Changes in Interspecific Associations Related to Grazing Pressures[1]

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A knowledge of interspecific associations is basic to the appreciation of organization or pattern within plant communities. Ecological surveys have furnished a wealth of descriptive and quantitative data on plant communities and their response to grazing pressures. However, the processes which control the horizontal distributions of component plant species remain largely undescribed.

Interspecific associations within plant communities are a result of aggregated populations. Aggregation may be a result of reproduction, symbiosis, or habitat heterogeneity. Cole (1946) pointed out that "When plants reproduce either vegetatively or by means of seeds there is a tendency for the offspring to be concentrated in the neighborhood of the parent plant." The tendency toward aggregation is more pronounced in rhizomatous species (Arrhenius, 1923). Parasitism, mechanical support, and shading are typical symbiotic relationships resulting in aggregation. Variations in habitat features such as soils and topography may also affect the distribution of species within the plant community.

The degree of aggregation is related to the length of time during which the species has been present in the succession. As stands approach the climax type, the habitat is more uniform, and aggregation is less pronounced (Whitford, 1949). Curtis and McIntosh (1940), working in woodland areas similar to those studied by Whitford, indicated that aggregation is related to age class, the maximum contagion being exhibited by seedlings and saplings.

Methods

The herbaceous vegetation within selected exclosures was compared with that found on immediate grazed areas possessing similar edaphic, climatic, and topographic features. All sites within the protected areas were sampled with 60 quadrats, each 1 square foot in area. Within the quadrat the numbers of individuals present for each herbaceous species were recorded. Similar data were collected from comparable sites subject to grazing pressures from elk and other game.

All possible pairs of species exceeding 10 percent frequency were tested for independent occurrence, using a chi-square test. Species which deviated significantly (0.05 confidence level), were grouped into units of positively associated species following the procedure outlined by Hopkins (1957). The units within the exclosure were then compared with the units on the grazed areas. Differences in association were interpreted in terms of grazing responses. The grazing response of each species was obtained through analysis of variance of the quadrat data.

Exclosures Studied

Three exclosures have been studied. They were the Bryan Flat, Camp Creek, and National Elk Refuge exclosures located in Teton County, Wyoming. Two communities are represented within the exclosures. A complete description of the exclosures and communities may be found in Smith (1958).

Table 1. Exclosures, types of vegetation, and numbers of quadrats studied.

Exclosure	Type of Vegetation	Total Number of Quadrats
Bryan Flat	Mesic shrub	60
Camp Creek	Mesic shrub	120
National Elk Refuge	Mesic grassland	240

The type of vegetation and

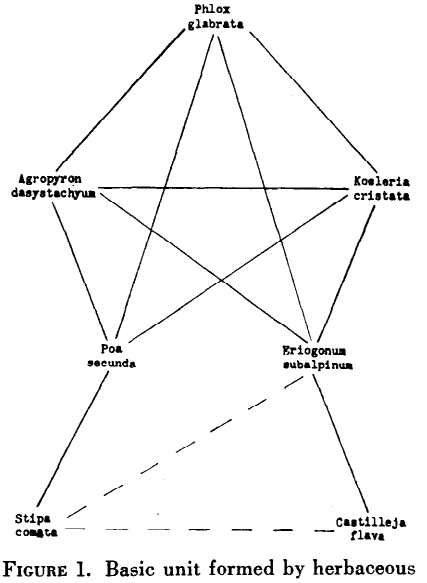

FIGURE 1. Basic unit formed by herbaceous species of 10 percent frequency or higher. Solid lines indicate associations existing under protection from grazing. Dashed lines indicate additional associations developing under the existing grazing pressures.

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number of quadrats used within each exclosure are given in Table 1.

Results

Bryan Flat Exclosure

Herbaceous species under protected conditions form a single, closely integrated unit (Figure 1). Forming a closely knit nucleus for the unit are thickspike wheatgrass *(Agropyron dasystachyum)*, smooth Hoods phlox *(Phlox glabrata)*, Junegrass *(Koeleria cristata)*, Sandberg bluegrass *(Poa secunda)*, and subalpine eriogonum *(Eriogonum subalpinum)*. Needle-and-thread *(Stipa comata)* and yellow paintedcup *(Castilleja flava)* are but loosely associated with the unit.

Under grazing pressures needle-and-thread made a significant increase in abundance. In increasing from a frequency of 12 percent to 30 percent it developed additional positive associations with subalpine eriogonum and yellow paintedcup. Since the abundance of the former was unaffected by grazing pressure, and the latter decreased, the pathway of invasion for needle-and-thread must be in microclimates characterized by the presence of these two species.

The National Elk Refuge Exclosure

The National Elk Refuge Exclosure contains four topographic sites: a ridgetop, southern, eastern, and western exposures. Floristically and vegetatively the ridgetop, eastern, and western exposures are closely related. The southern exposure, being a more xeric environment, is distantly related to the other three sites.

Within the exclosure, the herbaceous species form a single group or unit of associated species (Figure 2). Bluebunch wheatgrass *(Agropyron spicatum)* tapertip hawksbeard *(Crepis acuminata)* and smooth Hoods phlox are predominant on sites other than the southern exposure. These three species form the nucleus of an interrelated complex with which other locally abundant species are more or less associated.

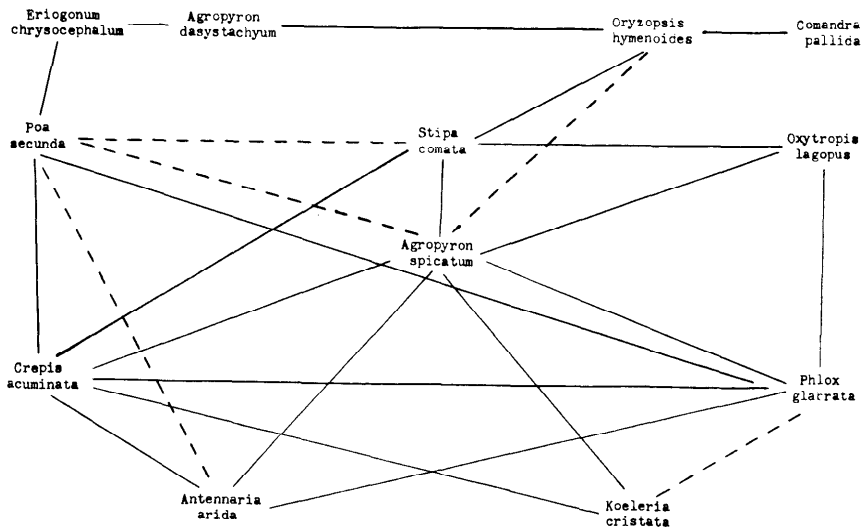

FIGURE 2. The basic unit composed of positively associated herbaceous species within the National Elk Refuge Exclosure. Solid lines indicate associations under protection from grazing. Dashed lines indicate additional associations developed under the existing grazing pressures.

Goldball eriogonum *(Eriogonum chrysocephalum)*, thickspike wheatgrass, Indian ricegrass *(Oryzopsis hymenoides)*, and comandra *(Comandra pallida)* form a group which is but loosely associated with the main body of the unit. Members of this group are limited to or predominate on the southern exposure.

Under the existing grazing pressures the most significant developments are the new associations formed by Sandberg bluegrass and pussytoes *(Antennaria arida)*, bluebunch wheatgrass and needle-and-thread. These new associations are a result of a very large increase in Sandberg bluegrass on sites other than the southern exposure. A dependency such as that developing between bluebunch wheatgrass and Indian ricegrass may well develop between two species, which decrease rapidly under grazing pressures and leave individuals of each species only in overlapping habitats.

The Camp Creek Exclosure

Herbaceous species within the Camp Creek Exclosure form a number of small basic units (Table 2). Grazing pressures result in the fusion of basic units as illustrated in Figure 3. Among the species involved there has been no significant increase in abundance or frequency. Thus,

Table 2. Basic units formed by herbaceous species within the Camp Creek Exclosure.

Basic Unit	Herbaceous Species
a	*Erigeron speciosus*
b	*Stipa comata*
c	*Poa secunda*
	Penstemon glaber
d	*Agropyron dasystachyum*
	Astragalus miser
e	*Achillea millefolium*

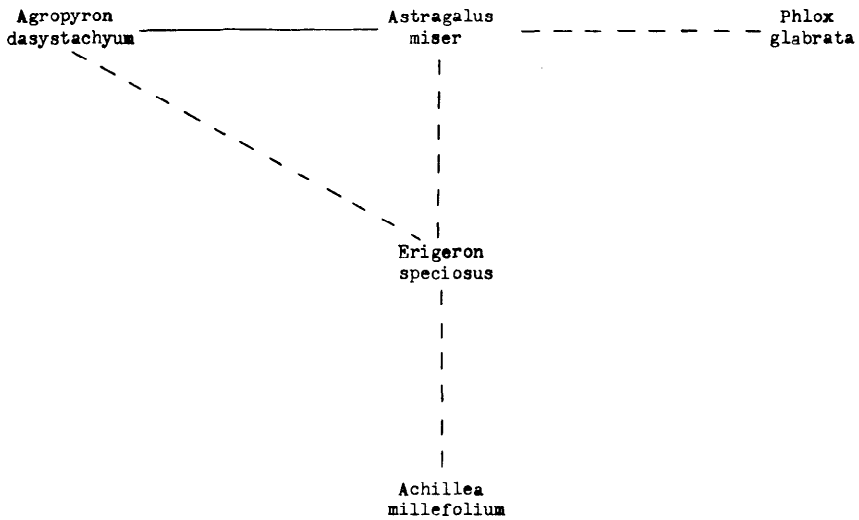

FIGURE 3. The fusion of basic units as a result of grazing pressures. Basic unit "d" within the Camp Creek exclosure acts as a stable center for the fusion with species of other units.

the fusion may not be explained by the spread of any species into new habitats.

However, a number of species decrease in frequency and abundance under grazing pressures. It may be that the development of new associations is due to an over-all decrease in abundance, leaving individuals in marginal or overlapping habitats.

One may also hypothesize that grazing pressures have eliminated some of the more favorable microclimates and have resulted in a more uniform habitat with a consequent breakdown of interspecific associations.

Summary and Conclusions

The interspecific relationships of grazed vegetation was compared with those found within similar vegetation within exclosures. Results were interpreted in terms of the vegetative response to grazing pressures. From this study a number of conclusions are made possible.

1. Within groups of associated species, the more frequent and abundant ones tend to form a nucleus around which the lesser species are associated.

2. The interrelationships within groups of associated species may aid in the recognition and classification of plant communities.

3. The conditions of dependency between associated species are apparently unstable and may very often reflect grazing pressures rather than natural habitat adaptations.

4. Interspecific relationships which reflect grazing pressures may develop in the following manner:

   a. Relatively unassociated species decreasing in abundance, leaving individuals of each species in overlapping or marginal microclimates.

   b. Or perhaps more commonly, species increasing in frequency and abundance may spread into new areas formerly occupied by individuals of other species.

   c. A standardization of microclimate resulting from dessication of the more favorable microhabitats.

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