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A survey of ground-dwelling invertebrates from Mount Gibson Wildlife Sanctuary and Karara–Lochada Pastoral Stations

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ABSTRACT

As part of a broader project to investigate baiting techniques for the control of feral cats and foxes in the southern rangelands of Western Australia, the abundance of their prey items (small mammals, reptiles, birds and invertebrates) was monitored at the two study sites of Mt Gibson Wildlife Sanctuary and Karara–Lochada Pastoral Stations. The two sites are located in the semi-arid *Eucalyptus* woodlands and *Acacia* shrublands within the Avon-Wheatbelt and Yalgoo bioregions of Western Australia. The aim of this sub-project was to evaluate the potential available invertebrate prey species, as invertebrates are known to be part of the diet of cats and foxes, depending on availability of other prey types. Approximately 200 ground-dwelling invertebrate species were collected, however, limited conclusions about distribution across the landscape and between sampling periods could be drawn as the majority of all individuals collected were juveniles. Exceptions were ants, beetles and Araneomorph spiders; the majority of these collected were adults. Immature crickets were collected at 22 of the 24 quadrats and were the most common taxon encountered along with *Iridomyrmex chasei* (Formicidae). A total of 57 species from 13 genera of ants, 71 species representing 18 spider families and 49 species from at least 12 beetle families were recorded in 24 quadrats within four land system types represented at each of the study sites. It was important to document the ground invertebrate fauna as part of the prey resource and it also provides the beginnings of a ground invertebrate species list for the two properties that may be expanded during future survey work. The sampling period for invertebrate collection was restricted to the same time-frame used to survey small mammals, reptiles and birds, in order to provide a snapshot of the prey resource over this same period. The short duration of this trapping period, however, resulted in an insufficient sampling of the resident ground invertebrates for a quantifying analysis of the invertebrates collected during the survey.

Keywords: Arachnida, Coleoptera, Formicidae, ground invertebrate assemblage, rangelands, semi-arid woodlands.

INTRODUCTION

The Department of Environment and Conservation (DEC) and the Australian Wildlife Conservancy (AWC), in partnership with the Invasive Animals Co-operative Research Centre (IA CRC), commenced a project in 2006 to investigate techniques for the sustained control of introduced predators in the semi-arid *Eucalyptus* woodlands and *Acacia* shrubland sandplains of the semi-arid southern rangelands of Western Australia (Richards & Algar 2008). At the treatment site, AWC's Mt Gibson Wildlife Sanctuary, a strategy for the control of introduced predators was implemented. At the control site nearby, DEC's Karara-Lochada Pastoral Stations, which has a similar suite of land system types, introduced predators were not controlled.

The broader project to control introduced predators (cats *Felis catus* and foxes *Vulpes vulpes*), and monitor the abundance of their normal prey items (small mammals, reptiles, and birds) at the two stations, also presented an opportunity to document the ground invertebrate fauna active during the same period. Other results of the broader project will be reported elsewhere, including papers within the same volume of this journal.

Knowledge of the ground invertebrate fauna in the region is limited but assemblages have been documented for some surrounding areas (Abensperg-Traun 1996; Carnarvon Basin: Harvey et al. 2000; Wheatbelt: Durrant 2004; Guthrie & Waldock 2004; Harvey et al. 2004; and unpublished records, WA Museum). In this paper we document the ground invertebrate species assemblages in 24 quadrats at the two study sites.

METHODS

Mt Gibson Wildlife Sanctuary Study Site

Mt Gibson Wildlife Sanctuary is located at 29° 36' S, 117° 24' E and covers an area of 130,500 ha straddling the boundary between the South-West and Eremaean Botanical Provinces. The area has a semi-arid climate with hot dry summers and mild wet winters. Summer temperatures range from 19–36 °C, and winter temperatures range from 6–18 °C. There are typically 9–11 months of dry weather, with an annual rainfall of 343 mm (Bureau of Meteorology records 1983 to 2007), which arrives as gentle soaking rains and thundery showers in winter or in summer as occasional tropical cyclones or rain bearing depressions. Evapotranspiration rates are considerably higher than rainfall, with the annual average for the Paynes Find region being 2,480 mm.

Mt Gibson Wildlife Sanctuary is characterized by mixed *Acacia* shrublands on sandplain and York gum (*Eucalyptus loxophleba*), Salmon gum (*E. salmonophloia*) and Gimlet (*E. salubris*) woodlands. The sanctuary contains 13 vegetation associations (Beard 1976). The dominant landforms are greenstone ranges in the north-east and banded ironstone formations to the north-west. Granites and gneisses of the Yilgarn Block underlie much of the area and outcrop as domes or breakaways (McKenzie & May 2003). The ranges are separated by gently sloping pediments and flood plains upslope from salt lakes and clay pans (McKenzie & May 2003). Sandplains occur extensively to the south. Drainage is internal and disorganized and an extensive salt lake, Lake Moore, bounds Mt Gibson Wildlife Sanctuary to the east. Mt Gibson Pastoral Lease was acquired by AWC in 2001 and subsequently destocked, removing most sheep (*Ovis aries*) and goats (*Capra hircus*).

Karara–Lochada Study Site

Karara (29° 14' S, 116° 43' E) and Lochada (29° 12' S, 116° 33' E) are adjacent, reclaimed pastoral leases, purchased for the creation of conservation reserves, and managed by DEC. The site is located 86 km north-west of Mt Gibson Wildlife Sanctuary, and the two leases cover an area of 109,300 and 114,600 ha respectively. The average annual rainfall recorded for Karara is 312.3 mm (Bureau of Meteorology, based on records 1928–1939 and 1992–2008) and for Lochada is 327 mm (Bureau of Meteorology, based on records 1911–1939).

The climate, landforms, land systems and vegetation associations within the Karara–Lochada Pastoral Leases are similar to those found on Mt Gibson. Karara–Lochada also lies on the interface between the South West Botanical Province and the Eremaean Botanical Province, and mainly lies within the Yalgoo bioregion. There are at least 14 land types (Van Vreeswyk & Godden 1998) and 14 vegetation types (Beard 1976) on Karara–Lochada. The area is characterized by mixed *Acacia* shrublands on sandplain and sparse York gum woodlands. The stations lie within the Yilgarn Craton and across the boundaries of the Murchison Plateau and the Salinaland Plateau, with frequent granite rises and low domes. Lochada Pastoral Station was purchased by DEC in 2000 and Karara Pastoral Station in 2002 and both were subsequently destocked for conservation purposes.

Invertebrate Surveys

Twelve quadrats were selected at each site within four habitat or 'land system' types (Department of Agriculture and Food Western Australia; DAFWA 1990) characteristic of both Karara–Lochada and Mount Gibson: 1) Joseph—undulating yellow sandplains supporting dense mixed *Acacia* shrublands; 2) Pindar—red loamy sandplain supporting *Eucalyptus* woodlands and *Acacia* shrublands; 3) Euchre—low granite breakaways with alluvial plains and sandy tracts supporting *Eucalyptus* woodlands and *Acacia* shrublands with patchy mallees on granitic breakaways; and 4) Carnegie—salt lakes with fringing saline plains, dunes and sandy banks. Each quadrat was 50 x 50 m, at least 0.5 km apart and adjacent to vehicle tracks for easy access.

Ground invertebrate surveys were conducted twice each year, over five consecutive days, for two years in each of the 24 quadrats: in winter (20–24 June 2006, 11–15 July 2007 at Mt Gibson and 26–30 June 2006, 6–10 July 2007 at Karara-Lochada), just prior to predator baiting to assess potential ground invertebrate abundance at its lowest; and in spring (25–29 September 2006, 3–7 October 2007 at Mt Gibson and 19–23 September 2006, 23–27 September 2007 at Karara–Lochada), when invertebrate populations were potentially at their greatest.

Each quadrat contained five pitfall traps; one at each corner and one in the middle. Each pitfall trap consisted of a two-litre UV resistant plastic jar (80 mm neck diameter) inserted into a PVC sleeve dug into the ground, flush with the ground surface. To form a continuous surface between the ground and jar lip, an acrylic ring covered in glued sand was attached between the PVC sleeve and jar lip. Two hoop iron stands fitted between the PVC sleeve and jar supported a 200 mm x 200 mm colourbond roof approximately four centimetres above the ground surface. A mix of one litre ethylene glycol with 4% formalin was used as the preserving fluid in each pitfall trap. At the end of each five-day sampling period each pitfall trap was emptied and sealed with a lid, replaced in the PVC sleeve, ready to be reset with fresh preservative at the next sampling period. Samples were returned to the laboratory, washed in water and stored in 75% ethanol until sorting, processing and identification.

Taxonomy

Adult specimens were identified using taxonomic literature (Bänninger 1940; Heterick 2009; Matthews 1980, 1984, 1987; Matthews & Bouchard 2008; Matthews & Lawrence 2005; Roig-Juñent 2000). A morphospecies approach was adopted where confidently assigning specimens to known described or undescribed taxa was difficult and available literature insufficient (Harvey et al. 2000). Specimens from the survey were lodged with the Western Australian Museum (WAM).

RESULTS

Approximately 200 taxa from 14 orders of ground-dwelling invertebrates were collected in the survey. The majority of material across all groups were juveniles (and usually very early instars or nymph stages) and could not be identified conclusively to genus, therefore they are only identified to the ordinal level and placed into provisional morphospecies where possible. This precludes any statistical analysis comparing assemblage structure between sampling periods or between quadrats, therefore the data presented here is of inventory nature only. A list of major groups recorded is presented in Table 1 (a provisional list of identifications is available on request).

The majority of the Orthoptera appear to be early instar nymphs of one taxon, and occured in 22 of the 24 quadrats. Centipedes were recorded in 15 quadrats, only OP02 had representatives collected in three sampling periods (June 2006, Sept 2006 and Sept 2007). No centipedes were recorded in July 2007. Ten species of terrestrial Lepidoptera larvae representing various instars were collected from 11 quadrats, plus 12 species of Hemiptera, and four roach taxa (plus juveniles) were recorded from eight quadrats. All five scorpion species were recorded in either September 2006 or 2007, from separate quadrats.

The Formicidae (ants), Coleoptera (beetles) and

Table 1

All taxonomic groups recorded in the 24 quadrats across all sampling periods are presented below. Mount Gibson: GR, granite; OP, open plain; SL, salt lake; YS, yellow sand; Part A: 20–24 June 2006, 25–29 September 2006; Part B: 11–15 July 2007, 3–7 October 2007. Karara–Lochada: KGR, granite; KOP, open plain; KSL, salt lake; KYS, yellow sand; Part C: 26–30 June 2006, 19–23 September 2006; Part D: 6–10 July 2007, 23–27 September 2007. Note: "1" indicates presence of a group; "Total" refers to the number of groups present at a quadrat, and "Taxon Total" refers to the number of taxa within a group across all quadrats.

Part A

June 2006	**GR01**	**GR02**	**GR03**	**OP01**	**OP02**	**OP03**	**SL01**	**SL02**	**SL03**	**YS01**	**YS02**	**YS03**	**TAXON TOTAL**
Areneomorphae	0	1	0	1	0	1	0	2	0	0	2	0	**7**
Mygalomorphae	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Pseudoscorpions	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Scorpions	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Blattodea	0	0	0	0	0	0	1	0	0	0	0	0	**1**
Chilopoda	0	1	0	0	1	0	0	1	0	1	0	0	**4**
Coleoptera (adult)	0	0	0	0	1	0	0	1	0	0	2	2	**6**
Coleoptera (larvae)	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Diplopoda	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Formicidae	0	0	0	3	0	0	1	4	1	2	0	0	**11**
Hemiptera	0	0	0	0	0	0	3	1	0	0	0	0	**4**
Isopoda	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Isoptera	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Lepidoptera (larvae)	0	1	0	0	0	0	1	1	0	1	0	0	**4**
Mantodea	0	0	0	0	0	0	1	0	0	0	0	0	**1**
Orthoptera	0	0	0	0	1	0	0	0	0	0	0	0	**1**
Phasmatoda	0	0	0	0	0	0	0	0	0	0	0	0	**0**
TOTAL	**0**	**3**	**0**	**4**	**3**	**1**	**7**	**10**	**1**	**4**	**4**	**2**	**39**
September 2006	**GR01**	**GR02**	**GR03**	**OP01**	**OP02**	**OP03**	**SL01**	**SL02**	**SL03**	**YS01**	**YS02**	**YS03**	**TAXON TOTAL**
Areneomorphae	3	0	1	4	5	5	2	1	1	0	9	2	**33**
Mygalomorphae	0	0	1	0	0	3	0	0	0	0	0	0	**4**
Pseudoscorpions	1	0	0	1	0	0	0	0	0	0	0	0	**2**
Scorpions	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Blattodea	0	0	0	0	1	0	0	0	0	0	0	0	**1**
Chilopoda	0	0	0	0	1	0	0	0	1	0	0	0	**2**
Coleoptera (adult)	0	0	3	0	2	5	2	5	1	1	3	2	**24**
Coleoptera (larvae)	0	0	0	0	0	1	0	0	0	0	0	0	**1**
Diplopoda	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Formicidae	0	0	4	8	1	1	4	9	7	4	1	2	**41**
Hemiptera	0	0	0	0	1	0	1	2	0	0	0	0	**4**
Isopoda	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Isoptera	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Lepidoptera (larvae)	0	0	0	0	1	0	0	0	0	0	0	0	**1**
Mantodea	0	0	0	0	0	0	1	0	0	0	0	0	**1**
Orthoptera	1	1	0	1	4	1	2	4	0	0	0	0	**14**
Phasmatoda	0	1	0	0	0	0	0	0	0	0	0	0	**1**
TOTAL	**5**	**2**	**9**	**14**	**16**	**16**	**12**	**21**	**10**	**5**	**13**	**6**	**129**

Table 1 (cont.)

Part B

July 2007	GR01	GR02	GR03	OP01	OP02	OP03	SL01	SL02	SL03	YS01	YS02	YS03	TAXON TOTAL
Areneomorphae	0	0	3	2	2	7	1	1	1	0	1	1	**19**
Mygalomorphae	0	0	1	1	0	0	0	0	0	1	0	0	**3**
Pseudoscorpions	0	0	1	0	0	1	0	0	0	0	0	0	**2**
Scorpions	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Blattodea	0	0	0	1	0	0	2	0	0	0	0	0	**3**
Chilopoda	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Coleoptera (adult)	2	3	1	0	0	3	0	2	0	0	5	1	**17**
Coleoptera (larvae)	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Diplopoda	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Formicidae	5	1	4	6	1	7	7	4	10	1	0	2	**47**
Hemiptera	0	0	1	0	0	1	0	0	2	0	0	0	**4**
Isopoda	0	0	0	0	0	0	1	0	0	0	0	0	**1**
Isoptera	0	0	0	1	0	0	0	0	0	0	1	0	**2**
Lepidoptera (larvae)	0	0	0	0	0	2	0	0	0	1	0	0	**3**
Mantodea	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Orthoptera	0	0	0	1	0	2	0	0	1	0	0	0	**4**
Phasmatoda	0	0	0	0	0	0	0	0	0	0	0	0	**0**
TOTAL	**7**	**4**	**11**	**12**	**3**	**23**	**11**	**7**	**14**	**2**	**7**	**4**	**105**

October 2007	GR01	GR02	GR03	OP01	OP02	OP03	SL01	SL02	SL03	YS01	YS02	YS03	TAXON TOTAL
Areneomorphae	4	1	3	1	2	4	1	3	1	1	9	2	**32**
Mygalomorphae	0	0	1	0	0	0	0	0	0	0	2	0	**3**
Pseudoscorpions	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Scorpions	0	0	0	0	0	0	1	0	0	0	0	1	**2**
Blattodea	3	0	0	0	0	0	0	0	1	0	0	2	**6**
Chilopoda	0	0	2	0	1	0	1	0	0	0	0	2	**6**
Coleoptera (adult)	5	8	2	0	2	1	2	2	1	1	2	4	**30**
Coleoptera (larvae)	0	0	0	0	0	0	0	0	1	0	0	0	**1**
Diplopoda	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Formicidae	8	5	3	7	4	0	5	2	7	2	0	1	**44**
Hemiptera	2	1	2	3	2	3	0	3	2	1	2	1	**22**
Isopoda	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Isoptera	0	0	0	0	0	0	0	0	0	0	0	1	**1**
Lepidoptera (larvae)	1	1	0	0	0	0	0	0	0	0	0	0	**2**
Mantodea	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Orthoptera	5	3	1	3	4	3	2	0	0	3	0	1	**25**
Phasmatoda	0	0	0	0	0	0	0	0	0	0	0	0	**0**
TOTAL	**28**	**19**	**14**	**14**	**15**	**11**	**12**	**10**	**13**	**8**	**15**	**15**	**174**

Araneae (spiders) were the only groups conclusively identified and 175 taxa were recorded from the two sites (57 species from 13 genera of ants, 71 species representing 18 spider families and 49 species from at least 12 beetle families). From these three groups only, site richness varied from two to 35 species (KGR03 and YS02 respectively) with an average of 16.6 species, (s.d. ± 8.1; n = 24 quadrats). One hundred species or 57% of the fauna were recorded at one site only. The most common species encountered were *Iridomyrmex chasei* (Formicidae), present in 22 quadrats, the spider taxon Molycriinae sp.2, present in 10 quadrats, and *Carenum* sp.3 (Carabidae, Coleoptera) present in eight quadrats. The genera represented by the most species were the ant genera *Iridomyrmex, Camponotus, Crematogaster, Monomorium* and *Pheidole* (fifteen, eight, six and six species respectively) and the beetle genus *Carenum* with seven species.

DISCUSSION

The aim of this study was to evaluate the potential ground invertebrate prey species for feral cats and foxes at Mt Gibson Wildlife Sanctuary and Karara–Lochada Pastoral Stations. Invertebrates are known to be part of the diet of both species (Triggs et al. 1984), depending on availability of other prey types. Catling (1988) found that when rabbits were absent foxes preyed extensively on invertebrates, and they can become locally important for feral cats when other prey types become scarce (Paltridge et al. 1997). Generally it appears that both predators take more invertebrates during the warmer months (Triggs et al. 1984; Catling 1988; Paltridge et al. 1997) and more often as juveniles rather than adults (Catling 1988). Invertebrate groups found to be targeted as major food sources during summer and autumn by foxes are Orthoptera, Blattodea, Lepidoptera, and both adult and larval Coleoptera, especially scarab beetles (McIntosh

Table 1 (cont.)

Part C

June 2006	KGR01	KGR02	KGR03	KOP01	KOP02	KOP03	KSL01	KSL02	KSL03	KYS01	KYS02	KYS03	TAXON TOTAL
Areneomorphae	0	1	0	3	1	0	0	1	2	0	0	0	**8**
Mygalomorphae	1	2	0	2	2	0	1	3	1	0	0	0	**12**
Pseudoscorpions	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Scorpions	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Blattodea	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Chilopoda	1	1	0	1	0	0	0	1	1	1	0	0	**6**
Coleoptera (adult)	1	1	0	1	0	0	0	0	0	0	1	1	**5**
Coleoptera (larvae)	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Diplopoda	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Formicidae	0	2	0	5	2	0	3	3	1	0	2	0	**18**
Hemiptera	1	1	0	1	1	0	0	1	0	0	0	0	**5**
Isopoda	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Isoptera	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Lepidoptera (larvae)	0	0	0	0	1	0	1	0	0	1	0	0	**3**
Mantodea	0	1	0	0	0	0	0	0	0	0	0	0	**1**
Orthoptera	0	0	0	1	2	0	0	0	0	0	0	0	**3**
Phasmatoda	0	0	0	0	0	0	0	0	0	0	0	0	**0**
TOTAL	**4**	**9**	**0**	**14**	**9**	**0**	**5**	**9**	**5**	**2**	**3**	**1**	**61**

September 2006	KGR01	KGR02	KGR03	KOP01	KOP02	KOP03	KSL01	KSL02	KSL03	KYS01	KYS02	KYS03	TAXON TOTAL
Areneomorphae	1	4	2	1	1	0	3	1	3	11	0	1	**28**
Mygalomorphae	0	2	1	0	1	0	0	0	0	8	0	0	**12**
Pseudoscorpions	0	0	0	1	0	0	0	0	0	0	0	0	**1**
Scorpions	0	0	1	0	0	0	0	0	0	0	0	1	**2**
Blattodea	0	0	0	0	1	0	0	0	0	1	0	0	**2**
Chilopoda	0	1	0	0	1	0	0	0	0	2	0	0	**4**
Coleoptera (adult)	0	6	0	0	5	0	0	0	3	4	2	0	**20**
Coleoptera (larvae)	0	1	0	0	0	0	0	0	0	0	0	0	**1**
Diplopoda	0	0	0	0	1	0	0	0	0	0	0	0	**1**
Formicidae	4	0	0	5	3	0	2	2	3	3	4	8	**34**
Hemiptera	0	0	0	0	0	0	1	0	0	1	0	1	**3**
Isopoda	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Isoptera	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Lepidoptera (larvae)	0	0	0	0	0	0	0	0	1	2	0	0	**3**
Mantodea	1	0	0	0	0	0	0	1	0	0	0	0	**2**
Orthoptera	1	0	0	3	0	0	4	3	3	1	3	4	**22**
Phasmatoda	0	0	0	0	0	0	0	0	0	0	0	0	**0**
TOTAL	**7**	**14**	**4**	**10**	**13**	**0**	**10**	**7**	**13**	**33**	**9**	**15**	**135**

1963; Martensz 1971; Coman 1973; Ryan & Croft 1974; Catling 1988; Griffin 1990). McIntosh (1963) found that centipedes and to a lesser extent, scorpions and spiders were also consumed. A study on foxes from the Dandarragan Plain found they were concentrating on beetles during spring and autumn (Griffin 1990).

The sampling period for invertebrates was restricted to the same time-frame used to survey small mammals, reptiles and birds (Richards et al. 2011a, 2011b), to provide a snapshot of the potential ground invertebrate resource at this time. The short duration of this trapping period resulted in an insufficient sampling of the resident ground invertebrates and therefore has prevented a quantifying analysis of the invertebrates collected during the survey. Harvey et al. (2004) sampled for 12 months and collected an average of 21.9 spider species per site (s.d. = 8.3) across the wheatbelt, compared with an average of 5.4 spider species (s.d. = 4.5) per quadrat over five days in this survey. The number of ant genera expected in the northern wheatbelt is 31 to 40 (Heterick 2009; Shattuck 1999), however only 13 ant genera were collected. There were also strong indications that the beetle fauna was highly under-represented in the survey (author's unpublished data).

Of the invertebrate groups recorded, few have the potential as food items for either foxes or cats. The taxa recorded in this survey that have the potential to be at risk from predation by cats or foxes are adult centipedes, *Urodachus* scorpions, the larger spiders (Mygalomorphinae, Lycosidae, Miturgidae and Sparassidae), larvae of Lepidoptera and Coleoptera, and Orthoptera. However, due to the short duration of the trapping period, little can be concluded from this survey in regards to evidence of either predator affecting current populations of these invertebrate groups. Trapping success can be affected by year to year population variation, weather conditions, individual species trappability and length of sampling period, however, the invertebrates collected in this survey

Table 1 (cont.)

Part D

July 2007	KGR01	KGR02	KGR03	KOP01	KOP02	KOP03	KSL01	KSL02	KSL03	KYS01	KYS02	KYS03	TAXON TOTAL
Areneomorphae	0	0	0	0	1	0	0	0	0	0	0	0	**1**
Mygalomorphae	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Pseudoscorpions	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Scorpions	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Blattodea	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Chilopoda	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Coleoptera (adult)	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Coleoptera (larvae)	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Diplopoda	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Formicidae	0	0	0	0	2	0	0	0	0	0	0	0	**2**
Hemiptera	0	0	1	0	0	0	0	0	0	0	0	0	**1**
Isopoda	0	0	0	0	1	0	0	0	0	0	0	0	**1**
Isoptera	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Lepidoptera (larvae)	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mantodea	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Orthoptera	0	0	0	0	1	0	0	0	0	0	0	0	**1**
Phasmatoda	0	0	0	0	0	0	0	0	0	0	0	0	**0**
TOTAL	**0**	**0**	**1**	**0**	**5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**6**
September 2007	**KGR01**	**KGR02**	**KGR03**	**KOP01**	**KOP02**	**KOP03**	**KSL01**	**KSL02**	**KSL03**	**KYS01**	**KYS02**	**KYS03**	**TAXON TOTAL**
Areneomorphae	2	2	0	1	2	0	4	3	2	2	0	0	**18**
Mygalomorphae	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Pseudoscorpions	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Scorpions	1	0	0	0	0	0	0	0	0	0	0	0	**1**
Blattodea	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Chilopoda	1	0	0	0	0	0	0	0	0	0	0	0	**1**
Coleoptera (adult)	0	0	0	0	0	0	0	0	0	0	2	0	**2**
Coleoptera (larvae)	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Diplopoda	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Formicidae	2	2	0	10	9	0	1	1	0	1	0	0	**26**
Hemiptera	1	1	0	2	1	0	2	4	0	1	0	0	**12**
Isopoda	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Isoptera	0	0	0	0	1	0	0	0	0	0	0	0	**1**
Lepidoptera (larvae)	0	0	0	0	0	0	0	0	1	0	0	0	**1**
Mantodea	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Orthoptera	1	4	1	4	2	4	1	3	2	0	0	1	**23**
Phasmatoda	0	0	0	0	0	0	0	0	0	0	0	0	**0**
TOTAL	**8**	**9**	**1**	**17**	**15**	**4**	**8**	**11**	**5**	**4**	**2**	**1**	**85**

are typical of the northern agricultural region and surrounding semi-arid region (Harvey et al. 2004; Heterick 2009) and provide the beginnings of an invertebrate species list for the two properties that may be expanded during future survey work.

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