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Herbivorous and parasitic insect guilds associated with Great Basin wildrye (*Elymus cinereus*) in southern Idaho

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HERBIVOROUS AND PARASITIC INSECT GUILDS ASSOCIATED WITH GREAT BASIN WILDRYE (*ELYMUS CINEREUS*) IN SOUTHERN IDAHO[1]

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ABSTRACT.—Insects inhabiting Great Basin wildrye (*Elymus cinereus* Scribn. & Merr.) were surveyed at two sites on the Snake River Plain in southern Idaho during 1982 and 1983. Forty-six species of phytophagous insects were observed. In addition, eight parasitoid species were reared from insect hosts in the plant culms and identified. Life stage, abundance, plant part utilized, and study site were recorded for each insect species collected. Insect guilds at the two sites were compared based on species presence utilizing Sorensen's similarity index. Overall, 26 insect species were common to both sites, yielding a moderate similarity index of 0.62.

The majority of the species that constitute the wildrye herbivore guilds were oligophagous (restricted to grasses). Many of these insects feed on grain crops as well as other native and introduced grasses. The relatively high diversity of phytophages on wildrye may be due to its tall, bunchgrass growth form, its abundance within its habitat, its broad geographic range, and the large number of related species of grasses in the region.

Great Basin wildrye (*Elymus cinereus* Scribn. & Merr.) is one of the largest and most widespread native bunchgrasses in the western U.S. (Lesperance et al. 1978). It is an important component of both the salt desert shrub and sagebrush/grass ecosystems. Every spring and summer the plant produces enormous amounts of biomass that may be exploited by vertebrate and invertebrate herbivores. Much is known of wildrye's palatability and utilization by large ungulate grazers (Perry and Chapman 1974, 1975, Krall et al. 1971, Lesperance et al. 1978, Murray et al. 1978), but there has been no comprehensive study of its phytophagous insect communities. An attempt was made to partition the plant into anatomical regions and identify the associated insect herbivore guilds and their parasitoids. The impacts and diversity of these guilds are discussed.

METHODS

Insects associated with Great Basin wildrye were surveyed at two sites on the Idaho Snake River Plain during 1982 and 1983. The 1.1-ha, lower-elevation (1,475 m), and drier (246 mm precipitation/yr) site was located on the Idaho National Engineering Laboratory (INEL), 10 km south of Howe, Butte Co. Wildrye occupied low, saline areas surrounded by higher ground that supported Wyoming big sagebrush (*Artemisia tridentata* subsp. *wyomingensis* Beetle). The second site was located in the north end of Craters of the Moon National Monument (CRMO), 29 km southwest of Arco at 1,817 m elevation. The precipitation is almost twice as abundant at this site (426 mm/yr). Wildrye grew on an 8.5-ha, relatively wet meadow that was surrounded by mountain big sagebrush (*Artemisia tridentata* subsp. *vaseyana* [Ryberg] Beetle).

Insects were monitored on the host plant from its three-leaf phenological stage in May through seed maturation in late August. Fifteen plants were randomly selected along two random, 50-m transects at each site at weekly intervals. The insect fauna on each host plant was observed for five minutes. Insect life stage, behavior, relative abundance, and plant parts utilized were recorded. Insects were hand-picked or aspirated from the grass for later identification. Presence of internal feeders was determined by dissecting five tillers from each plant. Each week five plants at each site were excavated, examined for root- and root-crown–infesting insects, and placed into Berlese funnels to collect the resident insects.

Insect feeding was determined by direct observation such as mouthpart insertion and plant damage. While not absolutely definitive in all cases, this method is more accurate than previous sweep-net sampling programs

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(Horning and Barr 1968).

RESULTS AND DISCUSSION

Forty-six insect species in 22 families and seven orders were identified as feeding on wildrye. Each species was categorized as to abundance, life-stage feeding on wildrye, region of the host plant utilized, and host specificity (Table 1). Eight species of parasitoids were also reared from insect hosts in the culms and identified (Table 2). The host plant was partitioned into five anatomical components: roots, culms, leaves, flowers, and seeds. Each region supported a variety of insect species that employed different feeding strategies. Many of the insects utilized more than one plant part and thus were identified in more than one guild.

Root-Feeders

Aphids, mealybugs, and beetle larvae were the most abundant insects feeding on wildrye roots. The aphids, *Forda marginata* and *F. olivacea*, were collected in low numbers in the spring and early summer. Both species have been reported to feed only on grass roots and are associated with ant nests (Gillette 1918, Patch 1939, Gittins et al. 1976, Smith and Parron 1978). Two pseudococcids were less frequently collected on the roots of the host plant. One, *Cryptoripersia trichura*, is known to inhabit grass roots in Arizona and New Mexico (MacGillivray 1921).

Elaterid larvae, wireworms, were very common in the soil surrounding the roots and are known as major pests of grains and range grasses. Chafer larvae, *Dichelonyx* sp., and adult weevils, *Brachyrhinus ovatus*, were found to infest Great Basin wildrye roots at CRMO. Adult billbugs, *Sphenophorous gentilis*, were very common on the seed heads of *E. cinereus* at INEL. Billbug larvae are known to feed on the roots of a variety of grasses (Asay et al. 1983, Tashiro and Personius 1970, Kamm 1969) and were believed to feed on the roots of wildrye at the study site, but could not be located. Cerambycid larvae were collected in the root masses of wildrye and identified to the subfamily Lepturinae. *Cortodera barri*, a cerambycid commonly observed feeding on wildrye pollen as an adult, was the only species belonging to this subfamily found in the area. Therefore, it seems likely that the larvae belonged to this species.

Culm- and Leaf-Feeders

A large number of herbivores utilize both the culms and leaves of grasses; therefore, these two anatomical regions are discussed together. Grasshoppers are one of the most common and destructive groups of insects on western ranges (Watts et al. 1982). They are the most visible pests and have been studied more than any other graminivorous insects. Five species of acridids were collected on wildrye during the summers of 1982 and 1983. Four of these species are in the genus *Melanoplus*, with the migratory grasshopper, *M. sanguinipes*, being most abundant.

A few beetles were also found to be external chewers. Adult *Dichelonyx* fed on the host plant in July at CRMO. *Anisostena californica*, a chrysomelid, was observed feeding on wildrye leaves at both sites.

Larvae of three species of Hymenoptera fed internally in the grass culm. *Cephus cinctus* larvae tunneled down the stems consuming parenchyma and vascular tissues. Larvae eventually cut the stems and overwintered in the remaining stubs. Sawfly herbivory may impair transport of water and nutrients through the stem, thus detrimentally affecting grain production (Holmes 1977, Seamans et al. 1944). Jointworms, *Tetramesa* spp., were reared from wildrye culms. *Tetramesa* larvae fed on internal tissues. At least one species formed "bump galls" on the stem below the inflorescence. Spears and Barr (1985) reported that these larvae adversely affect the growth and reproduction of several range grasses. Dipteran larvae, probably chloropids, were also collected within the stems but could not be reared to adults.

Although injury due to defoliators is more apparent, fluid-feeding Homoptera and Hemiptera may have the greatest impact on wildrye and other native grasses (Haws 1982). By extracting plant fluids and pumping saliva into the plant, these insects remove essential plant sap and cytoplasm and may inject toxic compounds or transmit viruses. Cicadas, *Okanogana bella*, were very visible in the summer clinging to wildrye stems at CRMO. Leafhoppers and delphacids were the most common insects feeding on wildrye. Over 50 individuals of a delphacid, *Eurysa obesa*, were counted at one time on an individual

TABLE 1. Insects collected and observed feeding on Great Basin wildrye at Craters of the Moon National Monument (C) and the Idaho National Engineering Laboratory Site (I) in 1982–83.

Taxa	Life stage[a]	Plant parts[b]	Location	Host spec.[c]	Abundance[d]
ORTHOPTERA					
Acrididae					
Melanoplus bivittatus (Say)	n, a	c, l	C	p	co
Melanoplus femurrubrum (DeGeer)	n, a	c, l	C	p	co
Melanoplus foedus Scudder	n, a	c, l	C	p	un
Melanoplus sanguinipes (Fabricius)	n, a	c, l	C, I	p	co
Phoetaliotes nebrascensis (Thomas)	n, a	c, l	C	o	co
THYSANOPTERA					
Aeolothripidae					
Aeolothrips auricestus Treherne	a	f, s	C, I	p	co
Aeolothrips sp.	n, a	f, s	C, I	u	co
Thripidae					
Aptinothrips rufus (Gmelin)	a	f, l	C, I	o	co
Frankliniella occidentalis (Pergande)	n, a	f, s	C, I	p	co
Frankliniella sp.	n, a	f, s	C	u	co
Sericothrips sp.	n, a	f, s	C, I	u	co
HOMOPTERA					
Cicadidae					
Okanogana bella Davis	a	c, l	C	p	co
Cicadellidae					
Dikraneura carneola (Stal)	n, a	c, l	C, I	p	co
Hecalus viridis (Uhler)	n, a	l	I	p	co
Delphacidae					
Eurysa obesa Beamer	n, a	c, l	C, I	o	co
Aphididae					
Forda marginata (Koch)	n, a	r	I	o	un
Forda olivacea Rohwer	n, a	r	C	o	un
Pseudococcidae					
Cryptoripersia trichura (Cockerell)	n, a	r	C	o	un
Phenacoccus sp.	n, a	r	I	u	un
Trionymus smithii (Essig)	n, a	c, l	C	o	co
Eriococcidae					
Eriococcus insignis Newstead	n, a	c, l	C	o	un
HEMIPTERA					
Miridae					
Irbisia pacifica (Uhler)	n, a	c, l	C, I	o	co
Labops utahensis Slater	n, a	c, l	C	o	co
Litomeris debilis (Uhler)	n, a	c, l	C, I	o	co
Stenodema laevigatum (Linnaeus)	n, a	c, l	C, I	o	co
Pentatomidae					
Aelia americana Dallas	a	f, l	C, I	p	co
Rhytidilomia uhleri Stal	a	f	C, I	o	co
COLEOPTERA					
Elateridae					
Anchastus cinereipennis Eschscholtz	l	r	C, I	o	co
Cardiophorus sp.	l	r	C	u	co
Limonius infuscatus Motschulsky	l	r	C	o	co
Limonius sp.	l	r	I	u	co
Melyridae					
Attalus glabrellus Fall	a	f	I	p	co
Attalus morulus smithi Hopping	a	f	I	p	co
Collops bipunctus (Say)	a	f	I	p	co
Anthicidae					
Notoxus serratus LeConte	a	f, s	C, I	p	co
Phalacridae					
Phalacrus pencillatus Say	a	f	C, I	p	co
Scarabaeidae					
Dichelonyx sp.	l	r	C	u	co
	a	c, l	C	u	co

Table 1 continued.

Taxa	Life stage[a]	Plant parts[b]	Location	Host spec.[c]	Abundance[d]
Cerambycidae					
Cortodera barri Linsley & Chemsak	l	r	C, I	o	ra
	a	f	C, I	p	co
Chrysomelidae					
Altica sp.	a	f	C, I	u	co
Anisostena californica Van Dyke	a	l	C, I	o	co
Curculionidae					
Brachyrhinus ovatus (Linnaeus)	a	r	C	p	co
Sphenophorus gentilis LeConte	l	r	I	o	—
	a	s	I	o	co
LEPIDOPTERA					
Noctuidae					
Faronta diffusa (Walker)	l	f, s	C, I	o	co
HYMENOPTERA					
Cephidae					
Cephus cinctus Norton	l	c(i)	C, I	o	co
Eurytomidae					
Tetramesa elymophaga (Phillips)	l	c(i)	C, I	m	co
Tetramesa sp.	l	c(i)	C, I	u	co

[a] n = nymph, l = larva, a = adult.
[b] c = culm, l = leaf, r = root, f = flower, s = seed, (i) = internal.
[c] p = polyphagous, o = oligophagous, m = monophagous, u = unknown.
[d] ra = rare (fewer than 10 insects collected), un = uncommon (10–50 insects collected), co = common (more than 50 insects collected).

TABLE 2. Insect parasitoids reared from insect hosts in Great Basin wildrye culms collected from Craters of the Moon National Monument (C) and the Idaho National Engineering Laboratory (I) in 1983.

Taxa	Host	Location
HYMENOPTERA		
Eulophidae		
Pediobius utahensis (Crawford)	*Cephus cinctus* Nort.	C, I
Zagrammosoma nigrolineatum Crawford	unknown[a]	I
Eupelmidae		
Calosota sp.	*Tetramesa* sp.	I
Torymidae		
Torymus thalassinus (Crosby)	*Tetramesa* sp.	I
Pteromalidae		
Homoporus atriscapus Gahan	unknown[b]	C
Homoporus sp.	*Tetramesa* sp.	C
Eurytomidae		
Eurytoma pachyneuron Girault	*Tetramesa* sp.	C
Eurytoma sp.	*Tetramesa* sp.	C, I

[a] Previously reported to be a parasite on *Argyresthia* sp. (Lepidoptera: Yponomeutidae) (Krombein et al. 1979).
[b] Probably parasitic on *Tetramesa* sp.

grass tiller. Less common were the scales found on the stems under the leaf sheaths. Impacts from these Homoptera could not be separated from the damage due to the fluid-feeding hemipterans.

Many species of mirids cause injury to range grasses through toxemia and loss of plant fluids (Watts et al. 1982). *Irbisia pacifica*, *Litomeris debilis*, and *Stenodema laevigatum* frequently fed on wildrye at both sites. In June 1983 at CRMO, a large section of the study site was observed turning brown. Basin wildrye plants were stunted in the four-leaf stage by infestations of the black grass bug, *Labops utahensis*, and the delphacid *Eurysa obesa*. When insect numbers declined later in the summer, wildrye resumed growth but did not produce any reproductive tillers. Adequate soil moisture and carbohydrate reserves may have enabled the plants to recover. However, the black grass bug can significantly reduce forage production and may cause death if droughty conditions prevail (Todd and Kamm 1974, Haws 1978).

TABLE 3. Sorensen coefficients of insect community similarity by guild on Great Basin wildrye at Craters of the Moon National Monument (CRMO) and the Idaho National Engineering Laboratory (INEL) in 1982 and 1983.

Guilds	Number of species			SI[a]
	CRMO	INEL	Common	
Fluid-feeders—roots	2	2	0	0.00
Chewers—roots	3	2	1	0.40
Fluid-feeders—leaves & culms	14	11	8	0.64
Chewers—leaves & culms	10	4	3	0.43
Fluid-feeders—flowers & seeds	5	4	4	0.89
Chewers—flowers & seeds	2	3	2	0.80
Internal chewers—culms	3	3	3	1.00
Internal parasites	5	5	2	0.40
Pollen feeders	6	9	6	0.80
Total species[b]	45	38	26	0.62

[a]SI = $\frac{2\,(\text{Common})}{\text{CRMO} + \text{INEL}}$ (Sorensen 1948, Wolda 1981).

[b]Columns do not add up to total because some insects overlap guilds.

Flower- and Seed-Feeders

Thrips, pentatomids, adult beetles, and larvae of a species of Lepidoptera were collected on wildrye inflorescences. Seven species of beetles consumed the pollen. Most of these beetles were polyphagous herbivores that switch hosts to take advantage of the available nutritious food source (Thomas and Werner 1981). This may also have been true of the pentatomids that were found feeding on the developing seeds. However, adult billbugs seemed to be monophagous on wildrye in this area. They were observed chewing on the developing seeds of *Elymus*. After seed maturation, adult billbugs were no longer observed. Thrips were collected throughout the season. Two families and six species of Thysanoptera were represented in the Great Basin wildrye insect community. *Frankliniella occidentalis*, the western flower thrip, is a widespread, generalist feeder that has previously been reported on grasses (Tingey et al. 1972, Watts and Bellotti 1967, Knowlton and Thomas 1933). Thrips are often cited as causing damage to grass seed (Thomas and Werner 1981, Riherd 1954, Bailey 1948). The only lepidopteran associated with wildrye, *Faronta diffusa*, fed on the inflorescences at both sites. This species is especially destructive to wheat, oats, and rye (Walkden 1950) and has been reported on a variety of native grasses in Arizona, New Mexico, and Utah (Godfrey 1972, Watts and Bellotti 1967).

Parasites

Eight chalcid parasitoids (Hymenoptera: Chalcidoidea) were reared from insect hosts in Great Basin wildrye culms. *Pediobius utahensis* was reared from sites of developing wheat stem sawflies in stubs of wildrye culms. The other chalcid parasitoids were collected within the culms in the second, third, and fourth internodes and were associated with *Tetramesa* species. It is not known whether any of these wasps were hyperparasites.

Herbivore Guild Complexity

Twenty-six of the 46 insect species collected on basin wildrye were found at both the CRMO and INEL sites (Table 3). Presence or absence of a species was utilized as an indicator of insect fauna similarity between sites. Similarity indices were estimated using Sorensen's (1948) coefficient (Wolda 1981). Each guild was examined individually. Internal chewers and flower and seed feeders displayed the greatest similarity. The small number of grasshopper species at the INEL site may account for differences in leaf and culm external chewers. Low similarity indices for root insects may reflect the very different soil types of the two stands. Although occurring only 40 km apart, the CRMO and INEL sites are different habitat types and represent the wide ecological amplitude of basin wildrye. Climatic and edaphic differences may account for much of the difference in insect species collected from each site.

The majority of the species that constitute the wildrye herbivore guilds are oligophagous, also feeding on cultivated grains as well as other native and introduced grasses. Rangelands are thought to be a source of most insect pests of cereal grains (Watts et al. 1982).

Wildrye, a large, structurally diverse plant, supports a sizable fauna and thus may serve as a reservoir for many of these herbivores. However, wildrye stands also may function as reservoirs for potentially useful predator and parasite species.

The number of phytophagous insect species exploiting Great Basin wildrye was quite large relative to other native grasses in the area. Very few studies have identified the total phytophagous insect community associated with an individual grass species. Watts (1963) collected 120 species on black grama grass, *Bouteloua eriopoda* Torrey; however, these included grass-feeders, parasites and predators, and casual visitors. Wight (1986) identified 33 phytophagous insects on the introduced crested wheatgrass, *Agropyron cristatum* (L.) Gaertn., in southern Idaho. Beisler and his colleagues (1977) collected phytophagous insects associated with three weedy grasses. They found 33 species feeding on Johnson grass, *Sorghum halepense* (L.) Pers.; 39 on fall panicum, *Panicum dichotomiflorum* Michx.; and 35 associated with large crabgrass, *Digitaria sanguinalis* (L.) Scop.

Plant structural diversity, species area relationships, and taxonomic isolation are thought to explain much of the richness of insect species on a host plant (Lawton and Schroder 1977, Southwood 1961, Strong and Levin 1979). Grasses and forbs are less structurally diverse than trees and shrubs and usually have fewer associated species (Niemela et al. 1982, Strong et al. 1984). However, wildrye's height and foliage diversity provide a greater variety of microhabitats than do most range grasses. Tallamy and Denno (1979) found the more structurally complex grass *Distichlis spicata* (L.) Greene supported a richer community of sap-feeders than the simpler *Spartina alterniflora* Loisel.

Taxonomically isolated plants may have impoverished insect faunas (Strong et al. 1984). Wildrye belongs to the grass tribe Triticeae. Idaho is included as one of the areas of the world with the greatest concentrations of species in this tribe (Hartley 1972). Therefore, many closely related grass genera, such as *Agropyron, Sitanion,* and *Hordeum,* are well represented in the area. Many insects that feed on wildrye are likely to feed on alternate hosts in related genera, thus increasing the geographical area they may exploit.

Insect species found on a particular host plant are influenced by the local abundance of the plant, both its density and extent (Strong et al. 1984, Fowler and Lawton 1982, Root 1973). On the study sites wildrye grew in almost pure stands, but in very different habitats. Wildrye has a large geographic range, grows in a variety of habitat types (Walker and Brotherson 1982), and is locally abundant within these types. Insects feeding on this grass find a large, conspicuous food source that remains available longer into the summer than any other C_3 grass species in the area.

Graminivorous insects were identified that have the potential to reduce forage and seed production of wildrye. This information may be valuable to grass breeders, seed companies, and range managers interested in revegetation of certain types of rangelands with basin wildrye. Some of the phytophagous insects in this study apparently reduced reproductive potential of wildrye and may have detrimental effects on reseedings. Although grasses are very tolerant of herbivory and have evolved many means of tolerating grazing (McNaughton 1979, Stebbins 1981), insect populations fluctuate greatly and in some years could reach injurious levels. Therefore, it is important to identify which plants and plant parts are fed upon by various members of the insect community and to determine the impact of herbivory on an individual plant species and its population dynamics.

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