An Inventory of Arthropods from Three Rangeland Sites in Central Montana

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Highlight: Three rangeland sites (mountain, foothill, and plains) in central Montana were surveyed for arthropods to determine their abundance and potential impact upon the vegetation. A vacuum quick trap (sampling method) showed that seven orders of arthropods were important on the basis of abundance and/or above-ground biomass: Acarina (mites); Thysanoptera (thrips); Collembola (springtails); Orthoptera (grasshoppers); Hemiptera (true bugs); Homoptera (leafhoppers and plant lice); and Hymenoptera (ants). The grasshoppers, true bugs, leafhoppers, and thrips consume parts of the plants and thus directly affect forage production. Springtails, mites (Oribatidae), and ants vary greatly in their habits and may affect forage production indirectly by breaking down organic matter in the soil or by affecting population densities of other insect species.

The abundance, distribution, and impact of arthropods on northern shortgrass rangeland are little known, though many workers have surveyed a certain group of insect fauna of prairies or a particular unit of vegetation (Whelan, 1927, 1936; Hendrickson, 1933; Wilbur and Sabrosky, 1936; Walkdens, 1943; Blocker et al., 1972). Also, workers (Allen, 1871; Adams, 1915; Hayes, 1927; Shackleford, 1929; Hendrickson, 1928, 1930, 1931; and Stoner et al., 1962) have sampled prairie insects in the central and southern rangeland areas of the United States. Since insects presumably affect plants directly, by consuming the vegetation, or indirectly, by transmitting diseases, influencing reproduction through pollination, or destroying

seeds, we surveyed the above-ground arthropods on three major areas of northern rangeland—mountain, foothill, and plains (Fig. 1). Our purpose was to determine population densities and biomass and potential impact on the vegetation present.

Methods and Procedures

The mountain rangeland sampling area at an elevation of 8,000 ft (15 miles northeast of Bozeman, Mont.) is a subalpine meadow within a lodgepole pine-alpine fir forest. It contains a mixture of grasses, forbs, and sedges with Idaho fescue (*Festuca idahoensis* Elmer) dominant. Other grasses present include timber danthonia (*Danthonia intermedia* Vasey), bottlebrush squirreltail [*Sitanion hystrix* (Nutt.) J. G. Smith], mountain brome (*Bromus carinatus* Hook. and Arn.), bearded wheatgrass [*Agropyron subsecundum* (Link) Hitchc.], alpine timothy (*Phleum alpinum* L.), and prairie Junegrass [*Koeleria cristata* (L.) Pers.]. The following forbs were also present on the study site: common yarrow (*Achillea millefolium* L.), Oregon flea-bane [*Erigeron speciosus* (Lindl.) DC.], gaillardia (*Gaillardia aristata* Pursh.), silvery lupine (*Lupinus argenteus* Pursh.), and white pointloco (*Oxytropis sericea* Nutt.). The soil

varies from sandy loam to rocky.

The foothill sampling area, at 5,700 ft (35 miles north of Big Timber, Mont.) is a flat bench near the base of the Crazy Mountains. This area receives more precipitation and produces more forage than the plains grassland area. This site also contains a mixture of grasses, forbs, and sedges, but the forbs predominate and the grasses are mainly fescues and wheatgrasses. The main fescue is Idaho fescue and the main wheatgrasses are western wheatgrass (*Agropyron smithii* Rydb.) and bluebunch wheatgrass [*A. spicatum* (Pursh.) Scribn. and Smith]. Other grasses present were prairie Junegrass, needleandthread (*Stipa comata* Trin. and Rupr.), and plains reedgrass [*Calamagrostis montanensis* (Scribn.) Scribn.]. Many species of forbs were recorded, but two species were the most abundant; silky lupine (*Lupinus sericeus* Pursh.) and cudweed sagewort (*Artemisia ludoviciana* Nutt.). The half-shrub fringed sagewort (*A. frigida* Willd.) and dense clubmoss (*Selaginella densa* Rydb.) were also abundant. The alluvial soil is gravelly loam.

The plains sampling area at 3,000 ft (22 miles north of Roundup, Mont.), receives less precipitation than the other two sites and is typical shortgrass rangeland. Needleandthread is the dominant grass species but western wheatgrass, blue grama [*Bouteloua gracilis* (H.B.K.) Lag ex. Steud.] and prairie Junegrass are also abundant. Two shrubs occur throughout the area: silver sagebrush (*A. cana* Nutt.) and fringed sagewort. Only one forb was abundant, American vetch (*Vicia americana* Muhl.). The soil is heavy and varies from gravelly to clay.

All sites were grazed by cattle: the mountain site lightly during July and August, the foothill site moderately during the winter and early spring, and

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the plains site moderately June through August.

Arthropods were collected on alternate weeks at all three sites. At each collection, 10 random samples were taken, except that 20 samples were taken on each date in 1972 at the mountain site. The mountain site was sampled six times from June 26 to September 6) in both years, and the foothill and plains sites were sampled 10 times in 1972 and 11 times in 1973 (from May to October).

Samples were collected with a $\frac{1}{2}$ -m² cage attached to a 4.9-m boom that was mounted on a 3-wheeled motorcycle. The cage was released from a height of 2.4 m while the motorcycle was moving along a transect line. The transect lines were randomized before sampling began and the cage was dropped every 10–20 meters at random. Arthropods trapped in the cage were vacuumed into a net placed in a 20.3 cm-diameter vacuum hose and were transferred from the net

into Berlese funnels that were installed in a van truck. A portable generator provided the power to heat the elements in the Berlese funnels and the lights used to attract the arthropods. The procedure allowed us to make a rapid (4 hours) and nearly complete extraction (95%) of the arthropods from the surface soil and plant litter. Adults of the most abundant arthropods were separated to species (except mites, thrips, springtails, and grasshoppers) in the laboratory, dried at 60°C, and weighed. The other arthropods were separated to order or group (aphids, mites, spiders, and immature forms). These groups were not weighed.

Results and Discussion

Population densities and biomasses of species that were considered important because of abundance are listed in Table 1. The density of other arthropods is reported in Table 2 where they are listed by order or group. Adult and late-instar nymphal grasshoppers were the heaviest arthropods collected, but the biomass was not determined since the quick trap did not quantitatively sample mobile arthropods (adult grasshoppers). Some specimens of other mobile groups such as Hymenoptera and Diptera also probably escaped while the cage was being dropped.

Leafhoppers and ant species were the most abundant insects on the basis of the densities (avg no./m²) listed in Table 1. Of the 14 species of leafhoppers listed, five were recorded from all three sites. *Aceratagallia fuscoscRIPTa* (Fig. 2), was abundant on all three sites and was collected on every

Fig. 1. Rangeland sites surveyed: (upper) mountain, (middle) foothill, (lower) plains.

Fig. 2. *Aceratagallia fuscoscRIPTa*—*Hemiptera* (Homoptera), adult.

Table 1. Density and biomass of selected (abundant) adult insect species collected with a vacuum quick trap on three rangeland sites (MT = mountain, FH = foothill, and PL = plains) in central Montana, 1972-1973.

Order, family, and species	Density (no./m ²)			Avg individual weight (mg) ¹	Avg biomass (mg/m ²) ²		
	MT	FH	PL		MT	FH	PL
Coleoptera							
Carabidae							
<i>Metabletus americanus</i> Dejean	0.44	1.97	0.02	0.36	0.16	0.71	0.01
Anthicidae							
<i>Notoxus calcaratus</i> Horn	0	0	.22	.49	0	0	.11
<i>Anthicus</i> spp.	.18	.13	0	.26	.05	.03	0
Pedilidae							
<i>Pedilus collaris</i> Say	0	.46	0	1.54	0	.71	0
Tenebrionidae							
<i>Blapstinus</i> spp.	0	.01	.18	2.48	0	.02	.45
Curculionidae							
<i>Otcorhynchus ovatus</i> (L.)	0	.61	.02	2.69	0	1.64	.05
Diptera							
Ephydriidae							
<i>Philygria debilis</i> Loew	.50	1.47	.90	.11	.06	.16	.10
Anthomyiidae							
<i>Hylemya cinerella</i> (Fallen)	.01	.18	0	.92	.01	.17	0
Trixoscelididae							
<i>Trixoscelis fumipennis</i> Melander	0	.43	.52	.27	0	.12	.14
Hemiptera (Heteroptera)							
Miridae							
<i>Chlamydatus associatus</i> (Uhler)	.02	1.12	.25	.28	.01	.31	.07
<i>Stenodema vicinum</i> (Provancher)	.46	.13	.01	1.74	.80	.23	.02
<i>Ceratocapsus</i> spp.	0	.75	.13	.34	0	.26	.04
<i>Labops hesperius</i> Uhler	5.98	0	0	.77	4.60	0	0
<i>Labops brooksi</i> Slater	0	.14	0	.77	0	.11	0
Nabidae							
<i>Nabis americanoferus</i> Carayon	.36	.44	.03	1.82	.66	.80	.05
Lygaeidae							
<i>Nysius tenellus</i> Barber	1.12	1.45	1.14	.89	1.00	1.29	1.01
<i>Geocoris bullatus</i> (Say)	.03	4.96	.42	.73	.02	3.62	.31
<i>Kolonetrus plenus</i> (Distant)	.01	.43	0	.41	.01	.18	0
<i>Emblethis vicarius</i> Horvath	.01	.57	.01	2.32	.02	1.32	.02
Hemiptera (Homoptera)							
Membracidae							
<i>Campylenchia curvata</i> (F.)	0	.22	0	2.68	0	.59	0
Cicadellidae							
<i>Aceratagallia fuscscripta</i> Oman	8.00	28.04	4.21	.41	3.28	11.50	1.73
<i>Hardya dentata</i> (Osborn and Ball)	0	1.74	.05	.29	0	.50	.01
<i>Diplocolenus configuratus</i> (Uhler)	.66	.44	.08	.87	.57	.38	.07
<i>Cuerna alpina</i> Oman and Beamer	0	.10	.11	1.98	0	.20	.22
<i>Hebecephalus truncatus</i> Beamer and Tuthill	.10	.93	.04	.27	.03	.25	.01
<i>Sorhoanus debilis</i> (Uhler)	.60	3.13	0	.62	.37	1.94	0
<i>Dikraneura carneola</i> (Stal)	.22	.30	0	.19	.04	.06	0
<i>Commellus sexvittatus</i> (Van Duzee)	0	1.89	0	1.06	0	2.00	0
<i>Cabrulus labeculus</i> (DeLong)	1.18	7.81	.56	.44	.52	3.44	.25
<i>Endria inimica</i> (Say)	.03	4.76	0	.68	.02	3.24	0
<i>Frigartus frigidus</i> (Ball)	0	1.06	.07	1.13	0	1.20	.08
<i>Chlorotettix unicolor</i> (Fitch)	0	.30	0	2.62	0	.79	0
<i>Orocastus</i> spp.	.16	6.07	1.31	.32	.05	1.94	.42
Psyllidae							
<i>Alphalara artemisiae</i> Foerster	0	1.58	6.10	.08	0	.13	.49
<i>A. veazei</i> Patch	.38	.40	.05	.19	.07	.09	.01
Cercopidae							
<i>Philaronia bilineata</i> (Say)	0	.65	.15	3.27	0	2.13	.49
Hymenoptera							
Formicidae							
<i>Tapinoma sessile</i> (Say)	.70	42.49	3.94	.15	.11	6.37	.59
<i>Formica lasioides</i> Emery	5.09	2.23	.30	.35	1.78	.78	.11
<i>F. obscuripes</i> Forel	.03	.47	.02	2.03	.06	.95	.04
<i>Myrmica americana</i> Weber	4.74	2.36	1.51	.89	4.22	2.10	1.34
<i>Leptothorax rugatulus</i> Emery	.70	.47	1.98	.03	.02	.01	.06
<i>Lasius crypticus</i> Wilson	.19	.53	1.30	.20	.04	.11	.26

¹ At least seven specimens (range 7-50) of each species were weighed to obtain mean weights.

² Avg biomass/m² is obtained by multiplying the avg individual dry weight times the avg no./m².

Table 2. Mean densities of other arthropods (order or group) collected with the vacuum quick trap from three types of rangeland in Montana, 1972-73.¹

Order or group	Common name	Stage of development	Density (no./m ²)		
			Mountain	Foothill	Plains
Acarina	Mites	Nymphs and adults	63.47	41.99	27.36
Aphidae	Aphids	Nymphs and adults	.12	13.27	2.19
Araneida	Spiders	Nymphs and adults	3.18	2.06	1.60
Coleoptera	Beetles	Adults	3.66	3.28	1.12
Collembola	Springtails	Nymphs and adults	8.17	14.93	3.48
Diptera	Flies	Adults	1.09	2.71	1.25
Hemiptera	Bugs	Adults	3.43	2.70	.83
Hemiptera	Bugs	Nymphs	7.31	23.20	3.20
Homoptera	Leafhoppers, etc.	Adults	6.63	8.82	3.12
Homoptera	Leafhoppers, etc.	Nymphs	42.73	176.32	21.57
Hymenoptera	Ants, wasps, bees	Adults	6.02	10.14	1.12
Lepidoptera	Moths and butterflies	Adults	1.12	3.15	.36
Misc. larvae ²			7.52	4.19	1.39
Orthoptera	Grasshoppers and crickets	Adults	.30	.58	1.04
Orthoptera	Grasshoppers and crickets	Nymphs	2.29	.82	4.48
Thysanoptera	Thrips	Nymphs and adults	51.20	15.98	1.62
Trichoptera	Caddisflies	Adults	.10	0	0

¹ During a 2-year period (1972-1973), a total of 105 m² was sampled at the foothill and plain sites and 90 m² was sampled at the mountain site.

² Coleoptera, Diptera, Lepidoptera, etc.

sampling date during both years. The seasonal density of adults of this species is shown in Figure 3: the pattern was in general similar at all three sites, but the increase in density occurred later at the mountain site due to the shorter, later growing season at that altitude. This same leafhopper species was found to be abundant in two crested wheatgrass pastures in Montana (Hewitt and Burleson, 1975).

Six ant species were collected at all three sites (Table 1). *Tapinoma sessile* was the most abundant ant species on the foothill and plains sites, and was collected on every sampling date during both years at the foothill site.

At the mountain site, the black grassbug, *Labops hesperius*, (Hemiptera) which is economically important on rangeland grasses was collected. *Labops hesperius*, reported as injurious by Todd and Kamm (1974), Knowlton and Roberts (1975), and Pepper et al. (1953), was the second most abundant insect species collected at that site. Adults first appeared in early July and had disappeared by the middle of August.

In general, of the arthropods collected average arthropod biomass per square meter correlated positively with density (Table 1) since four species were both the most abundant and had the greatest biomass on the mountain site: *Aceratagallia fuscoscipita* (leafhopper), *Labops hesperius* (true bug), *Myrmica americana* (ant), and *Formica lasioides* (ant). On the foothill site, the four most abundant species were: *Tapinoma sessile*, *A. fuscoscipita*, and

Cabrus labeculus (leafhoppers) and *Orocastus* spp. (leafhopper); the first two also had the greatest biomass. On the plain site, the four most abundant species were *A. fuscoscipita* and *T. sessile* plus *Apholara artemisiae* (jumping plant lice) and *Leptothorax rugatulus* (ant). *Aceratagallia fuscoscipita* (Fig. 2) had the greatest biomass.

Of the groups of arthropods shown in Table 2, four were generally the most abundant on all three sites: Acarina (mites), Thysanoptera (thrips), Collembola (springtails), and

immature Homoptera (mostly *Aceratagallia fuscoscipita*). Representative drawings of these four groups are shown in Figure 4. The species within these groups were not determined.

The average density of arthropods (based on the totals collected on each site) was greatest on the foothill site: (447.35 specimens/m² versus 240.33/m² on the mountain site, and 101.36/m² on the plains site). The seasonal pattern of density on all three sites is shown in Figure 5. During both years, density was always highest in the spring and fall and lowest during

Fig. 3. Seasonal density of *Aceratagallia fuscoscipita* adults during a 2-year period 1972-1973 at three rangeland sites in central Montana. MT = mountain, FH = foothill, PL = plains.)

Fig. 4. Representatives of the four most abundant groups of arthropods: A. Mite (Oribatidae); B. Thrips (Thripidae); C. Springtail (Entomobryidae); D. Immature leafhopper (Cicadellidae).

Fig. 5. Seasonal abundance of the total arthropods sampled at all three sites during a 2-year period 1972-1973 in central Montana. (MT = mountain, FH = foothill, PL = plains.)

the warmer months of summer. Also, an abrupt decrease in density occurred in September during at least 1 year at all three sites. We believe this decrease would have appeared in both years if sampling had been extended later into the fall. Arthropods were generally more abundant at all three sites in 1973 than in 1972.

On the basis of abundance and biomass, seven orders of arthropods can be considered to have the greatest potential influence on northern rangeland vegetation: Acarina (mites), Thysanoptera (thrips), Collembola (springtails), Orthoptera (grasshoppers and crickets), Hemiptera (true bugs), Homoptera (leafhoppers and plant lice), and Hymenoptera (ants). Four of these groups affect forage production directly: grasshoppers consume above-ground plant forage or convert it to litter; thrips feed on flowers and leaves; and Homoptera and Hemiptera cause necrosis by removing sap from the leaves. Also, many species of leafhoppers are vectors of plant diseases; for example, the leafhopper, *Endria inimica*, which was abundant on the foothill site, was listed by Slykhuus (1953) as the vector of striate mosaic of wheat in the United States. Two species of Hemiptera, *Geocoris bulbatus*, which was important in terms of biomass on the foothill site, and *Nabis americanoferus*, are predators of small insects. Most of the springtails and mites (Oribatidae) are scavengers and increase soil fertility by breaking down organic matter. A few species of springtails are phytophagous. The ants vary considerably in habits; for example, the genus *Lasius* contains species that feed largely on honeydew (an excretion from aphids), the genus *Formica* includes species that raid the nests of other species of *Formica* and carry off pupae, which are eaten or reared, and the genus *Myrmica* includes species that feed on seeds or fungi or that are parasitic. The last three groups mentioned (springtails, mites, and ants) only indirectly affect plant growth. However, some ants are seed feeders and can affect plant succession and abundance.

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