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Invertebrate survey of a modified native shrubland, Brookdale Covenant, Rock and Pillar Range, Otago, New Zealand

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Abstract This is the first published invertebrate survey focusing on a low-altitude shrubland community in New Zealand. Invertebrates were collected from a remnant native shrubland (450 m) protected by the Brookdale Conservation Covenant, Rock and Pillar Range, Otago, New Zealand in late summer/autumn 1999. Sampling was carried out by beating 30 randomly chosen shrubs of each of two native species: *Olearia bullata* H. D. Wilson & Garnock-Jones (Asteraceae) and *Coprosma propinqua* A. Cunn. (Rubiaceae). Fifty pitfall traps were also set under the same shrubs and on nearby open patches of exotic grassland. Three Phyla, six Classes, 25 Orders and approximately 280 species were recorded. An annotated list of taxa is presented, and plant/host associations plus other observations on the fauna are discussed. Approximately 90% of the identified species were endemic, emphasising the importance of such remnant habitats for the protection of New Zealand's biodiversity.

Keywords invertebrate survey; shrubland; Otago; pitfall traps; beating; *Olearia bullata*; *Coprosma propinqua*; Arachnida; Insecta; Crustacea; Diplopoda; Gastropoda; Oligochaeta

INTRODUCTION

It is acknowledged that the New Zealand biota is globally important. Myers et al. (2000) placed the fauna among the 25 biodiversity hotspots of the world. Holloway and Stork (1991) emphasised the importance of New Zealand's biodiversity even more dramatically: "extinction of the entire British fauna would result in little loss to global diversity.... Loss of the New Zealand fauna and flora, in contrast, would be devastating". New Zealand's invertebrate fauna is unique and diverse, and at least 90% of its members are endemic at the species level (Watt 1975; Patrick 1994; Klimaszewski 1997). This level of endemism is one of the highest in the world for a discrete area (Dugdale 1988). Despite its international importance, New Zealand's biota faces a severe decline (Department of Conservation/ Ministry for the Environment 2000).

The situation could be especially serious for invertebrates, as they are often neglected in conservation studies. Though they form the largest share of the world's biodiversity (Wilson 1987; Fearnside 1999), scientists, such as New (1998), have expressed concern that "most conservation managers and practitioners know very little about the biology of invertebrates or how to study and survey them adequately in the field". Moreover, when reserves are set aside they are often based on the distribution of charismatic large vertebrates or on botanical surveys. Reserves are seldom selected solely for the protection of individual invertebrate species, and never specifically for an invertebrate community. As a result, it is important to expand our knowledge about invertebrates in general, but especially on more efficient ways to study them. One such step is to provide baseline knowledge by cataloguing the diversity of invertebrates.

This study aims to provide information on the diversity of invertebrate species from one remnant lowland native shrubland. In general terms, the lowlands (roughly below 800 m) have the greatest productive agricultural value, and tend to be the most botanically modified. Hence, such areas are often under-represented in the protected natural areas network (Crisp et al. 1998). Nevertheless, they may still harbour high biodiversity, particularly among the invertebrate fauna (e.g., Barratt et al. 1998). Consequently, an inventory of New Zealand's invertebrate groups in lowland areas has become an urgent task.

Invertebrates were collected from a modified native shrubland at 450 m altitude (45°30′S, 170°03′E) in the Brookdale Conservation Covenant (private land protected under the Reserves Act 1977), on the lower eastern slopes of the Rock and Pillar Range, South Island, New Zealand. Located 50 km inland, the range rises gently to an elevation of 1450 m (Talbot et al. 1992), and experiences annual rainfall of approximately 600 mm at the study site (Knight Frank 1995). It is one of several rolling, block-faulted schist ranges running NE-SW, inland

from coastal Otago that form the distinctive characteristic Central Otago tor landscape (McCraw 1965). It is a region of extensive modified tussock grasslands, shrublands and alpine vegetation. The shrubland area has been protected because it is representative of this vegetation type on the range, and is significant for its botanical values (Knight Frank 1995). The covenant is protected in perpetuity in the land title, and while limited grazing is allowed, the use of fire as a management tool is not (Reserves Act 1977, S.77).

The native vegetation of the South Island has been dramatically altered since human occupation approximately 800 years ago (McGlone & Wilmshurst 1999). In the region of the Rock and Pillar Range, this continued human disturbance has restricted lower-elevation shrublands to gullies, which have been protected from fire (often also from heavy grazing) by the topography. These shrublands probably do not represent the original pre-human vegetation (McGlone 2001), but are still dominated by native woody species that survived the disturbance processes. The covenant area chosen for this study was the focus of a wider plant-invertebrate biodiversity research programme (Derraik 2001). A 5 ha area on the south facing (shady) aspect of the main gully bisecting the covenant was selected for sampling, as its vegetation cover was more suitable for the research programme. Moreover, the shady slope was predicted to have higher soil moisture and more favourable conditions for invertebrates than the drier, northerly (sunny) faces, especially given the steepness of the site.

This paper reports the results of the invertebrate sampling in this modified shrubland and provides the baseline inventory for the companion studies focusing on plant-invertebrate relationships (Derraik 2001).

METHODS

For the collection of invertebrate specimens we focused on the two most important native species in the shrubland community: *Olearia bullata* H. D. Wilson & Garnock-Jones (Asteraceae) and *Coprosma propinqua* A. Cunn. (Rubiaceae). They are both divaricating species (for definitions of divarication see McQueen 2000). Moreover, the two genera are known to harbour a rich invertebrate fauna (Spain 1967; Dugdale 1975; Patrick 2000). Thirty *O. bullata* and 30 *C. propinqua* shrubs were randomly selected from the south-facing slope. They were sampled in late summer/autumn (March/April 1999) by beating (New 1998). Each plant received 10 downward strokes with a 1.5 m long metal probe, and the falling material was collected on a polythene sheet, 1.0 m × 1.3 m, placed underneath. The material was then sealed in a plastic bag, labelled and frozen. Of the 30 *C. propinqua* sampled, collections from only 15 were used in this study. The other 15 plants were fruiting heavily, and the resulting stickiness seriously impaired the separation of invertebrates.

Fifty pitfall traps were also set during the same period to sample ground-dwelling invertebrates. These were set beneath 20 *Olearia* and 20 *Coprosma* plants. The other ten were randomly placed on open patches of exotic grassland within the shrubland study area, which were dominated by the exotic grasses *Agrostis capillaris* L. (browntop) and *Anthoxanthum odoratum* L. (sweet vernal). Each pitfall trap consisted of a PVC pipe 80 mm diameter and 100 mm long, containing a plastic cup (opening 75 mm diameter). Each cup was two-thirds filled with anti-freeze (ethylene glycol) and a plastic lid, supported 10–20 mm off the ground by bent wire, covered the trap. The traps were emptied once after 2 weeks.

The invertebrates were sorted initially into morphospecies by J. G. B. Derraik, using a low-power binocular microscope. The vials containing the morphospecies were then sent to taxonomists for identification or verification.

RESULTS AND DISCUSSION

In total, 9116 invertebrates were collected at the site. They represented three Phyla (Annelida, Mollusca and Arthropoda), six Classes (Oligochaeta, Gastropoda, Arachnida, Crustacea, Diplopoda and Insecta), 25 Orders and approximately 280 species.

The specimens were identified to the lowest taxonomic level possible. The taxonomy of many invertebrate species in New Zealand is unresolved and some specimens were battered or incomplete. Therefore, numerous taxa were identified only to the genus or family level. The taxa are summarised and discussed below with reference to Appendix 1, which gives authorities for each species.

Phylum Annelida

Class Oligochaeta

Only three species of this Class, one of the Order Haplotaxida and two of the Order Enchytraeida,

were collected in pitfall traps. However, pitfall traps are not the ideal sampling method for earthworms as most species rarely come to the soil surface. Sampling the soil using more destructive methods would probably have yielded more species. Another factor potentially influencing the outcome was the sampling period (late summer/early autumn), when most species are only beginning to get active again after the dry season (summer). Many Oligochaeta have a period of aestivation during the dry, hot summer conditions, therefore sample sizes tend to peak in late winter/early spring.

For the reasons given above, it is very likely that the species collected in this study are litter-dwelling. The specimens from the Haplotaxida may be of an undescribed endemic species. It probably belongs in the Acanthodrilidae, as the species in the other main native family (Megascolecidae) tend to be much larger in size. The remaining species in the Order Enchytraeida are probably from the family Enchytraeidae. Invertebrates from this Order are close cousins to earthworms (Order Haplotaxida), being anatomically similar, but much smaller (Coleman & Crossley 1996). Taxonomic expertise was not available to further identify the enchytraeid specimens to genera or species.

Phylum Mollusca

Class Gastropoda

Order Stylommatophora. Four species of molluscs from the order Stylommatophora were collected at the site. Two species are endemic snails of Punctidae: *Phrixgnathus celia* and an undescribed species of *Laoma*. Both species were widespread throughout the site and they were found on both shrub species, but only *P. celia* was taken in the pitfall traps.

Two species of exotic slugs were found. *Arion intermedius* has been passively introduced to New Zealand, and is now widespread (Barker 1999). It is most abundant in relatively undisturbed areas, but lives in a wide range of environments from open pasture to native forest areas (Barker 1999). The other species is *Deroceras reticulatum*, the most common and widespread of New Zealand's introduced slugs (Barker 1979). It has been widely dispersed around the world through human activities, and an extensive literature on this species is available due to its utility as a lab animal and its frequent pest status in cultivated crops (Barker 1999). In New Zealand it reaches large numbers in areas greatly modified by human activities; it does not inhabit native forests (Barker 1979).

Phylum Arthropoda

Class Arachnida

Order Acari. This was the most abundant Order represented, making up 27.8% of all invertebrates collected. Nineteen morphospecies were identified, but no information on taxonomic species is yet available due to difficulties in the identification process.

Order Araneae. Thirty-three spider species from 14 families were recorded for the site. Of those, four were identifiable just to family level, 14 as far as genus, and the other 15 to species level. Only two species were not endemic (the very common exotic *Diplocephalus cristatus* and the Australasian *Eriophora pustulosa*). There were also a number of specimens that were not identifiable beyond Order. These, as well as specimens identified only to family or genus level, were usually juveniles, and lacked the key diagnostic features of adult spiders. None of the fully identified species could be considered unusual records for this region. However, members of several as yet unrevised families for New Zealand (e.g., Theridiidae) may prove to be new species. It was not particularly surprising that two new Salticidae species were recorded, since New Zealand's large salticid fauna is still awaiting revision.

The majority of species were web-builders rather than hunting spiders, although overall there were similar numbers of individuals in each of these groups. *Olearia bullata* and *Coprosma propinqua* shared a similar fauna and the species did not appear to show any distinct pattern with regard to their distribution between the shrubs. The few species that were found on only one shrub, such as *Clubiona convoluta*, *Plectophanes* sp., *Coleranea viriditas* and *C. verutum*, were rare, and very few individuals were recorded. It is likely that rather than preferring one shrub species as habitat, they were not recorded on the second one by chance.

The faunules collected by pitfall traps and beating were quite distinct, with only *Diplocephalus cristatus* and *Dolomedes* sp. found in both shrub species and pitfall traps. *Dolomedes* sp. (only juveniles were available for identification) made up approximately 50% of the total number of spiders caught. It was found on all but one shrub sampled, but only one specimen was collected from a pitfall trap. Why it should be so abundant is uncertain, but this spider is often associated with this shrubland habitat (Forster & Forster 1999). Given the collection period of March–April, it seems likely that *Dolomedes* sp. produces many offspring that

overwinter as juveniles. Those that survive the winter go on to mature and mate in the spring (Sep–Nov).

Order Opiliones. Four endemic species of harvestmen were collected from the site. Three were from the family Triaenonychidae and one from the Monoscutidae. They were collected only from pitfall traps, indicating their strictly ground-dwelling habits.

Algidia cuspidata multispinosa has not been listed in published records from this locality before. However, given that this species appears to be known only from a handful of records in Forster's (1954) revision of the New Zealand Laniatores, it would not be surprising if its true range proved to be more extensive. *Nuncia* sp. is a difficult genus to identify further. The *Pristobunus henopoeus* specimen collected appears to be a new subspecies, and to our knowledge it is the first to be recorded from anywhere in Otago. *Pantopsalis* is an unrevised genus for New Zealand, and the species collected here may be new. Surprisingly, the similar but exotic *Phalangium opilio*, that is so widespread in even slightly modified shrubland and grassland habitats, was not collected.

Order Pseudoscorpiones. The only pseudoscorpion collected in the study was an undescribed *Apatochernes* species (Chernetidae). It was found throughout the site, on both shrub species and in the pitfall traps. The genus *Apatochernes* is the largest pseudoscorpion genus in New Zealand, with 16 described species (Beier 1976; Harvey 1991), ranging from Three Kings Island to the southern islands. The only *Apatochernes* species recorded outside New Zealand is *A. posticus* from Norfolk Island. However, the genus also contains a number of undescribed species from a wide variety of localities within New Zealand, and much taxonomic work is needed to ascertain the full extent of the fauna. Pseudoscorpions generally range in size from 4–8 mm, and are predators on other invertebrates. They inhabit various microhabitats in leaf litter, and under bark, stones and logs.

Class Crustacea

Order Amphipoda. The only amphipod collected at the site was the endemic species *Puhuruhuru aotearoa*. This species is very abundant and widespread throughout most of New Zealand, and it may actually be one of the most numerous native terrestrial animals (Duncan 1994). Its preferred habitat is in moss and leaf litter in forests, but it is also abundant in bush remnants and regenerating forests (Duncan 1994).

Order Isopoda. The European *Porcellio scaber* was the only species collected. All individuals were collected in pitfall traps, except for one specimen that was collected from *Coprosma propinqua*. It is widespread throughout temperate regions and is certainly the one most commonly seen in New Zealand.

Class Diplopoda

Order Juliformia. All six species of millipede were collected from pitfall traps. The exotic *Ophyiulus pilosus* was by far the most widespread and abundant millipede collected at the site. *O. pilosus* and *Cylindroiulus britannicus* (not found at the site) are the two most common introduced species in New Zealand. The other five species collected are endemic. The *Icosidesmus* species is probably *I. worthingtoni*, which extends through Central Otago from Queenstown to Dunedin. Little is known about the habitats of the other species. All millipedes are saprophagous or fungivorous and are an abundant group in the litter of New Zealand shrublands and forests.

Class Insecta

Order Blattodea. Only one species of cockroach was found at the site, an endemic *Parellipsidion* sp. Individuals were common in the shrubland, being found on *O. bullata*, *C. propinqua* and in pitfall traps. Though the species sampled was not identified beyond generic level, the secretive and pitfall-shy *Parellipsidion inaculeatum* and *P. pachycercum* are common cockroaches in the tussock and shrublands of Otago and elsewhere in the South Island. Both are known from a nearby site (P. M. Johns pers. obs).

Another species that is abundant in the alpine zone immediately above the study site, *Celatoblatta quinquemaculata*, was not found in this study. It rarely enters tussock or shrub habitats. Another species *C. anisoptera* is known from such habitats further inland, but as yet no species from this genus have been recorded from the more eastern valleys of Central Otago (Johns 1966; P. M. Johns pers. obs).

Order Coleoptera. Approximately 59 species of Coleoptera were collected during this survey, most of which were endemic. Among the exotic species collected were *Listronotus bonariensis*, a pasture pest introduced from South America, *Rhizobius forestieri* introduced from Australia, and *Adalia bipunctata* of palearctic origin.

As expected, the larger, active, ground fauna such as carabid beetles were collected mainly in pitfall traps along with grassland species such as the

weevils *Nicaeana cervina*, *Gromilus impressus* and *Listronotus bonariensis*. Beetles taken only from beating shrubs included most of the coccinellids, which presumably feed on aphids, mites and other small invertebrates on the shrub foliage; and also the undetermined weevils, *Catoptes* sp. (commonly found feeding on shrub species) and *Peristoreus* sp. (mostly host plant-specific). The tenebrionid, *Artystona obscura* feeds on lichens that grow on rocks and the bark of trees and shrubs.

Some Coleoptera use plants as refuge or resting sites although they may not use the plants as a food source (Colonnelli & Osella 1998). With reference to weevils, these authors defined host plants as those on or in which the larvae feed and develop, as distinct from refuge plants used by adult weevils for food, shelter and transport. This almost certainly applies to herbivorous Coleoptera in general, and there are probably examples of both reported in this study. For example, *Odontria striata* adults feed on a wide range of plant foliage, including shrubs, and they often assemble on prominent plants during mating flights, yet the larvae are subterranean non-specific root feeders (Barratt & Campbell 1982). *Olearia* would in this case be a refuge plant for this species. In comparison, *Praolepra infusca* is commonly associated with *Coprosma* sp., which would be considered a host plant for this species.

Spiller and Wise (1982) recorded only two species of Coleoptera from *Olearia* sp. in their catalogue: *Peristoreus olearia*e, which may be host specific, and the lemon tree borer *Oemona hirta* which has a broad host range. From *Coprosma* sp. only one coleopteran, *Eucolaspis brunneus*, was listed, and it has a wide host range. Kuschel (1990) recorded three species of *Praolepra* from *Coprosma* species in Auckland including *P. infusca*, which was collected from both shrub species in the current study.

The anthribids, colydiids, corticariids and leiodids collected during this study are largely mycophagous, and so associations of the Coleoptera with plants will depend upon the association between plants and fungi, but in many cases, this is likely to be non-specific. Similarly with the cerambycids, where the larvae feed and develop in dead wood, the host plant association is often not specific.

Among the native taxa, *Xenanthribus hirsutus*, a South Island species noted as one of the few exclusively ground-dwelling anthribids in New Zealand (Holloway 1982), was collected only by beating shrubs.

Order Collembola. Specimens from three families were collected: Onychiuridae, Sminthuridae and Tomoceridae. Due to the lack of available taxonomic expertise, species remain undetermined. From beating *C. propinqua* and *O. bullata* only Tomoceridae were collected. The three families were all represented in pitfall traps. Onychiuridae were extremely abundant in most of the pitfall samples. Unlike the other springtails, members of this family do not possess eyes and furca (Grant 1999). Only one unidentified specimen of Sminthuridae was collected overall.

Order Diptera. Three of at least 30 Diptera species were clearly exotic species that live in grassland or breed in dung. The endemic and possibly earthworm-parasitic *Pollenia* sp. was numerically prominent. The chloropids *Conioscinella* spp. and *Eutricimba* spp. were among the most numerous species collected. The presence of undescribed species of Chloropidae beyond the revision of Spencer (1977), and Helomyzidae not described in Harrison (1959), indicate that further species in these groups may well await identification from central and alpine areas in the South Island. The *Corynoptera* collected appear to prefer shrubland, as mainly *Ctenosciara* spp. were collected from adjacent snow tussock vegetation (Cathy Rufaut 2001, pers. comm.).

The much larger forest to shrubland dwelling *Allophylopsis, Mycetophila* and *Zelandoberis* were represented by only 1–2 specimens, and probably breed in the shrubland litter or the fungus in it. The fungus feeding Mycetophilidae was relatively poorly represented compared with other studies from a native forest (Ward et al. 1999). Incidental species that breed in fresh water include *Austrohelea tonnori*, *Odontomyia chloris* and chironomid midges.

Order Ephemeroptera. One subimagal exuvium of the mayfly *Austroclima*, possibly *A. jolli*, was beaten from *Olearia bullata*. Immature mayflies of Leptophlebiidae live in running freshwater (Winterbourn et al. 2000).

Order Hemiptera. Several endemic species of Hemiptera were collected. The exceptions being the exotic mirid *Coridromius variegatus*, the exotic "assassin bug" *Empicoris rubromaculatus* and probably the aphids (90% of the aphid species in New Zealand are introduced). There were Hemiptera species collected from all three sets of samples, but they were particularly plentiful in number of species and individuals on *Olearia bullata*. Most species are

common throughout New Zealand, a few have a more restricted distribution, but none of the species identified so far is considered rare.

The genus *Chinamiris* contains far more species than any other endemic New Zealand mirid genera (Eyles & Carvalho 1991), and one-third of its species occur on *Coprosma* sp. This is the first record of *Chinamiris punctatus* in Otago. *Romna scotti* is a widespread endemic New Zealand species that has already been recorded on both *Olearia* sp. and *Coprosma* sp. (Eyles & Carvalho 1988). In Brookdale, however, it was recorded only on *Olearia* sp. Another very common endemic species collected was *Diomocoris maoricus*, which is widespread throughout the North and South Islands, and in many offshore islands (Eyles 1999). It has a very wide range of hosts, having been recorded on dozens of different plant species, with occasional specimens recorded on *Olearia* sp. and *Coprosma* sp. (Eyles 1999). *D. maoricus* can be an orchard pest, especially on peach trees (Eyles 1999).

Coridromius variegatus was first recorded in New Zealand from the Three Kings Islands and Wellington by Woodward (1954). A. C. Eyles has recently collected it in the Coromandel Peninsula under chenopods growing in sand on beaches. This is the first record of it from Otago. This species is of interest because it lives on Chenopodiaceae which metabolise salt and grow worldwide on coastal or in dry inland habitats where soils have high salt concentrations (Webb et al. 1990). New Zealand records of this bug have so far been from coastal sites. This Brookdale site is the first inland record for *C. variegatus* in New Zealand. In Australia, Cassis & Gross (1995) recorded it from both coastal and inland sites such as the Lake Eyre basin.

The cicadellid species in the genus *Myerslopia* are found in leaf litter or moss, retain primitive characters, and are believed to be relicts from the Mesozoic (Evans 1966; Knight 1973). *Myerslopia variabilis* subsp. *austrina* was previously unrecorded in Otago, and little is known about its ecology and distribution. For the endemic stilt bug *Bezu wakefieldi*, previously known from Wanganui, Wellington, Stephens Island, and Banks Peninsula (Woodward 1961), and for the exotic thread-legged *Empicoris rubromaculatus*, Otago is a new distributional record.

Nysius huttoni is the New Zealand wheat bug, which relies on the seeds of annual weeds for breeding and feeding, but has also been found to breed and feed on several other species of native and exotic grasses, including tussocks (Every & Stufkens 1999). It is characteristically a seed-feeder, and although it feeds on the foliage of young crucifers (Eyles 1965), its presence up in *Coprosma propinqua* in the present study would be to feed on developing and mature drupes. It is a very widespread endemic species distributed throughout the country from sea level to 1800 m altitude (Eyles & Ashlock 1969). It can be a pest of wheat, causing serious problems for bread making producing sticky doughs due to proteinases from the insect's saliva (Every et al. 1992).

Two endemic Psyllidae species were recorded: *Trioza gourlayi* and another described but yet unpublished *Trioza* species. *T. gourlayi* was collected on both *Olearia bullata* and *Coprosma propinqua*, while the only specimen collected on the ground was recovered from a pitfall trap set beneath an *O. bullata* plant. All existing records for *T. gourlayi* are from the east coast of the South Island. *Trioza* sp. was among the most abundant species recorded in this study, and most of the 211 specimens were collected from *O. bullata*, with only seven of them recorded on *C. propinqua*. This is the first South Island record for the species, which has a relatively restricted distribution, previously known only from Taupo and Manawatu. Both *Trioza* species collected were previously known to be associated with the genus *Olearia* (Tuthill 1952), and this study has emphasised the importance of this genus for the New Zealand endemic psyllid fauna.

Scale insects (superfamily Coccoidea) were under-represented in this study, possibly due to the collection methods used, as sedentary insects attached to plants by their feeding tubes normally require hand collecting. Only two species of the more mobile mealybugs were taken, and both of these are common throughout New Zealand. The endemic *Balanococcus danthoniae* feeds on grasses, and *Chryseococcus arecae*, which is considered native to New Zealand, but also found in Australia, feeds on roots of a wide range of plants (Cox 1987). *Eriochiton pseudohispidus* is also an endemic species and this is a new record for Otago (Hodgson & Henderson 1996).

Order Hymenoptera. Over 30 species of Hymenoptera were collected. They were relatively evenly distributed throughout the three sets of samples. Although there is a paucity of information on their taxonomy, biology and ecology, none of the species seems to be rare and many have been seen in collections made from similar habitats in other

parts of Central Otago. Others, e.g., the endemic encyrtid *Odiaglyptus biformis*, are widespread throughout New Zealand.

Almost all species collected were parasitoids, the three species of ants (Formicidae) being the only exceptions. These ants are all abundant and widespread in New Zealand (Valentine and Walker 1991). Two are endemic (*Huberia striata* and *Monomorium antarcticum*), while one (*Amblyopone saundersi*) is shared with Australia. Predatory wasps (Pompilidae and Sphecidae) and bees (Apidae) will almost certainly be found in the study area but the collecting methods used are not suited to these groups.

The majority of species identified are probably endemic but it is impossible to be absolutely certain until basic taxonomic research has been carried out. At least three parasitic species are also found outside New Zealand. The European *Mymar pulchellum* (Mymaridae) is a parasitoid of Delphacidae eggs elsewhere, but hosts are unknown in New Zealand. The encyrtid *Microterys flavus* was introduced for biocontrol of soft brown scale, although it may have already been present (Valentine and Walker 1991). *Tetracnemoidea bicolour* (Encrytidae) is also found in Australia and New Zealand's subantarctic islands, but this seems a natural distribution. It parasitises mealybugs associated with grassy and shrubby vegetation. The two bethylids, *Goniozus* sp. and *Sierola* sp., are probably endemic since they are not the species introduced for biocontrol of leafroller moths.

Order Lepidoptera. Approximately 32 endemic New Zealand species of moth were taken during this study. Eleven could be identified to named species, seven to genus and the rest to family level only. Despite the number of species found, none of them is known to be rare. They are all widespread, and are found wherever their respective host plants are present.

Sampling of *Olearia bullata* yielded one species whose larvae are specialist feeders on this plant (Patrick 2000). The tiny *Stigmella ilsea* has larvae that mine the narrow leaves of *O. bullata* and is monophagous on species of *Olearia* section Divaricaster. This group of small-leaved, mostly deciduous shrubs and small trees, has the largest documented moth fauna, both specialists and generalists, within the entire New Zealand flora (Patrick 2000). In contrast, the large geometrid *Declana junctilinea* has larvae that are generalist feeders on a wide variety of native shrubs including *O. bullata*. The other 11 species of moth found on this shrub species are not known to feed as larvae on *O. bullata*. The three oecophorid species feed as larvae on leaf litter, the noctuid *Tmetolophota* on monocotyledons and *Caloptilia elaeas* on various *Coriaria* species.

The larvae of two of the five moth species found on *Coprosma gobiata* are specialist feeders on this genus. Both *Pasiphila sandycias* and *Austrocidaria gobiata* are widespread species, and their larvae are common on small-leaved shrubs of the genus. The genus *Coprosma* (including *Nertera*) supports the larvae of at least 22 endemic New Zealand moths in many families including *Gracillariidae*, *Geometridae* (two genera), *Gelechiidae*, *Oecophoridae* (subfamily Stathmopodinae), *Tortricidae* (two genera) and *Noctuidae*. In contrast to *Olearia*, there are no generalist larvae on *Coprosma*. The other three moth species are not associated as larvae with *C. propinqua*.

From pitfall traps, at least 14 moth species were recorded. Many, including *Orocrambus* sp., *Rictonis comma* and *Wiseana* sp., have ground-dwelling larvae. The rest are mostly arboreal or sward feeders, but most descend to the soil to pupate, or may hide as adults on or near ground level.

The New Zealand moth fauna has a relatively high percentage of species that depend on a single host-plant or a group of closely related hosts e.g., the genera *Pasiphila* and *Austrocidaria*. Additionally the fauna includes a significant number of species that feed as larvae on leaf litter or detritus, e.g., the genus *Tingena*.

This study has emphasised the main difference between *Olearia* and *Coprosma* as hosts to moth larvae. That is, *Coprosma* does not host generalist species.

Order Neuroptera. The two species of "lacewings" recorded were sampled only from *Olearia bullata*. *Micromus tasmaniae*, the Tasmanian lacewing, is a predator on Aphidoidea, and it is associated with a large array of plants, both in open and cultivated areas (Wise 1993). The other species is *Drepanacra binocula*. *M. tasmaniae* and *D. binocula* are widespread throughout New Zealand including many off-shore islands (Wise 1991). Both are native species but are also widespread in Australia and the Pacific Islands (Wise 1991).

Order Orthoptera. Two Orthoptera species were found at the site. Both are endemic, and were collected only in pitfall traps. One member of the family Gryllidae, a *Bobilla* sp. (formerly in

Pteronemobius (Swan 1972, Otte et al. 1987)) was found, previously known from tussock and shrub habitats in the South Island. There are two common species in this genus, but little research has been undertaken to distinguish their habitat requirements or determine their distribution patterns.

The other species was an undescribed *Hemiandrus* sp. (Anostostomatidae), a ground weta. Members of the weta genus *Hemiandrus* are burrowers in soils and forest litter. The *Hemiandrus* new species of central Otago seems to prefer loess soils under either tussock or shrubs. As it has also been found in well-developed forest closer to Dunedin, and even in household gardens there, it does not seem to have very specific habitat requirements. Another species in the same genus, *H. focalis*, is common in the alpine zone immediately above the study site, but was not recorded in this study.

Order Phasmatodea. Only one specimen was found in the whole of the site, sampled from a *C. propinqua*. The specimen was partly damaged, so identification is uncertain. Nevertheless, the key from Salmon (1991) indicated that it is probably a *Mimarchus* sp. This genus has two species with type localities in the Dunedin area: *M. annulatus* and *M. salebrosus*.

Order Plecoptera. Only one specimen was collected, beaten from a *Coprosma propinqua*. It was a female *Spaniocerca longicauda*, a common endemic species with aquatic nymphs, restricted to the southern half of the South Island. Adults are terrestrial and the females probably feed on fungi and pollen, which are important food sources for egg development (Smith & Collier 2000).

Order Psocoptera. At least nine species of booklice have been recorded from the sampled shrubland at Brookdale. This represents a relatively high Psocoptera diversity for the site, since there are 61 known species for the whole of New Zealand. All specimens were taken in beating samples, and showed little host-specificity. No species is believed to be rare or a new record for Otago.

The dominant species were the endemic *Spilopsocus avium* and *Interpsocus axillaris*. The apparently Australian *Pteroxanium kelloggi* with its shortened and pointed wings was among the most easily recognised species. The introduced *Ectopsocus briggsi*, which can be common in suburban gardens in Christchurch, and was a dominant species in a national survey of orchards, was the least common of the species collected.

Order Thysanoptera. Three Phlaeothripidae morphospecies were recorded. All were especially abundant on *Olearia bullata*. As with Collembola, due to the lack of available taxonomic expertise, these specimens remain undetermined beyond family level.

Order Trichoptera. Only one caddisfly species, *Oxyethira albiceps*, was present and was collected from both shrub species. *O. albiceps* is a common endemic species, whose larvae are widespread in freshwater (Winterbourn et al. 2000).

FINAL REMARKS

The invertebrate fauna reported in this contribution is likely to represent a small proportion of the biodiversity within the Brookdale shrubland. Both sampling methods used are biased to some extent, and not capable of collecting some sections of the invertebrate community. Moreover, analyses using species estimators, which included morphospecies information on the Orders that have not been taxonomically identified, showed that, at most, two-thirds of the ground fauna has been recorded by pitfall trapping, and a much lesser percentage of the canopy invertebrates by beating (Derraik 2001). As a result, it would be necessary to use other sampling methods such as Malaise traps, pan traps and light traps, as well as sampling over a greater time period in order to compile an exhaustive invertebrate inventory of the site.

This is the first published survey for New Zealand that focuses on a lowland shrubland community. Despite the reduced size and fragmentation of the Brookdale shrublands and their isolation from other similar habitats, a diverse invertebrate fauna still occupies the area. Moreover, some species are undescribed and approximately 90% of the species recorded are endemic. As a result, such remnant habitats are likely to be of major importance for the protection of New Zealand's invertebrate biodiversity, especially in lowland areas.

Clarification of the conservation importance of the undescribed species must await further collections and revisions of the appropriate families. These species could be either less common or dwell in more restricted areas and habitats. Some are likely to be characteristic for the habitat and of regional conservation interest.

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Appendix 1 Annotated list of species collected from a shrubland within the Brookdale Conservation Covenant, Rock and Pillar Range, Otago. Specimens were identified to lowest taxonomic level possible. Data are also given on the origin of the species, and on the plant species/pitfall traps where it was found.

Phylum	Class	Order	Family	Species	Origin	*Olea. bull.*	*Cop. prop.*	Pitfall
Annelida	Oligochaeta	Haplotaxida	?Acanthodrilidae	? undescribed species	endemic?	–	–	X
		Enchytraeida	Enchytraeidae	Species A	endemic?	–	–	X
				Species B	endemic?	–	–	X
Mollusca	Gastropoda	Stylommatophora	Agriolimacidae	*Deroceras reticulatum* (Muller 1774)	exotic	–	–	X
			Arionidae	*Arion intermedius* (Normand, 1852)	exotic	–	–	X
			Punctidae	*Laoma* sp. (undescribed sp.)	endemic?	X	X	–
				Phrixgnathus celia Hutton, 1883	endemic?	X	X	X
Arthropoda	Arachnida	Acari	–	? 19 spp.	–	X	X	X
		Araneae	Amaurobiidae	*Pakeha maxima* Forster & Wilton, 1973	endemic	–	–	X
			Araneidae	*Coleranea viriditas* (Urquhart, 1887)	endemic	–	X	–
				Coleranea verutum (Urquhart, 1887)	endemic	X	–	–
				Eriophora pustulosa (Walckanaer, 1841)	native?	X	X	–
				Zealaranea crassa (Walckanaer, 1841)	endemic	X	–	–
			Clubionidae	*Clubiona convoluta* Forster, 1979	endemic	X	–	–
			?Cyatholipidae	–	endemic?	X	?	–
			Cyclоctenidae	*Plectophanes* sp.	endemic	–	X	–
				Toxopsiella sp.	endemic	X	X	–
			Desidae	*Laestrygones otagoensis* Forster, 1970	endemic	X	X	–
			Hahniidae	*Rinawa otagoensis* Forster, 1970	endemic	–	–	X
			Linyphiidae	*Diplocephalus cristatus* (Blackwall, 1833)	exotic	X	X	X
				Promynoglenes sp.	endemic	–	–	X
			Lycosidae	*Allotrochosina schaunslandi* (Simon, 1899)	endemic	–	–	X
				Lycosa hilaris L. Koch, 1877	endemic	–	–	X
				Pardosa adumbrata (Urquhart, 1887)	endemic	–	–	X
			Mimetidae	*Mimetus* sp.	endemic?	X	–	–
			Orsolobidae	–	endemic?	X	–	–
			Pisauridae	*Dolomedes* sp.	endemic	X	X	X
			Salticidae	New species A	endemic	X	–	X
				New species B	endemic	X	X	–
			Stiphidiidae	*Cambridgea agrestis* Forster & Wilton 1973	endemic	X	X	–
				Cambridgea antipodiana (White, 1849)	endemic	–	–	X
				Cambridgea arboricola (Urquhart, 1891)	endemic	–	–	X
			Theridiidae	*Achaearanea* sp.	endemic	X	X	–
				? *Argyrodes* sp.	endemic?	X	–	–
				cf. *Episinus* sp.	endemic?	X	X	–
				Moneta sp.	endemic?	X	–	–
				Phoroncidia sp. (? 3 spp.)	endemic	X	–	–

Continued over page

Appendix 1 *Continued*

Phylum	Class	Order	Family	Species	Origin	*Olea. bull.*	*Cop. prop.*	Pitfall
			Thomisidae	*Diaea* sp.	endemic	X	X	–
				Sidymella sp.	endemic	–	–	X
		Opiliones	Monoscutidae	*Pantopsalis* sp.	endemic	–	–	X
			Triaenonychidae	*Nuncia* sp.	endemic	–	–	X
				Pristobonus henopoeus subsp.	endemic	–	–	X
				Algidia cuspidata multispinosa Forster, 1954	endemic	–	–	X
		Pseudoscorpiones	Chernetidae	*Apatochernes* sp. nov.	endemic	X	X	X
	Crustacea	Amphipoda	Talitridae	*Puhuruhuru aotearoa* Duncan, 1994	endemic	–	–	X
		Isopoda	Porcellionidae	*Porcellio scaber* Latreille 1804	exotic	–	X	X
	Diplopoda	Juliformia	Dalodesmidae	*Icosidesmus* sp.	endemic	–	–	X
				Pseudoprionopeltis sp.	endemic	–	–	X
			Julidae	*Ophyiulus pilosus* (Newport, 1843)	exotic	–	–	X
			Julomorphidae	*Eumastigonus* sp.	endemic	–	–	X
			Polyzoniidae	*Siphonethus* sp.	endemic	–	–	X
			Schedotrigonidae	*Schedotrigona* sp.	endemic	–	–	X
	Insecta	Blattodea	Blattellidae	*Parellipsidon* sp.	endemic	X	X	X
		Coleoptera	Anthribidae	*Sharpius sandageri* (Broun, 1893)	endemic	X	–	X
				Xenanthribus hirsutus Broun, 1893	endemic	X	X	–
			Byrrhidae	cf. *Epichorius* sp.	endemic	–	–	X
			Carabidae	*Agonum otagoensis* (Bates, 1886)	endemic	–	–	X
				Holcaspis placida Broun, 1881	endemic	–	–	X
				Mecodema sculpturatum Blanchard, 1853	endemic	–	–	X
				Megadromus fultoni / meritus (Broun, 1886)	endemic	–	–	X
				Oregus aereus White, 1846	endemic	–	–	X
			Cerambycidae	*Somatidia longipes* Sharp, 1878	endemic	–	X	–
				Psilocnaeia cf. *asteliae* Kuschel, 1990	endemic	X	–	–
			?Chrysomelidae	– [larvae]	–	–	–	X
			Coccinellidae	cf. *Scymus* sp.	endemic?	X	X	–
				cf. *Adoxellus* sp.	endemic?	–	–	X
				coccinelid sp. (? 5 spp.)	endemic?	X	X	–
				Adalia bipunctata (Linnaeus, 1758)	exotic	–	X	–
				Rhizobius forstieri (Mulsant, 1853)	exotic	X	–	–
				Scymus cf. *prolongatus* Broun, 1914	endemic	X	X	–
			Corticariidae	*Aridius bifasciatus* (Reitter, 1877)	exotic	X	X	–
				Cortinicaria hirtalis (Broun, 1880)	exotic	X	X	X
				Cortinicaria sp.	exotic?	X	?	?
			Corylophidae	*Holopsis* sp. nr. *lawsoni* Broun, 1886	endemic	X	X	X
				Holopsis sp.	endemic	X	X	–
			Cryptophagidae	cryptophagid sp.	endemic?	–	–	X
				Paratomaria crowsoni Leschen, 1996	endemic	X	X	X

Phylum	Class	Order	Family	Species	Origin	*Olea. bull.*	*Cop. prop.*	Pitfall
			Curculionidae	cf. eugnomine sp.	endemic?	–	–	X
				cf. *Eurymneus* sp.	endemic	–	–	X
				cf. *Pactola* sp.	endemic	–	X	–
				cf. *Peristoreus* sp.	endemic	X	–	–
				cf. *Catoptes* sp.	endemic	X	–	–
				eugnomine sp.	endemic	–	X	–
				cf. *Eurymneus* sp.	endemic	–	–	X
				Gromilus impressus Broun, 1893	endemic	–	–	X
				Irenimus stolidus Broun, 1886	endemic	?	X	?
				Listronotus bonariensis (Kuschel, 1955)	exotic	?	X	?
				Nicaeana cervina Broun, 1893	endemic	?	X	?
				Phrynixus astutus Pascoe, 1876	endemic	–	–	X
				Praolepra infusca Broun, 1880	endemic	X	X	X
			Dermestidae	– [larvae]	–	X	–	X
			Leiodidae	cf. *Paracatops* sp.	endemic?	–	–	X
			Ptiliidae	cf. *Acrotrichis* sp.	exotic	–	–	X
			Scarabaeidae	*Odontria striata* White, 1884	endemic	X	–	X
			Scirtidae	scirtid sp.	endemic?	X	–	–
			Staphylinidae	aleocharine sp. (? 7 spp.)	endemic?	–	–	X
				tachyporine sp. (? 3 spp.)	endemic?	X	X	X
			Tenebrionidae	*Artystona obscura* Sharp, 1886	endemic	X	–	–
			Trogossitidae	trogossitid sp.	endemic	X	X	–
			Zopheridae	colydiine sp.	endemic?	X	–	–
		Collembola	Onychiuridae	–	–	–	–	X
			Sminthuridae	–	–	–	–	X
			Tomoceridae	–	–	X	X	X
		Diptera	?Agromyzidae	–	exotic?	X	–	–
			Calliphoridae	*Calliphora quadrimaculata* (Swederus, 1787)	endemic	–	X	–
				?*Pollenia* sp.	endemic	–	–	X
			Ceratopogonidae	*Austrohelea tonnori* (Macfie, 1932)	endemic	X	–	–
			Chironomidae	*Chironomus* ?*zealandicus* (Hudson 1892)	endemic	X	–	X
				Orthocladinae spp.	–	X	X	X
			Chloropidae	*Aphanotrigonum huttoni* (Malloch, 1931)	endemic	X	–	–
				Conioscinella badia (Hutton, 1901)	endemic	X	?	?
				Conioscinella grandis Spencer, 1977	endemic	?	?	X
				Eutricimba new species A	endemic	X	X	–
				Eutricimba new species B	endemic	–	–	X
				Melanum neozelandicum Malloch, 1931	endemic	X	–	–

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Appendix 1 *Continued*

Phylum	Class	Order	Family	Species	Origin	*Olea. bull.*	*Cop. prop.*	Pitfall
			Dolichopodidae	*Parentia* sp.	endemic	X	–	–
			Ephydridae	*Hydrellia tritici* Coquillett, 1903	exotic	X	X	X
			Heleomyzidae	?*Allophylopsis* new species	endemic	–	–	X
			Lonchopteridae	*Lonchoptera furcata* (Fallen, 1823)	exotic	–	–	X
			Muscidae	New species A	endemic	X	–	–
				New species B	endemic	–	–	X
			Mycetophilidae	*Anomalomyia guttata* (Hutton, 1901)	endemic	–	–	X
				Mycetophila sp.	endemic	–	–	X
			Sarcophagidae	*Oxysarcodexia varia* (Walker, 1836)	exotic	–	X	X
			Sciaridae	*Bradysia*	endemic?	X	–	–
				Corynoptera harrisi group	endemic?	X	–	X
				Epidapis sp.	endemic	–	X	–
			Sphaeroceridae	*Phthtia thomasi* Harrison, 1959	native?	–	–	X
			Stratiomyidae	*Odontomyia chloris* (Walker, 1854)	endemic	X	–	–
				Zelandoberis sp.	endemic	X	–	–
			Tachinidae	*Calcager apertum* Hutton 1901	endemic	–	–	X
				Pales clathrata (Nowick 1875)	endemic	–	–	X
			Tipulidae	–	endemic	X	–	–
		Ephemeroptera	Leptophlebiidae	*Austroclima* sp.	endemic	X	–	–
		Hemiptera	Aphididae	?9 spp.	exotic?	X	X	X
			Berytidae	*Bezu wakefieldi* (White, 1878)	endemic	X	–	–
			Cicadellidae	*Myerslopiini variablilis* sub.sp. *austrina* Knight,1973	endemic	–	–	X
				Zygina sp.	endemic?	X	–	X
			Eriococcidae	*Eriochiton pseudohispidus* (Hodgson & Henderson, 1996)	endemic	X	–	–
			Lygaeidae	*Nysius huttoni* White, 1878	endemic	–	X	–
				– [nymphs]	–	–	–	X
			Miridae	*Chaetedus reuterianus* (White, 1878)	endemic	X	–	–
				Chinamiris punctatus Eyles & Carvalho 1991	endemic	X	X	–
				Chinamiris sp. Woodward, 1950 [nymphs]	endemic	–	X	–
				Coridromius variegatus (Montrouzier,1861) [nymphs]	exotic	–	X	–
				Diomocoris maoricus (Walker, 1873)	endemic	X	–	–
				Romma scotti (White, 1878)	endemic	X	–	–
			Pseudococcidae	*Balanococcus danthoniae* (Morrison, 1925)	endemic	X	–	–
				Chryseococcus arecae (Maskell, 1890)	native	–	–	X
			Psyllidae	*Trioza gourlayi* Tuthill, 1952	endemic	X	X	–
				Trioza sp.	endemic	X	X	X

Phylum	Class	Order	Family	Species	Origin	*Olea. bull.*	*Cop. prop.*	Pitfall
			Reduviidae	*Empicoris rubromaculatus* (Blackburn, 1889)	exotic	X	X	–
		Hymenoptera	Bethylidae	*Goniozus* sp.	endemic?	X	–	–
				Sierola sp.	endemic?	X	–	–
			Braconidae	*Ascogaster* sp.	endemic	X	–	–
			Chapridae	–	–	–	–	X
			Diapriidae	*Entomacis* sp.	–	–	X	–
				Spilomicrus spp. (?4 spp.)	endemic	X	X	X
				Trichopria spp. (?3 spp.)	endemic	–	?	X
			Encyrtidae	*Microterys flavus* (Howard, 1881)	native	X	–	–
				Odiaglyptus biformis Noyes, 1988	endemic	–	–	X
				Tetracnemoidea bicolor (Girault, 1915)	native	–	–	X
			Eulophidae	?4 spp.	–	X	X	–
			Formicidae	*Amblyopone saundersi* Forel, 1892	native	X	X	X
				Huberia striata (Smith, 1876)	endemic	–	–	X
				Monomorium antarcticum (Smith, 1858)	endemic	X	X	–
			Ichneumonidae	?3 spp.	–	X	X	X
			Megaspilidae	–	–	X	–	–
			Mymaridae	*Mymar pulchellum* Curtis, 1832	exotic	–	–	X
				Scleromymar ?breve, Noyes & Valentine, 1989	endemic	–	–	X
			Platygastridae	*Errolium* sp.	endemic	?	–	?
				Zelandonota ?kiwi, Masner & Huggert, 1989	endemic	–	–	X
			Proctotrupidae	*Oxyserphus* sp.	endemic	X	–	–
			Pteromalidae	?*Trichomalopsis* sp.	endemic	X	X	X
				Ophelosia australis Berry, 1995	endemic	X	X	–
			Scelionidae	*Baeus* sp.	endemic	X	–	X
				Idris sp.	endemic	X	X	X
				Telenomus sp.	endemic	X	–	?
				?*Trimorus* sp.	endemic	X	–	–
				Trissolcus sp.	endemic	X	–	–
		Lepidoptera	Choreutidae	*Asterivora* sp.	endemic	–	X	–
			Crambidae	– [larvae]	endemic	–	–	X
			Elachistidae	*Cosmiotes ombrodoca* (Meyrick, 1889b)	endemic	X	–	X
			Gelechiidae	– [larvae]	endemic	–	–	X
			Geometridae	– [larvae]	endemic	X	–	–
				Austrocidaria gobiata Felder & Rogenhofer, 1875 [larvae]	endemic	–	X	X
				Declana junctilinea (Walker, 1865) [larvae & pupa]	endemic	X	–	–
				Epiphryne undosata (Felder & Rogenhofer, 1875)	endemic	–	–	X
				Epyaxa sp. [larvae]	endemic	–	–	X

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Appendix 1 *Continued*

Phylum	Class	Order	Family	Species	Origin	*Olea. bull.*	*Cop. prop.*	Pitfall
				Pasiphila sandysias (Meyrick, 1905) [larvae]	endemic	–	X	–
			Gracillariidae	*Caloptilia elaeas* (Meyrick, 1911b)	endemic	X	–	–
			Hepialidae	*Wiseana* sp. [larvae]	endemic	–	–	X
			Nepticalidae	*Stigmella ilsea* Donner & Wilkinson, 1989	endemic	X	X	–
			Noctuidae	*Rictonis comma* (Walker, 1856) [larvae]	endemic	–	–	X
				Tmetolophota sp. [larvae]	endemic	X	–	–
			Oecophoridae	? 4 spp. [larvae]	endemic	–	–	X
				Izatha sp. [larvae]	endemic	–	–	X
				Leptocroca sp. [larvae]	endemic	–	–	X
				Tingena melanamma (Meyrick,1905) [larvae]	endemic	X	X	–
				Tingena sp. [larvae]	endemic	–	–	X
			Pterophoridae	–	endemic?	X	–	–
			Tineidae	– [larvae]	endemic	X	–	–
			Tortricidae	Genus and species not yet described	endemic	X	X	–
				? 4 spp. [larvae & pupa]	endemic	X	–	–
				Ctenopseustis obliquana (Walker, 1863) [larvae]	endemic	X	–	X
				Epichorista loxias (Meyrick, 1888)	endemic	–	–	X
		Neuroptera	Hemerobiidae	*Drepanacra binocula* (Newman, 1838)	exotic	X	–	–
				Micromus tasmaniae (Walker, 1860)	exotic	X	–	–
		Orthoptera	Anostostomatidae	*Hemiandrus* sp. (undescribed species)	endemic	–	–	X
			Gryllidae	*Bobilla* sp.	endemic	–	–	X
		Phasmatodea	Phasmatidae	cf. *Mimarchus* sp.	endemic?	–	X	–
		Plecoptera	Notonemouridae	*Spaniocerca longicauda* McLellan 1977	endemic	–	X	–
		Psocoptera	Caecilidae	*Caecilus flavus* Smithers 1969	endemic	X	X	–
			Elipsocidae	*Interpsocus axillaris* Smithers 1969	endemic	X	X	–
				Spilopsocus avium Smithers 1964	exotic	X	X	–
			Myopsocidae	*Phtolodes australis* (Brauer 1865)	native?	X	X	–
			Peripsocidae	*Pteroaxanium kelloggi* (Ribaga 1905)	exotic	X	X	–
				Ectopsocus briggsi McLachlan 1899	endemic	X	–	–
			Philotarsidae	2 spp.	endemic?	X	X	–
			Trogiidae	–	–	X	X	X
		Trichoptera	Hydroptitidae	*Oxyethira albiceps* (McLachlan, 1862)	endemic	X	X	–
		Thysanoptera	Phlaeothripidae	? 3 spp.	–	X	X	X

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Errata

On p. 285 under Lycosidae:
schaunslandi should read *schauinslandi*

On p. 286:
"*Parellipsidon*" should be "*Parellipsidion*"

On p. 287:
colydiine sp. should read zopherid sp.
Listronotus bonariensis (Curculionidae) was found in pitfall traps

On p. 288:
Myerslopiini variablilis should read *Myerslopia variabilis*
Romma scotti should read *Romna scotti*

On p. 289
Eulophidae spp. was also found in pitfall traps

On p. 290:
Hydroptitidae should read Hydroptilidae