | Mqn | Sapfeeder |
| *Boreioglycaspis melaleucae* Moore | C | NQ, NSW, SQ | Mqn, Mlb | Sapfeeder |
| *B. palidus* Moore | R | NQ | Mqn | Sapfeeder |
| *Boreioglycaspis* sp. A | R | NSW, SQ | Mqn | Sapfeeder |
| *Ctenarytaina* sp. | R | SQ | Mqn | Sapfeeder |
| Undet. Psyllidae sp. J | U | NQ, SQ | Mqn | Sapfeeder |
| Triozidae | | | | |
| *Trioza* sp. | C | NQ | Mqn, Mdl, Mlb | Sapfeeder |
| HEMIPTERA (AUCHENORRHYNCHA) | | | | |
| Aphrophoridae | | | | |
| *Philagra parva* (Donovan) | C | NQ, NSW, SQ | Mqn, Cvm, Esp | Sapfeeder |
| *?Philagra* sp. B | R | NSW | Mqn | Sapfeeder |
| Undet. Aphrophoridae sp. A | U | NQ | MspA | Sapfeeder |
| Cicadellidae | | | | |
| *Austroasca* sp. | R | NQ | Mdl | Sapfeeder |

**Appendix 1. Continued.**

| Taxonomy | Abundance | Region | Host | Host Relationship/ Comments |
|---|---|---|---|---|
| *Balclutha rosea* (Scott) | U | NQ | Mdl | Sapfeeder |
| *Batracomorphus ixion* Knight | R | SQ | Mqn | Sapfeeder |
| *B. latona* Knight | U | NQ | Mdl, Mqn | Sapfeeder |
| *Batracomorphus* sp. E | C | NSW, SQ | Mqn | Sapfeeder |
| *Brunotartessus* nr. *aroaensis* F. Evans | U | NQ | Mqn, Cvm, Mcj | Sapfeeder |
| ?*Chunra* sp. | R | NQ | Mqn | Sapfeeder |
| *Hishimonus melaleucae* (Kirkaldy) | U | NT, SQ | Mqn, Mnv | Sapfeeder |
| *?Kahaono* sp. | U | NQ, SQ | Mqn, MspA | Sapfeeder |
| *Ledropsis crocina* Distant | R | NSW | Mqn | Sapfeeder |
| *Microtartessus idyia* (Kirkaldy) | R | NQ | Mqn | Sapfeeder |
| *Zaletta aulonias* (Kirkaldy) | U | NQ, SQ | Mdl, Mlb, Mqn | Sapfeeder |
| *Zaletta* sp. B | R | SQ | Mqn | Sapfeeder |
| Undet. Tartessinae sp. | U | NQ | Mqn, Mcj | Sapfeeder |
| Undet. Cicadellidae sp. L | R | NQ | Mqn | Sapfeeder |
| Cicadidae | | | | |
| Undet. Cicadidae sp. A | R | NQ | Mqn | Sapfeeder |
| Undet. Cicadidae sp. B | R | NSW, SQ | Mqn | Sapfeeder |
| Cixiidae | | | | |
| *Myndus* sp. | R | NQ | Mqn | Sapfeeder |
| *Oliarus lilinoe* Kirkaldy | U | NQ | Mqn, Mnv, Mdl | Sapfeeder |
| Undet. Cixiidae sp. | R | NQ | Mqn | Sapfeeder |
| Delphacidae | | | | |
| Undet. Delphacidae sp. B | U | NQ | Mdl | Sapfeeder |
| Dictyopharidae | | | | |
| *Hasta paupera* Kirkaldy | R | NQ | Mqn | Sapfeeder |
| Eurymelidae | | | | |
| *Anacornutipo lignosa* (Walker) | R | NQ | Mqn, Mlb | Sapfeeder |
| *Ipo aegrota* Kirkaldy | R | NQ | Mqn | Sapfeeder |
| *I. conferta* Kirkaldy | A | NQ, SQ | Mqn, Mlb, Mdl | Sapfeeder on tips and stems |
| *I. pellucida* (Fabricius) | U | NQ | Mqn, Mvr, Mdl, Mlb | Sapfeeder |
| *Ipoides loranthae* Evans | R | NQ | Mqn | Sapfeeder |
| *I. melaleucae* Evans | C | NQ, SQ | Mqn, Cvm, Csg, Mnv, Mdl, Mlb | Sapfeeder |
| *Ipoides* nr. *melaleucae* Evans | R | NQ | Mqn | Sapfeeder |
| *Ipoides* nr. *minor* Evans | R | NQ | Mlb | Sapfeeder |
| *Malipo ?bianchii* Evans | R | NQ | Mqn | Sapfeeder |
| Undet. Eurymelidae sp. H | R | NQ | Mqn | Sapfeeder |
| Undet. Eurymelidae sp. I | U | NQ | Mdl | Sapfeeder |
| Undet. Eurymelidae sp. J | U | NQ | Mdl | Sapfeeder |
| Flatidae | | | | |
| *Colgar rufostigmatum* Distant | U | NQ | Mlb, Mdl | Leaf sapfeeding nymph, stem/branch sapfeeding adult |
| *Colgar* sp. A | U | NQ | Mlb, Mqn, Mdl, Mvr | Leaf sapfeeding nymph, stem/branch sapfeeding adult |
| *Colgar* sp. B | C | NQ | Mlb, Mqn, Mdl, Mcj | Leaf sapfeeding nymph, stem/branch sapfeeding adult |

**Appendix 1. Continued.**

| Taxonomy | Abundance | Region | Host | Host Relationship/ Comments |
|---|---|---|---|---|
| *?Dworena* sp. | R | NQ | Mqn | Sapfeeder |
| *Euphanta* nr. *acuminata* Melichar | R | SQ | Mqn | Sapfeeder |
| *Paradaksha ?meeki* Distant | R | NQ | Mqn | Sapfeeder |
| *Parasiphanta lanceolata* Fletcher | R | NQ | Mdl | Sapfeeder |
| *Sephena* sp. | R | NQ | Mqn | Sapfeeder |
| *Siphanta galeata* Kirkaldy | U | NQ | Mqn | Sapfeeder |
| *S. ?hebes* (Walker) | R | NSW | Mqn | Sapfeeder |
| *S. patruelis* (Stål) | C | NQ, NSW, SQ | Mqn, Mdl, Mlb, Mdi, Etr | Sapfeeder |
| *S. ?roseicincta* (Walker) | R | SQ | Mqn | Sapfeeder |
| *S. ?rubra* (Schmidt) | R | NSW | Mqn | Sapfeeder |
| *Siphanta* sp. A | R | NQ | Mqn | Sapfeeder |
| Fulgoridae | | | | |
| *Eurynopsyche obscurata* (Fabricius) | R | NQ | Mdl | Sapfeeder |
| Lophopidae | | | | |
| Undet. Lophopidae sp. | R | SQ | Mqn | Sapfeeder |
| Machaerotidae | | | | |
| Undet. Machaerotidae sp. | U | NQ | Mqn | Tube-dwelling sapfeeder |
| Membracidae | | | | |
| *Eufaimaiaria* sp. | R | NQ | Mqn | Sapfeeder |
| Undet. Membracidae sp. A | R | NQ | Mqn | Sapfeeder |
| Undet. Membracidae sp. B | R | NSW | Mqn | Sapfeeder |
| Undet. Membracidae sp. D | R | NSW | Mqn | Sapfeeder |
| Ricaniidae | | | | |
| *Scolypopa australis* (Walker) | R | SQ | Mqn | Sapfeeder |
| Undet. Ricaniidae sp. A | C | NQ | Mqn, Mlb | Sapfeeder |
| Undet. Ricaniidae sp. B | C | NQ | Mqn, Mlb | Sapfeeder |
| HEMIPTERA (HETEROPTERA) | | | | |
| Acanthosomatidae | | | | |
| *Panaetius lobulatus* Stål | U | NQ, SQ | Mqn | ?Sapfeeder |
| Coreidae | | | | |
| *Acroelytrum muricatum* Mayr. | U | NT | Mcj | ?Sapfeeder |
| *Clavigralla horrens* Dohrn | U | NT | Mcj | ?Sapfeeder |
| *Pomponatius typicus* Distant | C | NQ, NT, SQ | Mqn, Cvm, Mnv, Csg | Nymphs and adults sapfeed on stems of new tips |
| Undet. Coreidae sp. | R | NQ | Mqn | ?Sapfeeder |
| Cydnidae | | | | |
| *Blaena* sp. | R | NQ | Mqn | (Root-feeder)[1] |
| Lestoniidae | | | | |
| Undet. Lestoniidae sp. | U | SQ | Mqn | (Sapfeeder)[1] |
| Lygaeidae | | | | |
| *Arocatus aenescens* Stål | R | NSW | Mqn | (Sapfeeder)[1] |
| *Cerocrompus* sp. A | R | SQ | Mqn | (Granivore)[1] |
| *Cerocrompus* sp. B | U | NQ | Mlb, Mqn | (Granivore)[1] |
| *Cerocrompus* sp. C | R | NQ | Mqn, Mlb | (Granivore)[1] |

**Appendix 1. Continued.**

| Taxonomy | Abundance | Region | Host | Host Relationship/ Comments |
|---|---|---|---|---|
| *Crompus* sp. | U | NQ, NSW, SQ | Mqn, Mdl, Cvm | (Feeds on Myrtaceae)[2] |
| ?*Crompus* sp. | R | NQ | Mlb | (Feeds on Myrtaceae)[2] |
| *Eurynysius meschioides* Ashlock | R | NQ | Mnv, Mvr | (Granivore)[1] |
| *Graptostethus pubescens* Slater | R | NQ | Mnv | ?Sapfeeder on flowers and leaves |
| *G. servus* (Fabricius) | U | NQ, NT | Mnv, Mcj, Mlb | Sapfeeder on flowers and leaves |
| *Nysius* sp. | U | NQ | Mqn | ?Sapfeeder |
| *Onocopeltus microps* Horvath | R | NQ | Mqn | ?Phytophagous |
| *Oxycarenus luctuosus* (Montrouzier) | R | NQ | Mlb | (Sapfeeder)[1] |
| *Paraeucosmetus* sp. | R | NQ | Mqn, Mlb | (Sapfeeder)[1] |
| *Paramyocara punctatum* Woodward and Malipatil | R | NQ | Mqn | (Granivore)[1] |
| *Plinthisus* sp. | R | NQ | Mqn, Esp | (Seedfeeder)[1] |
| Undet. Mydochiini sp. | R | NQ | Mqn | (Seedfeeder)[1] |
| Undet. Heterograstrinae sp. | U | NQ | Mqn | (Seedfeeder)[1] |
| Undet. Ischnorhynchinae sp. B | R | SQ | Mqn | (Feeds on Myrtaceae)[2] |
| Miridae | | | | |
| *Eucerocoris suspectus* Distant | C | NQ | Mqn | Adult and nymph sapfeed on leaves |
| nr. *Calocoris* sp. | U | NQ | Mdl, MspA. Mqn | Feeds on sap of flowers |
| *Campylomma austrina* Malipatil | R | NQ, SQ | Mqn | ?Sapfeeder |
| *Eurystylus* sp. B | U | NQ | Mdl, Mqn | (Sapfeeder)[1] |
| *Leucophoroptera* nr. *novoirlandense* Schuh | R | SQ | Mqn | (Sapfeeder)[1] |
| *Leucophoroptera* sp. B | R | NQ | Mqn | (Sapfeeder)[1] |
| *Megacoelum* sp. A | R | NQ | Mdl | (Sapfeeder)[1] |
| *Megacoelum* sp. B | R | NQ | Mdl, Mlb | Feeds on sap of flowers |
| *Sejanus* sp. | C | NQ, SQ | Mqn, Mvr, Mlb | (Sapfeeder)[1] |
| ?*Singhalesia* sp. | R | NQ | Mnv | (Sapfeeder)[1] |
| *Termatophylum* sp. | U | NQ, NSW, SQ | Mqn | (Sapfeeder)[1] |
| Undet. Orthotylini sp. A | R | NQ | Mlb | (Sapfeeder)[1] |
| Undet. Orthotylini sp. B | C | NSW, SQ | Mqn | (Sapfeeder)[1] |
| Undet. Orthotylini sp. C | U | NQ | Mqn, Mlb, Mvr | (Sapfeeder)[1] |
| Undet. Orthotylini sp. E | R | NQ | Mnv | (Sapfeeder)[1] |
| Pentatomidae | | | | |
| *Amyotea hamata* (Walker) | R | NQ | Mqn | (Sapfeeder)[1] |
| *Aspideurus quadrimaculatus* Signoret | R | SQ | Mqn | (Sapfeeder)[1] |
| *Avicenna inquinata* (Westwood) | C | NQ, NSW, SQ | Mqn, Mlb, Mdl, Mvr, Mnv | Sapfeeder on flowers, fruit and young tips |
| *A. virescens* (Distant) | R | NQ | Mlb | ?Feeds on sap of flowers and fruit |
| *Austromalaya* sp. | R | NQ | Mlb | (Sapfeeder)[1] |
| *Menida* nr. *purpuraria* Distant | R | NQ | Mqn | (Sapfeeder)[1] |

**Appendix 1. Continued.**

| Taxonomy | Abundance | Region | Host | Host Relationship/ Comments |
|---|---|---|---|---|
| *Oncocoris detersus* (Walker) | R | NQ | Mqn | ?Sapfeeder |
| *Piezodorus hybneri* (Gmelin) | U | NQ | Mdl, Mqn, Mlb, Mnv | Feeds on sap of leaves |
| *Plautia* sp. | R | NQ | Mqn | (Sapfeeder)[1] |
| *Poecilometis pallescens* (Distant) | R | NQ | Mdl, Mlb | (Sapfeeder)[2] |
| *P. spenceri* Bergroth | R | NQ, SQ | MspA, Mqn | (Sapfeeder)[2] |
| Plataspididae | | | | |
| *Coptosoma* sp. | R | NQ | Mqn | (Sapfeeder)[1] |
| Tingidae | | | | |
| *Epimixia* sp. | R | NQ | Mqn | (Sapfeeder)[1] |
| *Paracopium albofasciata* Hacker. | R | NQ | Mqn | (Gall-former)[1] |
| THYSANOPTERA | | | | |
| Thripidae | | | | |
| *Haplothrips* sp. | U | NQ | Mqn | (Flower-feeder)[3] |
| *Katothrips* sp. | U | NQ | Mdl | ?Phytophagous |
| COLEOPTERA | | | | |
| Anobiidae | | | | |
| *Dryophilodes* sp. A | U | NQ, SQ | Mqn | (Larva bore into woody fruit)[4,5] |
| *Dryophilodes* sp. B | R | SQ | Mqn | (Larva bore into woody fruit)[4,5] |
| Anthicidae | | | | |
| *Anthicus* sp. A | U | NQ | Mnv | ?Flower-feeding adult |
| *Anthicus* sp. B | C | NQ | Mqn | Flower-feeding adult |
| *Anthicus* sp. C | U | NQ | Mqn, MspA | Flower-feeding adult |
| *Anthicus* sp. D | C | NQ | Mqn, MspA, Mlb, Mnv | Flower-feeding adult |
| *Anthicus* sp. E | C | NQ, NSW | Mlb, Mqn, MspA, Mdl | Flower-feeding adult |
| *Anthicus* sp. F | U | NQ | MspA | ?Flower-feeding adult |
| *Anthicus* sp. G | C | NQ, NSW, SQ | Mqn, Mnv | ?Flower-feeding adult |
| Apionidae | | | | |
| *Apion ?macleayense* Lea | U | NQ | MspA | ?Leaf-feeding adult |
| *Apion* sp. B | C | NQ, NT | Mqn, Cvm, Mnv, Mcj, Mdl, MspA, Mlb | Leaf-feeding adult |
| *Apion* sp. C | U | NQ | Mqn, Mdl, Mlb | ?Leaf-feeding adult |
| *Apion* sp. D | R | SQ | Mqn | ?Flower-feeding adult |
| *Apion* sp. E | R | SQ | Mqn | ?Flower-feeding adult |
| *Apion* sp. F | R | SQ | Mqn | ?Phytophagous |
| *Apion* sp. G | R | SQ | Mqn | ?Flower-feeding adult |
| *Apion* sp. I | U | NT | Mcj | ?Phytophagous |
| *Apion* sp. J | U | NQ | Cvm, Mqn, Mdi | ?Phytophagous |
| Undet. Apionidae sp. B | U | SQ | Mqn, Mlb | ?Phytophagous |
| Cerambycidae | | | | |
| *Rhytiphora* sp. | R | SQ | Mqn | Bark-feeding adult, ?wood-boring larva |

**Appendix 1. Continued.**

| Taxonomy | Abundance | Region | Host | Host Relationship/ Comments |
|---|---|---|---|---|
| *Platyomopsis pedicornis* (Fabricius) | R | NQ | Mvr | Collected as adult, ?wood-boring larva |
| Undet. Cerambycidae sp. larvae | U | NQ | Mqn | Wood-boring larva |
| Chrysomelidae | | | | |
| *Altica* sp. | R | SQ | Mqn | ?Flower feeder |
| *Aporocera clara* (Lea) | R | NQ | Mqn | Adult feeds on stamens and infructescences |
| *A. conjugata* (Chapius) | R | NQ | Mqn | ?Phytophagous |
| *A. gracilior* (Chapius) | U | NQ | Mqn | Flower-feeding adult |
| *A. iridipennis* (Chapius) | R | NQ, SQ | Mqn | Leaf-feeding adult |
| *Arsipoda* sp. | C | NQ, NSW, SQ | Mqn, Mlb | (Phytophagous)[6] |
| *Aspidomorpha larta* Blackburn | U | NT | Mcj | Leaf-feeding larva |
| *Bruchidius* sp. | R | NQ | Mqn | (Seed-feeding larva)[4] |
| *Callosobruchus chinensis* (Fabricius) | U | NQ | MspA, Mnv, Mqn | Introduced seed-feeder |
| *Chaetocnema* sp. B | R | NQ | Mqn | ?Phytophagous |
| *Crysophtharta* sp. | R | SQ | Mqn | ?Leaf-feeder |
| *Dicranosterna picea* (Olivier) | R | NSW | Mqn | ?Leaf feeder |
| *Ditropidus* sp. A | U | NQ | Mqn, Mlb, Mvr | (Flower-feeder)[7] |
| *Ditropidus* spp. | C | NQ | Mqn, Mvr | (Flower-feeder)[7] |
| *Geloptera* sp. A | R | NQ | Mqn | (Phytophagous)[6] |
| *Geloptera* sp. B | R | NQ | Mqn | (Phytophagous)[6] |
| *Geloptera* sp. C | R | SQ | Mqn | (Phytophagous)[6] |
| *Geloptera* sp. D | R | NSW | Mqn | (Phytophagous)[6] |
| *Longitarsus* sp. | R | NQ | Mqn | ?Phytophagous |
| *Monolepta australis* (Jacoby) | U | NQ, NSW, SQ | Mqn, MspA | (Phytophagous)[8] |
| *"Monolepta" sensu latu* | R | NQ | Mqn | ?Phytophagous |
| *Octotoma scabripennis* Guérin-Méneville | R | SQ | Mqn | (Introduced leaf-miner)[4] |
| *Paropsisterna octomaculata* (Marsham) | R | SQ | Mqn | Leaf-feeding adult |
| *P. tigrina* (Chapius) | U | NT, NQ | Mcj, Mnv, Mlb | Leaf-feeding adult and larva |
| *Paropsis thyone* Blackburn | U | NQ | Mqn, Mlb, Mnv | Leaf-feeding adult and larva |
| *Paropsis* cf. *variolosa* (Marsham) | C | SQ | Mqn | Leaf-feeding adult and larva |
| *Pyrgoides amabilis* (Chapius) | R | SQ | Mqn | ?Flower feeder |
| *Rhyparida* nr. *australis* (Bohemon) | U | NQ | Mqn, Mlb, Mnv | Leaf-feeding adult |
| *Rhyparida* nr. *brevilineata* Jacoby | C | NQ, SQ | Mqn, Mlb | Leaf-feeding adult |
| *Rhyparida* sp. C | R | NQ | Mqn | ?Phytophagous |
| *Rhyparida* sp. D | U | NQ | MspA | ?Phytophagous |
| *Rhyparida* sp. E | R | NQ | Mqn | ?Phytophagous |
| *Rhyparida* sp. F | R | NQ | Mqn, Mlb | ?Phytophagous |
| Undet. Hispinae sp. | R | NQ | Mlb | ?Phytophagous |
| Coccinellidae | | | | |
| *Epilachna vigintioctopunctata pardalis* (Biosduval) | R | NQ | Mdl | ?Leaf-feeding larva |

**Appendix 1. Continued.**

| Taxonomy | Abundance | Region | Host | Host Relationship/ Comments |
|---|---|---|---|---|
| Curculionidae | | | | |
| *Alcidodes bubo* (Fabricius) | R | NQ | Mdl, Mqn | Leaf-feeding adult |
| *"Baris" australis* Lea | C | NQ, SQ | MspA, Mlb, Mqn, Mvr, Mnv | ?Flower feeder |
| *"Baris" bryanti* Lea | C | NQ, NSW, SQ | MspA, Mqn, Cvm | ?Flower feeder |
| *Emplesis* sp. | R | NQ | Mdl | ?Phytophagous |
| *Epamoebus ziczac* Lea | U | NQ | MspA | ?Phytophagous |
| *Epamoebus* sp. B | R | SQ | Mlb | ?Phytophagous |
| *Gonipterus* sp. A | R | NQ | Mqn | Leaf-feeding adult and larva |
| *Gonipterus* sp. B | R | NQ | Mqn | Leaf-feeding adult and larva |
| *Haplonyx circularis* Lea | R | NSW, SQ | Mqn | Leaf-feeding adult, flower-feeding larva |
| *H. multicolor* Lea | C | NQ, SQ | Mqn, Mvr, Mdl, | Leaf-feeding adult |
| *Haplonyx* sp. G | R | NQ, SQ | Mqn, Mbr | Leaf-feeding adult |
| *Haplonyx* sp. H | R | NSW, SQ | Mqn | Leaf-feeding adult |
| *Hypurus bertrandi* (Perris) | R | NQ | Mdl | Flower-feeding adult |
| *Leptopius clavus* (Fabricius) | U | NQ | Mqn, Mlb | Leaf-feeding adult |
| *Melanterius* sp. | R | NQ | Mqn | ?Seed-feeder |
| *Myllocerus* sp. B | R | NQ | Mlb | ?Phytophagous |
| *Oxyops fasciculatus* Redtenbacher | U | NQ, NSW, SQ | Lgf, Mqn | Leaf-feeding adult |
| *O. vitiosa* Pascoe | A | NQ, SQ | Mqn, Mvr, Mnv, Mdi, Cvm, Erb | Leaf-feeding adult and larva |
| *Oxyops* sp. A | U | NQ | Mqn, Mlb | Leaf-feeding adult |
| *Rhaprobdinosomus lacordairei* Pascoe | R | NSW | Mqn | Adults feed on leaves and young stems |
| Undet. Entiminae sp. | R | SQ | Mqn | ?Leaf-feeder |
| Undet. Storeini sp. A | C | NQ | Mqn | Flower-feeding larva, leaf-feeding adult |
| Undet. Storeini sp. B | U | NQ | Mqn, Mlb, Mvr | ?Phytophagous |
| Undet. Tychiinae sp. A | U | NQ | MspA | ?Phytophagous |
| Undet. Tychiinae sp. D | U | NQ | Mnv | ?Phytophagous |
| Undet. Tychiinae sp. E | U | NQ | Mqn, Mlb | ?Phytophagous |
| Undet. Tychiini sp. A | R | NQ | Mqn, Mdl | ?Phytophagous |
| Undet. Tychiini sp. B | C | NQ | Mqn, Mvr | ?Phytophagous |
| Undet. Tychiini sp. C | R | NQ | Mqn | ?Phytophagous |
| Undet. Tychiini sp. D | R | NQ | Mqn, Mdl | ?Phytophagous |
| Undet. Tychiini sp. E | R | NQ | Mqn | ?Phytophagous |
| Undet. Tychiini sp. F | U | NQ | Mlb, Mnv | ?Phytophagous |
| Undet. Curculionidae sp. C | R | NQ | Mqn | ?Phytophagous |
| Undet. Curculionidae sp. D | R | NQ | Mqn | ?Phytophagous |
| Undet. Curculionidae sp. E | R | NQ | Mqn | ?Phytophagous |
| Dermestidae | | | | |
| *Trogoderma* sp. | R | NQ | MspA, Mlb | (Pollen and nectar feeder)[4] |
| Mordellidae | | | | |
| *Mordella* sp. A | R | SQ | Mqn | ?Flower feeder |
| *Mordella* sp. B | R | SQ | Mqn | ?Flower feeder |

**Appendix 1. Continued.**

| Taxonomy | Abundance | Region | Host | Host Relationship/ Comments |
|---|---|---|---|---|
| Nitidulidae | | | | |
| *Aethina (Olliffura) nigra* (Reitter) | C | NQ, NSW, SQ | Mqn | ?Pollen-feeding adult |
| *Aethina* (*Circopes*) sp. | C | NQ, NSW, SQ | Mqn | Flower feeder (Pollen feeder)[6] |
| *Brachypeplus* sp. | R | NSW | Mqn | ?Flower feeder (Found in fermenting bark of tree wounds)[4] |
| *Carpophilus* sp. A | U | NQ | MspA, Mqn | (Feed on rotten, dried and ripe fruits)[6] |
| *Carpophilus* sp. B | R | NSW | Mqn | ?Flower-feeder (feed on rotten, dried and ripe fruits)[6] |
| *Epuraca* sp. | C | NQ, NSW, SQ | Mqn | ?Flower feeder |
| *Platychoropsis* sp. | C | NQ | Mqn | ?Pollen-feeding adult |
| Scarabaeidae | | | | |
| *Glycyphana* sp. A | R | SQ | Mqn | ?Flower-feeding adult |
| *Glycyphana* sp. B | R | SQ | Mqn | ?Flower-feeding adult |
| *Protaetia fusca* (Herbst) | R | NQ, SQ | Mqn | Flower-feeding adult |
| Silvanidae | | | | |
| *Silvanolomus* sp. A | A | NQ, NSW, SQ | Mqn, Mvr, MspA, Mlb, Mnv, Esp | ?Pollen-feeding adult |
| DIPTERA | | | | |
| Cecidomyiidae | | | | |
| Undet. Cecidomyiidae sp. A | A | NQ, NSW, SQ | Mqn, Mlb | Reared from pea-shaped leaf galls |
| Undet. Cecidomyiidae sp. B | A | NQ | Mvr | Reared from pea-shaped leaf gall |
| Undet. Cecidomyiidae sp. C | A | NQ | Mdl | Reared from pea-shaped galls |
| Undet. Cecidomyiidae sp. D | C | NQ | Mqn | Reared from "tulip" gall |
| Undet. Cecidomyiidae sp. E | C | NQ | Mvr, Mdl | Reared from "trumpet" gall |
| Fergusoninidae | | | | |
| *Fergusonina* spp. | A | NQ, NSW, SQ | Mqn, Mlb, Mdl | Forms fleshy gall on growth tips |
| LEPIDOPTERA | | | | |
| Arctiidae | | | | |
| Undet. Arctiidae sp. | R | NQ | Mqn | Leaf-feeding larva |
| Cosmopterigidae | | | | |
| *Labdia* sp. | R | NQ | Mlb | Emerged from wood |
| *Leptozestis daserodes* (Meyrick) | R | SQ | Mqn | Flower-feeding larva |

**Appendix 1. Continued.**

| Taxonomy | Abundance | Region | Host | Host Relationship/ Comments |
|---|---|---|---|---|
| Undet. Cosmopterigidae sp. A | C | NQ, NSW, SQ | Mqn, Mvr | Flower-feeding larva |
| Undet. Cosmopterigidae sp. B | U | NQ, SQ | Mqn | Fruit-boring larva |
| Undet. Cosmopterigidae sp. C | R | NQ | Mqn | Fruit-boring larva |
| Undet. Cosmopterigidae sp. E | R | NSW, SQ | Mqn | Tip-binding larva |
| Gelechiidae | | | | |
| *Hypatima* sp. | R | SQ | Mqn | Flower-feeding larva |
| *Protolechia* sp. | R | NQ, SQ | Mqn | Tip-binding larva |
| Undet. Gelechiidae sp. A | R | NQ | Mqn | Tip-binding larva |
| Geometridae | | | | |
| *Aelochroma quadrilinea* (Lucas) | R | NQ, SQ | Mqn, Mlb | Leaf-feeding larva |
| *Anisozyga pieroides* (Walker) | C | NQ, NSW, SQ | Mqn | Leaf-feeding larva |
| *Boarmia lithina* (Warren) | U | SQ | Mqn | Leaf-feeding larva |
| *Chloroclystis insigillata* Walker | U | NQ | Mqn, Mvr | Flower- and leaf-feeding larva |
| *Chloroclystis* sp. C | U | SQ | Mqn | Flower-feeding larva |
| *Cleora repetita* Butler | U | NQ, SQ | Mqn | Sapling leaf-feeder, shadehouse pest |
| *Cleora* sp. B | R | NQ | Mqn | Leaf-feeding larva |
| *Comostola laesaria* (Walker) | C | SQ | Mqn | Flower-feeding larva |
| *?Gymnoscelis lophopus* Turner | R | NQ | Mqn | Leaf-feeding larva |
| *Hypodoxa erebusata* (Walker) | R | NQ | Mqn | Leaf-feeding and leaf-mincing larva |
| *Hyposidra janiaria* (Guenee) | U | NQ | Mqn, MspA | Leaf-feeder, shadehouse pest |
| *Lobus lithinopa* (Meyrick) | C | NQ, SQ | Mqn, Mlb | Leaf-feeding larva |
| *Metallochlora militaris* (Lucas) | R | NQ | Mqn | Flower-feeding larva |
| *Syneora hemeropa* (Meyrick) | R | SQ | Mqn | Leaf-feeding larva |
| *Thalassodes quadraria* Guenee | U | NQ | Mqn, Mlb | Flower-feeding larva |
| *Uliocnemis partita* (Walker) | R | NQ | Mlb | Flower-feeding larva |
| Undet. Geometridae sp. | R | NQ | Mqn | Flower- and leaf-feeding larva |
| Gracillariidae | | | | |
| *?Acrocercops* sp. | C | NQ | Mqn | Larva forms a blotch mine in leaf |
| Immidae | | | | |
| *Imma* sp. | C | NQ | Mqn, Mlb | Leaf-feeding larva |
| Lasiocampidae | | | | |
| *Entometa* sp. | R | NQ, SQ | Mqn | Leaf-feeding larva |
| *Porela arida* (Walker) | U | NQ, SQ | Mqn, Mlb | Leaf-feeding larva |
| *Porela* sp. B | R | NQ | Mlb, Mqn | Leaf-feeding larva |
| Limacodidae | | | | |
| *Comana* sp. | R | NQ | Mqn | Leaf-feeding larva |
| *Doratifera vulnerans* (Levin) | R | NQ | Mqn | Leaf-feeding larva |
| *Pygmaeomorpha ocularis* (Lucas) | U | NQ | Mlb, MspA | Leaf-feeding larva |
| Lycaenidae | | | | |
| *Arhopala centaurus* (Fabricius) | R | NQ | Mqn | Leaf-feeding larva |
| Lymantriidae | | | | |
| *Euproctis* sp. | R | SQ | Mqn | Leaf-feeding larva |
| *Olene* sp. B | R | NQ | Mlb | Flower-feeding larva |

**Appendix 1. Continued.**

| Taxonomy | Abundance | Region | Host | Host Relationship/ Comments |
|---|---|---|---|---|
| *Olene mendosa* Hubner | R | NQ | Mdl | Leaf-feeding larva |
| *Porthesia* sp. B | R | NQ | Mqn | Flower-feeding larva |
| *Porthesia* sp. C | R | NQ | Mqn | Flower-feeding larva |
| *Porthesia* sp. D | R | NQ | Mlb | Flower-feeding larva |
| *Porthesia* sp. E | U | NQ | Mqn, Cvm, Mlb, Mvr | Flower and leaf-feeding larva |
| *Porthesia* sp. F | R | NQ | Mlb | Flower-feeding larva |
| *Porthesia* sp. G | R | NQ | Mlb, Ept | Flower-feeding larva |
| Noctuidae | | | | |
| *Agrotis* sp. | R | SQ | Mqn | Leaf-feeding larva |
| *Careades plana* Warren | C | NQ | Mqn | Leaf-feeding larva |
| *Celama argentea* Lucas | R | NQ | Mqn | Flower- and leaf-feeding larva |
| *Characoma vallata* (Meyrick) | C | NQ, NSW, SQ | Mqn, Mvr | Flower-feeding and tip-binding larva |
| *Eublemma silicula* (Swinhoe) | U | NQ, SQ | Mqn, MspA | Flower- and leaf-feeding larva |
| *Homodes bracteigutta* (Walker) | R | NQ | Mqn | Leaf-feeding larva |
| *Nanaguna breviuscula* Walker | R | NQ | Mqn | Flower-feeding larva |
| *Ophiusa disjungens* (Walker) | R | NQ, SQ | Mdl, Mqn | Leaf-feeding larva |
| *Pataeta carbo* (Guenee) | C | NQ, NT, SQ | Mqn, Mcj, Mdi, Mdl | Leaf-feeding larva |
| *Spodoptera litura* (Fabricius) | U | NQ, SQ | Mqn | Leaf-feeding larva, only in shadehouse |
| *S. mauritia* (Boisduval) | R | SQ | Mqn | Larva feeds on saplings in glasshouse |
| Undet. Sarrothripinae sp. A | R | NQ | Mqn | Tip-binding larva |
| Undet. Sarrothripinae sp. B | U | NQ | Mvr | Leaf-feeding larva |
| Oecophoridae | | | | |
| *Agriophara* sp. | U | NQ | Mlb | Leaf-feeding larva |
| *Chrysonoma consularis* (Meyrick) | C | NQ | Mnv | Leaf-feeding larva |
| *C. fascialis* (Fabricius) | R | NQ | Mqn | Leaf-feeding larva |
| *Clerarcha poliochyta* Turner | C | NQ | Mqn, Mvr | Wood-boring, leaf-feeding larva |
| *Compsotropha* sp. | U | NQ | MspA | Leaf-feeding larva |
| *Cryptophasa nephroserna* Turner | R | NQ | Mqn | Wood-boring, leaf-feeding larva |
| *Cryptophasa* sp. C | R | SQ | Mqn | Wood-boring, leaf-feeding larva |
| *Cryptophasa* sp. D | R | NSW, SQ | Mqn | Wood-boring, leaf-feeding larva |
| *Eochrois* sp. B | U | NQ | Mqn | Leaf-feeding larva |
| "*Garrha*" sp. A | U | NQ | Mlb | Leaf-feeding larva |
| "*Garrha*" sp. B | U | NQ | Mqn, Mdl | Leaf-feeding larva |
| "*Garrha*" sp. C | R | NQ | Mqn | Leaf-feeding larva |
| *Lophopepla igniferella* (Walker) | C | NQ | Mcj, Mvr | Leaf-feeding larva |
| *Lophopepla* sp. B | U | NQ | Mqn, Mvr | Leaf-feeding larva |
| *Ptyoptila matutinella* (Walker) | R | SQ | Mqn | Leaf-feeding larva |
| *Xylorycta* sp. | R | NQ | Mqn | Wood-boring, leaf-feeding larva |
| Undet. Oecophoridae sp. B | R | NQ | Mlb | ?Leaf-feeding larva |
| Undet. Oecophoridae sp. C | R | SQ | Mqn | Leaf-feeding larva |
| Undet. Oecophoridae sp. D | R | NSW | Mqn | Tip-feeding larva |

**Appendix 1. Continued.**

| Taxonomy | Abundance | Region | Host | Host Relationship/ Comments |
|---|---|---|---|---|
| Undet. Oecophorinae sp. | R | NQ | Mlb | Tip-feeding larva |
| Undet. Xyloryctinae sp. A | U | NQ | Mqn | Wood-boring, leaf-feeding larva |
| Undet. Xyloryctinae sp. B | R | SQ | Mqn | Leaf-feeding larva |
| Psychidae | | | | |
| ?*Hyalarcta* sp. | R | NQ | Mqn | Leaf-feeding larva |
| Undet. Psychidae sp. | C | NQ | Mqn | Leaf-feeding larva |
| Pyralidae | | | | |
| *Addyme* cf. *defiguralis* (Walker) | R | NQ | Mqn | Flower-feeding larva |
| *Agrotera amathealis* (Walker) | R | NQ, SQ | Mqn | Tip-binding larva |
| *Cryptoblabes* nr. *adoceta* Turner | U | NQ, NSW, SQ | Mqn | Flower- and leaf-feeding larva |
| *Cryptoblabes* sp. B | C | NQ | Mqn | Flower- and fruit-feeding larva |
| *Cryptoblabes* sp. C | R | NQ | Mlb | Flower-feeding larva |
| *Endotricha mesenterialis* (Walker) | R | NQ | Mlb | Fruit-boring larva |
| *Epipaschia* sp. B | U | NQ | Mqn | Tube-building, leaf-webbing, leaf-feeding larva |
| *Orthaga thyrisalis* (Walker) | R | SQ | Mqn | Flower-feeding larva |
| *Syntonarcha iriastis* Meyrick | A | NQ, SQ | Mqn, Mlb, Mvr | Flower-feeding larva |
| *S. vulnerata* Lucas | U | NQ, NSW, SQ | Mqn | Flower-feeding larva |
| Undet. Phycitinae sp. | R | SQ | Mqn | Flower-feeding larva |
| Undet. Pyralidae sp. | R | SQ | Mqn | Leaf-feeding larva |
| Thaumetopoeidae | | | | |
| *Epicoma protrahens* (Lucas) | C | SQ | Mqn | Leaf-feeding larva |
| Tineidae | | | | |
| *Metapherna* sp. | R | SQ | Mqn | Stem-boring larva |
| Tortricidae | | | | |
| *Adoxophyes templana* (Pagenstecher) | U | NQ | Mqn, Mdl | Tip-binding larva |
| *Adoxophyes* sp. B | U | NT | Mnv | Leaf-feeding larva |
| *"Bathrotoma" quietana* (Meyrick) | R | NQ, NT, SQ | Mqn, Mnv | Tip-binding larva |
| *Bathrotoma* sp. E | R | NQ | Mqn | Leaf-binding larva |
| *Dudua aprobola* (Meyrick) | C | NQ | Mqn, Mlb | Flower- and leaf-feeding larva |
| *Epiphyas postvittana* (Walker) | R | SQ | Mqn | Flower-feeding larva |
| *Holocola* cf. *thalassinana* (Meyrick) | C | SQ | Mqn | Tip-binding and flower-feeding larva |
| *Holocola* sp. B | U | NQ | Mvr | Flower-feeding larva |
| *Holocola* sp. D | R | SQ | Mqn | Tip-binding larva |
| *Isotenes* cf. *miserana* (Walker) | U | NQ, NSW | Mqn | Flower-feeding larva |
| *Isotenes* sp. E | R | NQ | Mqn | Tip-binding larva |
| *Lobesia* cf. *peltophora* (Meyrick) | R | NQ | Mqn | Flower-feeding larva |
| *L. peltophora* complex | C | NQ, SQ | Mqn | Flower-feeding larva |
| *Ophiorrhabda* sp. | U | NQ | Mlb | Leaf-binding larva |
| *Strepsicrates* prob. *dyselia* (Turner) | U | NT | Mnv, Mcj, Mdl, Mqn | Flower-feeding and tip-binding larva |
| *S. semicanella* (Walker) | C | NQ, NSW, SQ | Mqn | Flower-feeding and tip-binding larva |

**Appendix 1. Continued.**

| Taxonomy | Abundance | Region | Host | Host Relationship/ Comments |
|---|---|---|---|---|
| *Strepsicrates* cf. *semicanella* (Walker) | C | NQ, SQ | Mqn, Mdl, Mlb | Tip-binding and flower- and fruit-feeding larva |
| *Strepsicrates* cf. *transfixa* (Turner) | U | NQ, SQ | Mqn | Tip-binding larva |
| HYMENOPTERA | | | | |
| Pergidae | | | | |
| *Acanthoperga cameronii* (Rohwer) | C | SQ | Mqn | Larvae feed on young foliage of saplings and trees |
| *Lophyrotoma zonalis* (Rohwer) | A | NQ | Mdl, MspA, Mlb, Mqn, Mvr | Leaf-feeding larva |
| *Lophyrotoma* sp. B | C | NSW, SQ | Mqn | Leaf-feeding larva |
| *Pergagrapta* sp. | C | NSW, SQ | Mqn | Larvae feed on young foliage of saplings and trees |
| *Perga vollenhovii* Westwood | U | NQ | Mlb | Leaf-feeding larva |

CODES:

*Abundance*: R= Rare–Collected 3 times or less; U= Uncommon–Collected 4-10 times; C= Common–Collected regularly; and A= Abundant–Numerous specimens collected on some occasions.

*Host Species*: Mbr= *Melaleuca bracteata* F. Muell.; Mcj= *M. cajuputi* ; Mdi= *M. diosmatifolia*; Mdl= *M. dealbata* ; MspA= *Melaleuca* new sp. A; Mlb= *M. leucadendra*; Mnv= *M. nervosa*; Mqn= *M. quinquenervia*; Mvr= *M. viridflora;* Csg= *Callistemon salignus* (Smith) DC; Cvm= *C. viminalis*; Ept= *E. ptychocarpa* F. Muell.; Erb= *E. robusta*; Esp= *Eucalyptus sp.*; Etr= *E. tereticornis* Smith; and Lgf= *Lophostemon grandiflorus.*

*Host Relationship*: ?= Suspected host relationship; and ( )= Information obtained from other sources than the authors.

*Region*: NQ= northern Queensland; NSW= northern New South Wales; NT= Northern Territory; and SQ= south-east Queensland.

*References*: [1]= Cassis, G.C. (personal communication); [2]= Slater (1991); [3]= Mound and Heming (1991); [4]= Lawrence and Britton (1991); [5]= Andersen and New (1987); [6]= Lawrence, J.F. (personal communication); [7]= Reid, C.A.M. (personal communication); and [8]= Jones and Elliot (1986).