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Insect Grazers on the Cold Desert Biome

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Highlight

When the seasonal abundance of phytophagous, saprophagous, and entomophagous insects was determined in several habitat types of native range on the Squaw Butte Experiment Station in Oregon, more phytophagous insects were present on range under a managed grazing program with domestic livestock than on range that had not been grazed for 37 years. Root aphids and root coccids were the dominant insect grazers in the *Artemisia arbuscula Festuca-idahoensis* and in *Artemisia tridentata-Agropyron spicatum* habitats. Both the aphids and coccids were considered to be at tolerable levels. Revegetation of the range with susceptible grasses may result in a disproportionate amount of forage being consumed by these insects. Thus, candidate grasses for use in range revegetation should be evaluated for insect resistance in advance.

Most research on rangeland insects has focused on species capable of serious defoliation, such as grasshoppers (Anderson 1973). Smaller insects that reduce forage productivity more subtly are often not observed (Hewitt *et al.* 1974). The saprophagous insects and mites also go unobserved yet play an essential role in recycling dead organic matter (Butcher *et al.* 1971). In a forest ecosystem, normal insect grazing may consume between 5 and 30 percent of the foliage (Mattson and Addy 1975). We need similar awareness of the role of rangeland insects in different types of habitats to evaluate potential loss and recovery of that due to insect grazers.

Most plant-pest relationships that involve phytophagous insects on native range have evolved to a relatively stable balance. For example, the plant bug *Labops hesperius* Uhler was of no reported importance to man until new wheatgrasses were introduced into its habitat. Subsequently, dense populations developed and reduced the productivity of the introduced wheatgrasses (Todd and Kamm 1974). Perhaps insect-resistant varieties could be in use today if the pest potential of this bug had been recognized earlier (Danning 1948).

Since the plant-pest relationship can change as a result of management practices, we conducted an exploratory study to determine the dominant grass-insect associations in several habitat types on the Squaw Butte Experimental Range. The effect of long-term grazing by cattle on the insect populations was also assessed, with emphasis on insects that feed within the plant crowns and on the roots.

Materials and Methods

The Squaw Butte Experiment Station is located 78 km west of Burns in southeastern Oregon. The vegetation, soils, native flora and fauna typify that of the high, cold desert biome. The mean elevation of the station is about 1,372 m. About 29 cm of precipitation is received annually, mostly as snow during the winter months. Mean monthly maximum air temperatures peak at about 30 C in July and drop to a mean monthly minimum temperature of 9 C in January. Six 800-ha ranges, under a managed grazing program since 1936, each with a 2-ha exclosure erected in 1936, were selected for study. The vegetation in and about the exclosures of Ranges 1 and 7 was classified as *Artemisia arbuscula-Festuca idahoensis* and that in Ranges 2, 3, 6, and 10 as *Artemisia tridentata-Agropyron spicatum*. Both types occupy millions of hectares within the Great Basin. Detailed vegetation and soil characteristics associated with these types have been described by Eckert (1957). All ranges were grazed moderately during the following time periods in 1974: Range 1 — July 5 to August 20; Range 2 — May 16 to July 10; Range 3 — April 15 to May 1; Range 6 — August 21 to September 9; Range 7 — April 17 to August 20; and Range 10 — May 17 to August 23.

Production of standing herbaceous biomass was sampled on April 29 (pre-boot), May 28 (late boot), and July 15 (mature) from 10 randomly selected 3-m^2 plots in and outside each exclosure. Vegetation harvested at ground level was separated into species groups, and oven-dry weights were recorded. Nitrogen concentrations in the yield samples and of new and old growth only were determined at each harvest. The percentage of new growth was estimated by the constituent difference method (Cooper *et al.* 1957) on the first two dates.

The insect populations were periodically sampled from three replicated plots (10 × 30 m) both inside and outside exclosures. One quadrat (15 cm diameter) was selected randomly within plots at two week intervals. The foliage, plant crown, and roots (to 5 cm deep) of all grasses in one quadrat were removed from each of the three replicated plots and combined to form one observation. Samples were transported to the laboratory in plastic bags and then placed in Berlese funnels for 72 hours to extract the insects. In addition, we used the same sampling procedure to determine the dominant insects on *A. spicatum* and *F. idahoensis* when these grasses represented one-third or more of the forage inside and outside exclosures. The relatively few insects present that were capable of flying or hopping often escaped, but were not considered significant in this study. The insects in the samples were broadly classified as phytophagous, saprophagous or entomophagous. The dominant insects were identified only to the taxon necessary for adequate discussion. The diverse species are preserved and on record in the insect collection at Oregon State University.

Results

The growing season (April to June, inclusive) of 1974 was somewhat cooler and drier than normal, but crop-year precipitation (September to June, inclusive) was near normal. Mean monthly maximum soil temperature at the 5-cm depth was 15.7, 25.2, and 39.5 C for April, May and June, respectively. Mean daily insolation was 402, 571, 625, 596, and 580 langleys for the months April through August, respectively.

The number of insects within a trophic level both inside and outside exclosures (Fig. 1) can be compared with the species composition (Fig.

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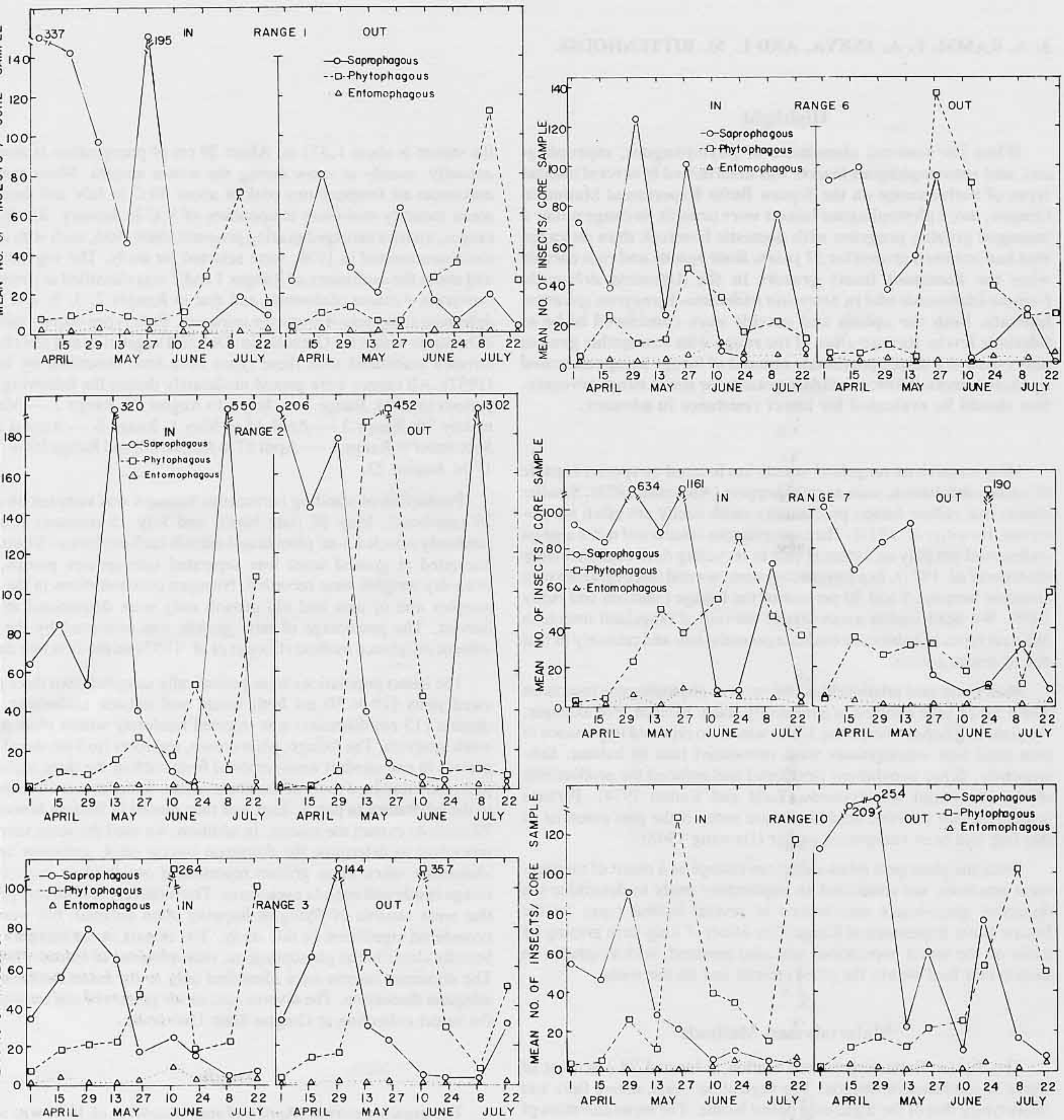

Fig. 1. Seasonal abundance of insects on grasses during the growing season.

2) and the amount of herbage present during the growing season (Fig. 3). More herbage was present inside than outside exclosures and reflects accumulations of herbage over years on the inside and yearly grazing use outside. The data (Fig. 1) show a general trend toward more phytophagous insects outside than inside exclosures. In order of abundance, the Aphididae, Coccoidea, and Formicidae were the dominant phytophagous insects. Few entomophagous insects were present but in relatively stable numbers and at about the same density both in and outside exclosures. The large and highly variable numbers of saprophagous insects were predominantly Collembola. Populations of both phytophagous and saprophagous insects fluctuated widely relative to those of entomophagous species.

Some comparative data were obtained where *A. spicatum* and *F. idahoensis* represented at least one third of the plant species composition (Figs. 4 and 5). Again, the general trend showed more phytophagous insects outside than inside exclosures on ranges 2, 6, and 7. The taxons present were: 43% Aphididae, 26% Coccoidea, 31% Formicidae, Lepidoptera, Cicadellidae, and Thysanoptera. Thus, 69% of the phytophagous insects were root aphids and coccids. Similarly, *F. idahoensis* had more phytophagous insects outside than inside exclosures; 79% were Coccoidea, and 21% Formicidae, Aphididae, Cicadellidae, Lepidoptera, and Thysanoptera. Clearly, the coccids were the dominant phytophagous insect on *F. idahoensis*.

Discussion

Aphids and coccids were the principal insect grazers on the dominant grasses. The increase in phytophagous insects on grazed range areas outside of the exclosures probably reflects differences in forage vigor and quality since ungrazed vegetation tends to stagnate to the detriment of the stand (Tueller and Tower 1977). In our study the composition of new growth in the standing biomass in the grazed areas ranged from 4 to 54% and averaged 19% greater than in nongrazed exclosures. The mean nitrogen concentration of dominant grasses in grazed areas for the 3 harvest dates was 1.77 compared with 1.18% in herbage from nongrazed exclosures. Old growth in ungrazed areas reduces light within the grass canopy, and this increase in shade has been shown to lower yield, crude plant protein, and plant minerals P, Ca, and Mg (Burton *et al.* 1951). In this locale, the mean crude protein content of new herbage on May 15 grown in the protection of old growth contained 0.8% unit less than that in new growth grown in the absence of old herbage protection (Sneva 1967). The insect grazers probably detected the better quality grass outside of exclosures and took advantage of it to increase in number. Insects readily detect differences in cultural practices such as nitrogen fertilization (Kamm and Fuxa 1977).

The insect grazers on the native range on Squaw Butte appear to be at a tolerable level. However, any change such as range revegetation could result in consumption of a disproportionate amount of forage by insects as occurred with *L. hesperius* (Todd and Kamm 1974). We checked this possibility on range 2, a portion of which had recently been seeded to *Agropyron desertorum*. However, sampling disclosed relatively few aphids or coccids, suggesting that *A. desertorum* was less susceptible to these insects than *A. spicatum*. It is this point that range management should not leave to chance. Recently S. D. Kindler (personal communication) found enormous numbers of a root aphid on *Eragostis trichodes* in Nebraska. The root-feeding insects do not cause spectacular defoliation but rather a continual drain of the plants resources. An analogous situation occurred in potatoes infected with symptomless viruses where significant increases in yield were obtained by planting virus free seed (Wright 1970). Awareness of the insect grazers and use of insect-resistant varieties or management practices can often recover forage otherwise lost to insects and permit the new seeding to realize maximum potential for utilization by domestic livestock. Not all habitat types have potential for recovering losses due to insect grazers, but the problem remains of identifying those that do.

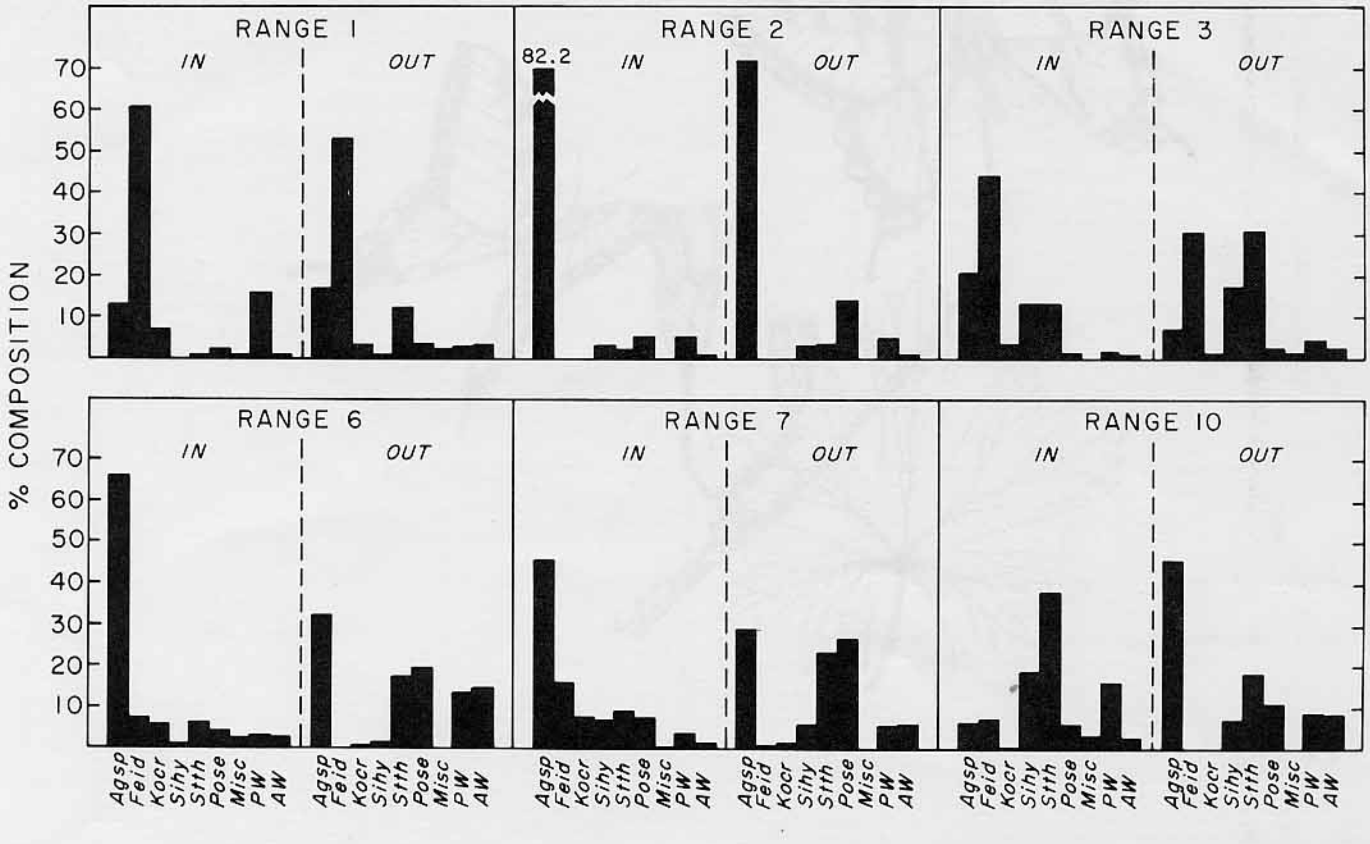

Fig. 2. Species composition of forage on study ranges. Agsp (*Agropyron spicatum*), Feid (*Idaho fescue*), Kocr (*Koeleria cristata*), Sihy (*Sitanion hystrix*), Stth (*Stipa thurberianai*), Pose (*Poa secunda*), Misc (Miscellaneous grasses), PW (perennial weeds), AW (annual weeds).

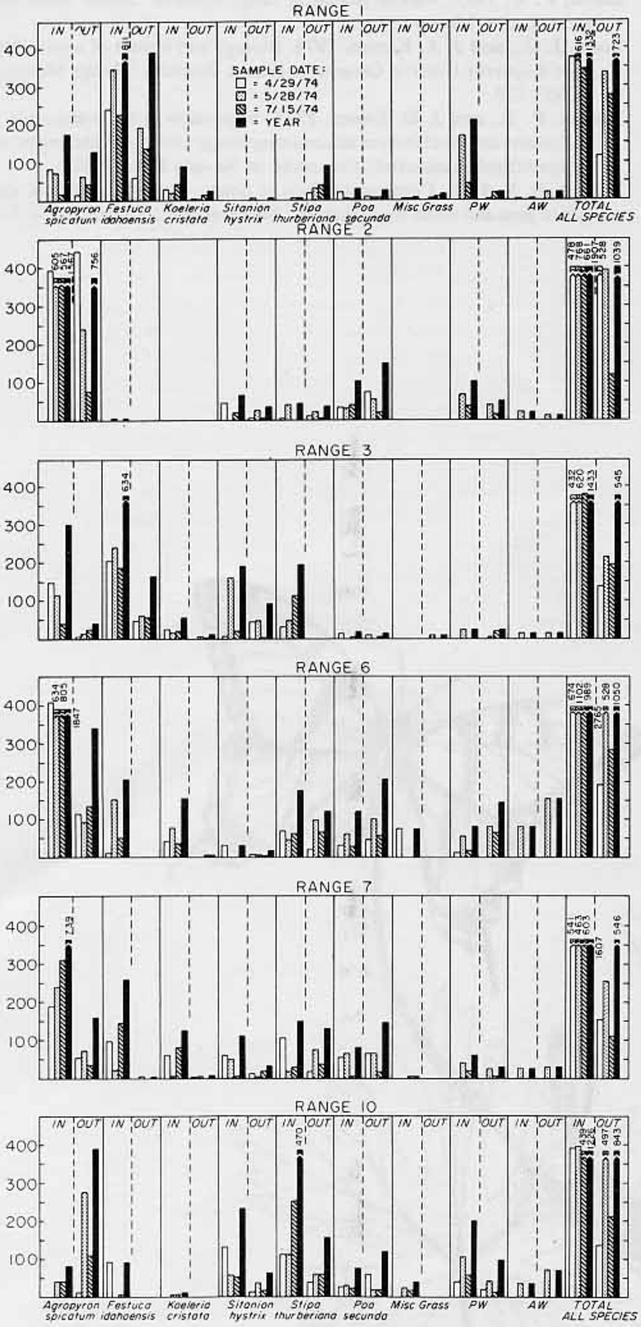

Fig. 3. Seasonal herbage production on the six study ranges.

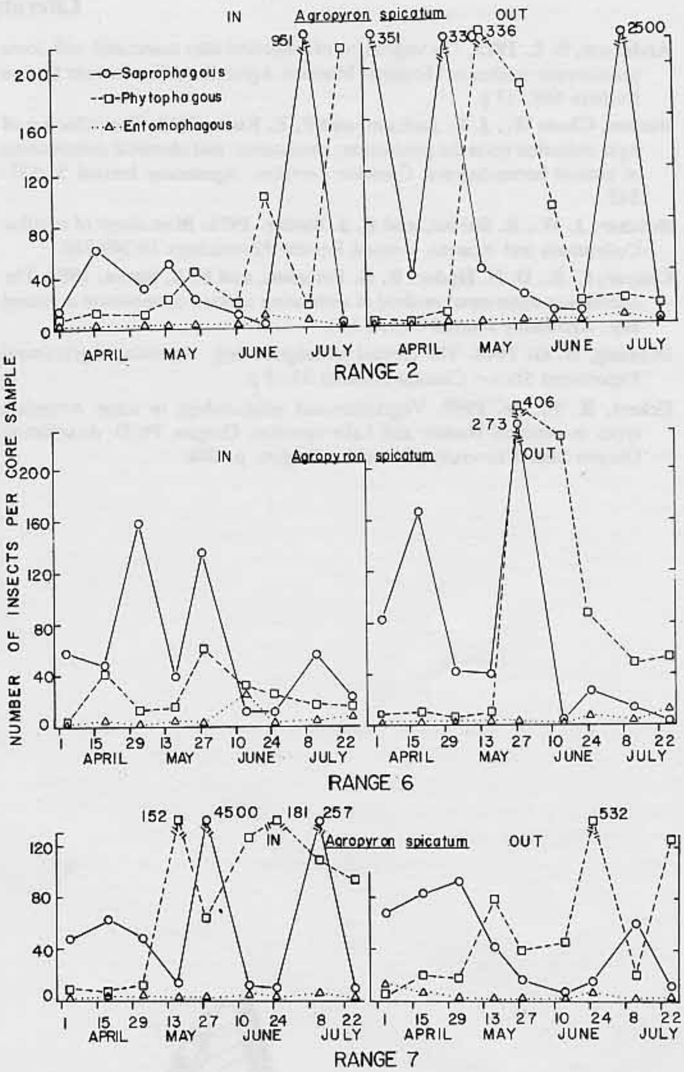

Fig. 4. Seasonal abundance of insect trophic levels on *A. spicatum*.

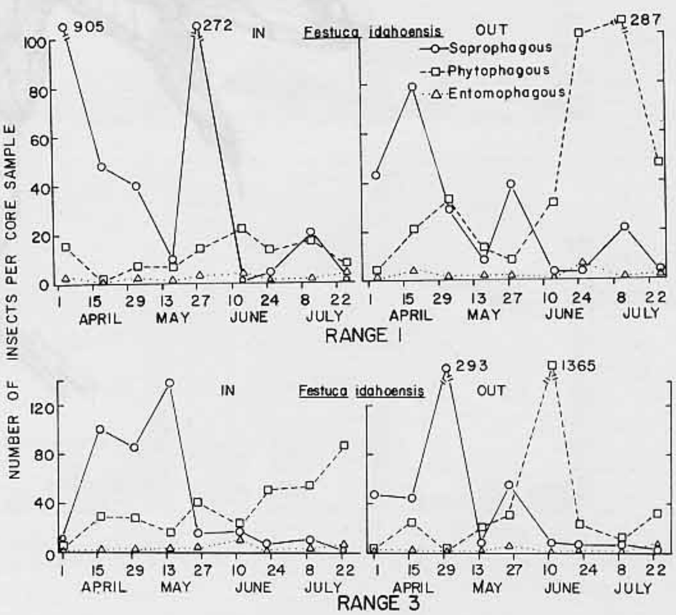

Fig. 5. Seasonal abundance of insect trophic levels on *F. idahoensis*.

Literature Cited

Anderson, N. L. 1973. The vegetation of rangeland sites associated with some grasshopper studies in Montana. Montana Agricultural Experiment Station Bulletin 668. 47 p.

Burton, Glenn W., J. E. Jackson, and F. E. Knox. 1951. The influence of light reduction upon the production, persistence, and chemical composition of coastal bermudagrass, *Cynodon dactylon*. Agronomy Journal 51:537-542.

Butcher, J. W., R. Snider, and R. J. Snider. 1971. Bioecology of edaphic Collembola and Acarina. Annual Review Entomology 16:249-288.

Cooper, C. S., D. N. Hyder, R. G. Peterson, and F. A. Sneva. 1957. The constituent differential method of estimating species composition in mixed hay. Agromony Journal 49:190-193.

Denning, D. G. 1948. The crested wheatgrass bug. Wyoming Agricultural Experiment Station Circular Number 33. 2 p.

Eckert, R. E., Jr. 1957. Vegetation-soil relationships in some Artemisia types in northern Harney and Lake counties, Oregon. Ph.D. dissertation Oregon State University, Corvallis, Oregon. p. 208.

Hewitt, G. B., E. W. Huddleston, R. J. Lavigne, D. N. Uechert, and J. G. Watts. 1974. Rangeland Entomology. Range Science Series No. 2. Society Range Management.

Kamm, J. A., and J. R. Fuxa. 1977. Management practices to manipulate populations of the plant bug *L. hesperius* Uhler. Journal of Range Management (in press).

Mattson, W. J., and N. D. Addy. 1975. Phytophagous insects as regulators of forest primary production. Science 190:515-522.

Sneva, F. A. 1967. Annual Report of range research. Squaw Butte Experiment Station Mimeo. 53 p.

Todd, J. G., and J. A. Kamm. 1974. Biology and impact of a grass bug *Labops hesperius* Uhler in Oregon rangeland. Journal of Range Management 27:453-458.

Tueller, P. T., and J. D. Tower. 1977. Vegetation in three-phase big game exclosures and its effects in determining forage utilization and productivity. (Unpublished manuscript) University of Nevada Reno 89512.

Wright, N. S. 1970. Combined effects of potato viruses X and S on yield of netted gem and white rose potatoes. American Potato Journal 47:475-478.