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Invertebrate Density and Biomass Distribution Patterns in an Old-Field Community in South-Central Washington

Abstract

Invertebrate density and biomass were estimated in an old-field community vegetated primarily with cheatgrass (*Bromus tectorum* L.) in south-central Washington. An analysis in terms of taxonomic and trophic groupings revealed mites, beetles, and thrips to be the most abundant taxa present. Beetles and grasshoppers contributed most to total biomass. Maximum density and biomass values were obtained in April and May, respectively, the period of peak green plant standing crop values. Herbivores and omnivores were the largest trophic groups in terms of density and biomass.

Introduction

Cheatgrass (*Bromus tectorum* L.) is an introduced annual grass that readily invades disturbed habitats of south-central Washington. Once established, cheatgrass is able to maintain itself for long time periods. Cheatgrass communities on the Energy Research and Development Administration's Hanford Reservation have existed as a continuous sward for over 30 years, with little evidence that nearby native species are regaining dominance (Rickard, 1972).

Although cheatgrass communities are now an important component of the ecology of the grassland regions of this area, little is known about associated animal populations. This study was designed to ascertain the taxonomic and trophic distributions of invertebrate density and biomass in a cheatgrass community. An abandoned wheatfield last cultivated in 1943 served as the study site. Cheatgrass is the dominant plant species present, but others such as yellow salsify *(Tragopogon dubius),* lanceleaf microseris *(Microseris lacinata),* jagged chickweed *(Holosteum umbellatum),* and tumble-mustard *(Sisymbrium altissimum),* are common (Rogers and Uresk, 1974). The old-field is about 400 ha in size and is located at an elevation of 533 m.

Methods

Invertebrates were sampled at one-month intervals from April to August using a drop-trap technique. A cage 0.5 m^2 in area, 40 cm tall, and covered with 32 x 32 mesh saran netting was suspended from a tripod device on the day prior to collection. On the sample day the tripod was approached with care and the cage released from a distance

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of about 6 m using a trip cord. Large invertebrates (grasshoppers, flies, etc.) were removed by hand or with a small aspirator. The vegetation within the cage was clipped by reaching through an access hole protected by tubular stocking material. A 10 cm diameter hose connected to a D-Vac suction apparatus was then used to remove all material down to bare ground. Collected plant and invertebrate material was taken to the laboratory and the invertebrates were extricated into 75 percent ETOH using a Berlese funnel technique. Specimens were then sorted by hand, measured, and identified with the aid of a dissecting microscope. Weight estimates were calculated for individual specimens using length-weight regression equations developed by Rogers *et al.* (1977). Average weights were determined by drying and weighing representative specimens where regression equations were not available.

Results

The seasonal distribution of estimated density and biomass values are shown in Figure 1. The highest density values were obtained in April, although the actual peak density

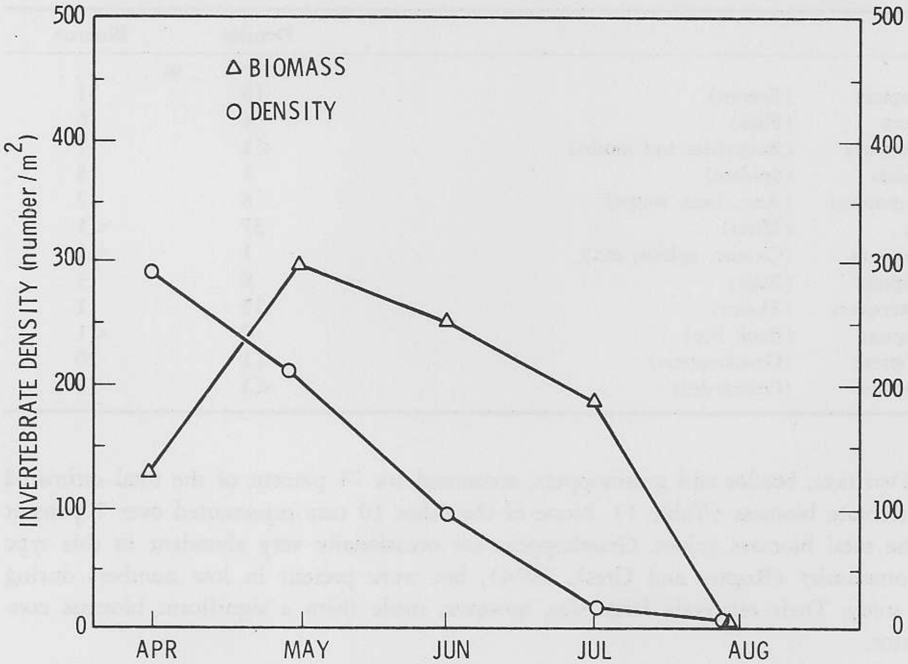

Figure 1. Seasonal distribution of estimated density and biomass.

may have been earlier. A steady decline in density progressed into the summer months, reaching a low point during August. Estimated biomass followed a similar trend, peaking in May and declining through summer with the minimum value recorded in August. These patterns approximate the live plant biomass trend; peak biomass values for green vegetation occur during April or May and then decline with the onset of summer drought conditions (Uresk, pers. comm.). Little green vegetation remains after the first of July. This fact suggests that the dominant invertebrate groups, in terms of biomass and density, are correlated with the green growth period of early spring.

The taxonomic composition of the invertebrate fauna is shown in Table 1, expressed as percentages of density and biomass. The most abundant invertebrates were mites, beetles, and thrips. The mites were largely members of the family Tetranychidae, a group that feeds on green vegetation. Their life cycle would be expected to be closely attuned to the availability of host plants. There was one abundant beetle family present, the Tenebrionidae, or darkling beetles. They are generally regarded as omnivores (Hewitt *et al.,* 1974) and probably do not require a diet of green vegetation because they are able to feed on detritus. Darkling beetles were most abundant during the months of May and June, with 54 and 34 individuals per m^2 respectively—mostly larvae. The Thysanoptera (thrips) were the third largest contributor to total invertebrate density (Table 1). Thrips are small, frequently overlooked insects. Most are phytophagous and occur on the foliage and in flower heads of various plants.

TABLE 1. Taxonomic distribution (%) of invertebrate density and biomass.

Taxa		Density	Biomass
		...... %	
Coleoptera	(Beetles)	18	51
Diptera	(Flies)	4	6
Lepidoptera	(Butterflies and moths)	<1	7
Araneida	(Spiders)	1	3
Hymenoptera	(Ants, bees, wasps)	8	7
Acari	(Mites)	37	<1
Homoptera	(Cicadas, aphids, etc.)	1	<1
Hemiptera	(Bugs)	8	3
Thysanoptera	(Thrips)	15	1
Psocoptera	(Book lice)	7	<1
Orthoptera	(Grasshoppers)	<1	20
Chilopoda	(Centipedes)	<1	<1

Two taxa, beetles and grasshoppers, accounted for 71 percent of the total estimated invertebrate biomass (Table 1). None of the other 10 taxa represented over 7 percent of the total biomass values. Grasshoppers are occasionally very abundant in this type of community (Rogers and Uresk, 1974), but were present in low numbers during this study. Their relatively large size, however, made them a significant biomass contributor.

An analysis of the trophic distribution of invertebrate density and biomass is shown in Table 2. The herbivore and omnivore groups were the two most important trophic levels, in terms of both density and biomass. The tissue and sap feeders comprised 28 and 24 percent of the total herbivore density, and pollen- and nectar-feeding insects consisted of only 4 percent. There were few flowering plants inhabiting the cheatgrass community, so the paucity of pollen and nectar foragers was expected and is consistent with our field observations. The percent biomass value for pollen and nectar feeders was higher (19 percent) than the density value, mainly resulting from the presence of a few large adult moths.

TABLE 2. Trophic distribution (%) of invertebrate density and biomass.

Trophic Level	Density	Biomass
	.... %	
Herbivore	56	47
Tissue	28	24
Sap	24	4
Pollen & Nectar	4	19
Predator	8	4
Omnivore	34	48
Fungivore	<1	<1
Unknown	<1	<1

Conclusions

Our data show that in an old-field cheatgrass community: (1) invertebrate populations reach maximum density and biomass early in the season (April, May), correlated with peak biomass of green vegetation; (2) the most abundant invertebrate taxa present are mites, beetles, and thrips; (3) beetles and grasshoppers are the largest contributors to invertebrate biomass; and (4) herbivores and omnivores are the largest trophic groups in terms of both density and biomass. We do not know how invertebrate density and biomass in cheatgrass communities compare to those for more pristine communities in the surrounding area. These comparisons are planned as the data become available.

Acknowledgments

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