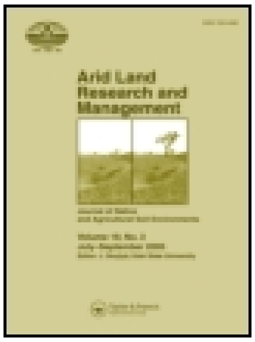

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Ground-Dwelling Arthropods of the Rio Puerco Watershed, New Mexico

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Abstract *One of the most important components of a terrestrial ecosystem is the ground-dwelling arthropods, which play a functional role as general detritivores and predators. Because of their sensitivity to rangeland deterioration, a study on the abundance of the ground-dwelling arthropods was undertaken in four different habitats of the Rio Puerco Watershed in New Mexico. Thirty-two traps (768 trap nights) were placed in each of four habitats: grama grassland, sagebrush, shrubland, juniper grassland, and pine woodland. There were more genera of ants in the juniper grassland habitat than in the other habitats. Fieldcrickets,* Gryllus *sp., were most abundant in the grama grassland and entomobryid collembolans were most abundant in juniper grassland and pine woodland habitats. Despite differences in species composition, the ground-dwelling arthropod fauna was dominated by detrivorous forms in every habitat.*

Keywords arthropods, desert rangeland, watershed

Introduction

Ground-dwelling arthropods are conspicuous and important components of many ecosystems. Important groups of ground-dwelling arthropods include tenebrionid beetles, crickets, and collembolans, which are general detritivores, scarabid beetles, which are detritivores or dung feeders, and carabid beetles, which are predators. The detrivorous tenebrionids feed on a variety of materials including decaying vegetation, fungi, seeds and seed hulls, and parts of living plants (Arnet 1963, Kramm and Kramm 1972). Dung beetles are very important in removing and processing during of domestic livestock, and in some places exotic species have been introduced to improve pastures for livestock (Fincher 1981). The spatial distribution of tenebrionids may be influenced by soil type (Calkins and Kir 1975, Doyen and Tschinkel 1974) or by vegetation type and topography (Richard 1970, Tanner and Packham 1965).

Management of semiarid rangelands should include consideration of groups of arthropods that have functional importance in such ecosystems. Also, some species of ground-dwelling arthropods could be sensitive indicators of rangeland deterioration and can be used to compare between different habitats on a watershed. To examine the relative abundances of ground-dwelling arthropods on the Rio Puerco Watershed in New Mexico, we undertook a trapping study in July and August 1987.

Study Area

The study area, referred to as the Upper Rio Puerco Watershed, is 64-km northwest of Albuquerque, New Mexico. Approximately 207, 172 ha are within the study area, with an elevation gradient from 1662 m to 2743 m above sea level. The climate is semiarid (Tuan et al. 1969). Annual precipitation ranges between 215.9 and 322.6 mm, with most of the rainfall occurring in the summer (July–September) from convectional rainstorms. The maximum summer temperature reaches 38 °C and the minimum winter temperature reaches −4 °C. July is the only month without frost. The average frost-free growing season in this area ranges between 109 to 170 days at the northern and lower southern elevations, respectively. The soils are classified as Entisols and Aridisols, with minor representation from Mollisols and units mapped as Complexes (Boul et al. 1973).

Forty-five plant communities have been quantified and classified in this area (Francis 1986) according to the dominant and/or co-dominant plant species by R. E. Francis within each life form synusia. From among these plant communities, 11 were considered the most representative and woodland, shrubland, and grassland formations. Of these, four habitats were selected that provide a gradient of varying aridity with vegetative cover dominants varying over blue grama [*Bouteloua gracilis* (HBK) Lag.] grasslands, sagebrush (*Artemisia tridentata* Nutt.) shrublands, juniper [*Juniperus monosperma* (Engelem.) Sarg.] grassland, and open ponderosa (*Pinus ponderosa* Laws.) and pinyon (*Pinus edulis* Engelm.) woodlands. The grassland and juniper grassland habitats grade into desert shrublands and the pine types may approach forest in physiognomy.

The soils of four habitats samples in this study area were classified as (1) pine woodland—silt clay loam soil; (2) juniper grassland—clay loam soil; (3) sagebrush shrubland—sandy clay loam soil; and (4) grassland—clay loam soil (Folks and Stone 1968, Buol et al. 1973 and as classified later by the USDA Soil Conservation Service 1977).

Methods

Two pitfall trap grids, 16 traps per grid, (6 × 6 m) 2 m between traps (a total of 32 traps), were placed randomly in each of the four habitats (32 × 4; 128 traps): grama grassland, sagebrush shrubland, juniper grassland, and pine woodland in the summer.

Each pitfall trap consisted in a 12-ounce (340.8-mL) cup buried flush with the soil surface in which a 10-ounce (284-mL) cup was placed. The 284-mL cup contained a layer of ethylene glycol. The small inside cup was replaced at 6-day intervals. The collected cups were covered with a lid and transported in the laboratory for counting and identification. Representatives of different taxa were preserved in 70% ethanol and sent for species determinations to New Mexico State University. Since the initial sorting failed to distinguish a number of forms as separate species, the count data on beetles and collembolans are at the family level not at the species level. Because the data were in the form of counts for 768 trap nights per grid, we used a chi-square test to examine differences in abundances among habitats.

Results

During the study period large numbers of ants were trapped. Seven genera, *Pheidole, Campanotus, Conamyrma, Crematogaster, Mymecocystus, Iridomyrmex,* and *Neivamyrmex* were found in the juniper habitat (Fig. 1) in comparison to the pine, sagebrush, and grassland, which were only 70 and 85% of those groups presented, respectively.

There were large numbers of field crickets *Gryllus* sp. A. in the grama grassland and low numbers of this species in the other habitats. The camel crickets, *Centophilus* spp. were present but not very abundant in all four habitats (Table 1). The entomobryid collembolans were more abundant than expected in the juniper grassland and pine woodlands (Table 2). There were six species of tenebrionid beetles that were not separated during the counting stage. Tenebrionids were more abundant than expected in the juniper grassland and pine woodland (Table 3). The tenebrionids were represented by *Eleodes, Embaphion, Peleryphorus,* and *Asidopsis polita* species.

Tenebrionid beetles were less patchily distributed than were the carabids and scarabs (Fig. 2*A*). Except in the juniper grassland, carabid and scarab beetles were taken in less than 20% of the traps (Fig. 2*B*). There were low numbers of scarab beetles in all habitats, and extremely low numbers in the sagebrush and pine woodland habitats (Table 3). The scarab beetles were represented by three species of *Diplotaxis* and one species of *Phyllophaga.* The carabid *Amara* sp. was very abundant in the juniper grassland and in

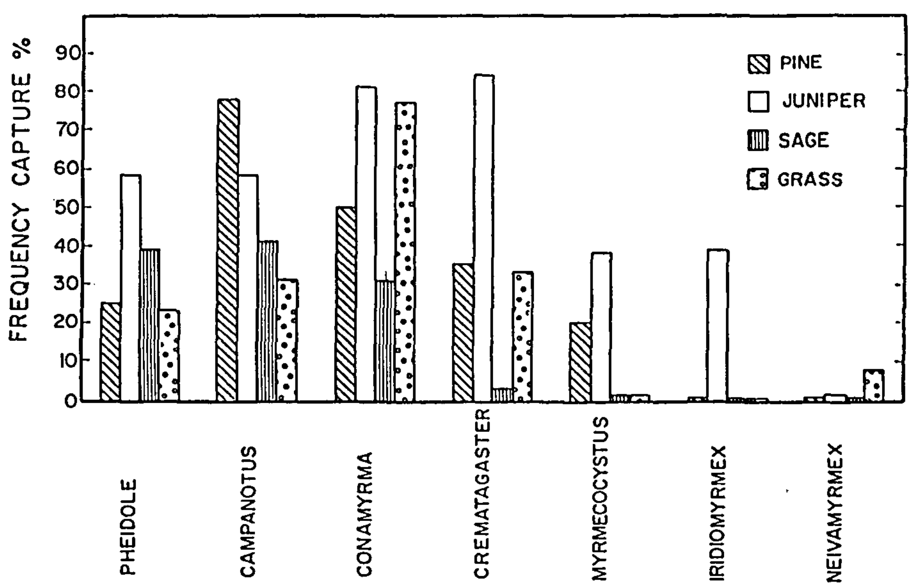

Figure 1. Frequency distribution of ant population in the different plant communities during the study period.

Table 1
Total Numbers of Orthopterans Taken in Pitfall Traps in Four Habitats on the Rio Puerco Watershed, New Mexico

	Grama grassland	Sagebrush	Juniper	Pine
Gryllidae				
Gryllus sp. (omnivore)	104	6	3	3
Gryllacridae				
Ceutophilus spp. (omnivore)	8	15	3	16

relatively low abundance in other habitats (Table 3). A number of elatirid, curculionid, and cicindellid beetles were trapped in all of the habitats sampled.

Discussion

Pitfall trap data must be treated with caution because some taxa are more suited for sampling by this method than are others (Thomas and Sleeper 1977). Pitfall trapping has been successfully used to compare habitats within an area (Parameter and MacMachon 1984), which was the primary goal of the work reported here. The numbers reported in this study must therefore be interpreted as relative abundances comparable across the habitats included in this study but not comparable to abundances reported in other studies. We can, however, examine and compare proportional species composition and trophic structure with data from other studies. The ground beetles fauna was dominated by tenebrionid beetles which were more abundant in the pine and juniper habitats. The species recorded in this study are all classified as detritivores (Kramm and Kramm 1972). The tree habitats that are open savanna-like woodlands may provide more resources for tenebrionids or less exposure to predators than the other habitats. However, Parameter and MacMahon (1984) found no difference in abundance of ground beetles on plots with shrubs compared to cleared plots.

The grassland differed from shrub and woodand habitats primarily with respect to field crickets, *Gryllus* sp. These are omnivorous arthropods that utilize both live and dead plant material but may also feed on seeds and even on carrion. The woodland habitats also supported higher numbers of entomobryid collembolans. These surface-

Table 2
Total Numbers of Surface Dwelling Collembolans from Pitfall Traps in Four Habitats on the Rio Puerco Watershed, New Mexico

	Grama grassland	Sagebrush	Juniper	Pine
Entomobryinae (detritivore)	911	371	1210*	1866*
Sminthuridae (herbivore/detritivore)	1	218	9	6

*Significantly different from expected values using chi square analysis.

Table 3
Total Numbers of Ground Dwelling Beetles Taken in Pitfall Traps in Four Habitats on the Rio Puerco Watershed, New Mexico

	Grama grassland	Sagebrush	Juniper	Pine
Tenebrionidae	59	41	118	79*
Carabidae				
Pasimachus elongatus	6	3	0	3
Amara	0	0	228*	1
Scarabidae	41*	0	22	2
Elateridae	8	0	52	3
Curculionidae	15	48	54	22
Cicindellidae	11	28	33	10

Note. In families of beetles where collections were not separated to species, the species present in that family group were listed below the family name.
*Significantly different from expected values using chi square analysis.

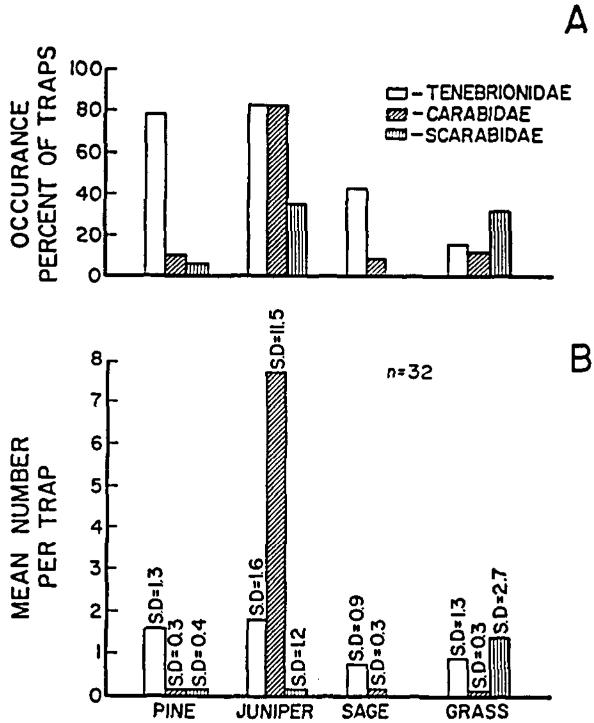

Figure 2. The occurrence of ground beetles in pitfall traps expressed as percent of traps in which beetles occurred (A) and average numbers per trap (B).

dwelling collembolans feed primarily on decomposing plant materials. They may be favored by the presence of large quantities of surface liter, 51.7% cover in pines compared to the surface litter in grassland habitats of 24.9%. Loring et al. (1987) reported relatively high abundances of entomobryid collembolans from pitfall traps on a desert watershed. Despite the abundance of scarab beetles found in this study, it is doubtful that scarabs are important in dung breakdown in these habitats. The scarabs found in this study are all classified as herbivores that feed on live vegetation; the genus *Phyllophaga* sp. (plant feeder) for example, was named for that behavior. If the scarabid fauna of these habitats does not include dung beetles, the breakdown of dung is probably due to the activity of subterranean termites (Whitforder et al. 1982).

The herbivorous cunculionid and elaterid beetles were reasonably evenly distributed across the habitats with some exceptions. The highest numbers were taken in the juniper woodland, which may reflect resource differences or chance because of the trappign technique.

The large numbers of *Amara* sp., a small predatory carabid, in the juniper woodland probably reflects and abundance of suitable small prey arthropods in that habitat that do not occur in pine woodlands. Pitfall trapping in an effective means of sampling carabids (Eruson 1979, Baard 1979). Therefore, these numbers represent real differences.

Summary

The Rio Puerco watershed supports a diverse and abundant ground arthropod fauna dominated by detritus-feeding tenebrionid beetles. Field crickets are abundant only in the grassland habitat. The woodland habitat supports higher abundances of tenebrionid beetles and entomobryid collembolans than the other habitats. There were significantly more smaller carabids *Amara* sp. in the juniper grassland than in other habitats. The absence of dung-feeding scarab beetles in these habitats suggests that termites may be processing the livestock dung.

Acknowledgments

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