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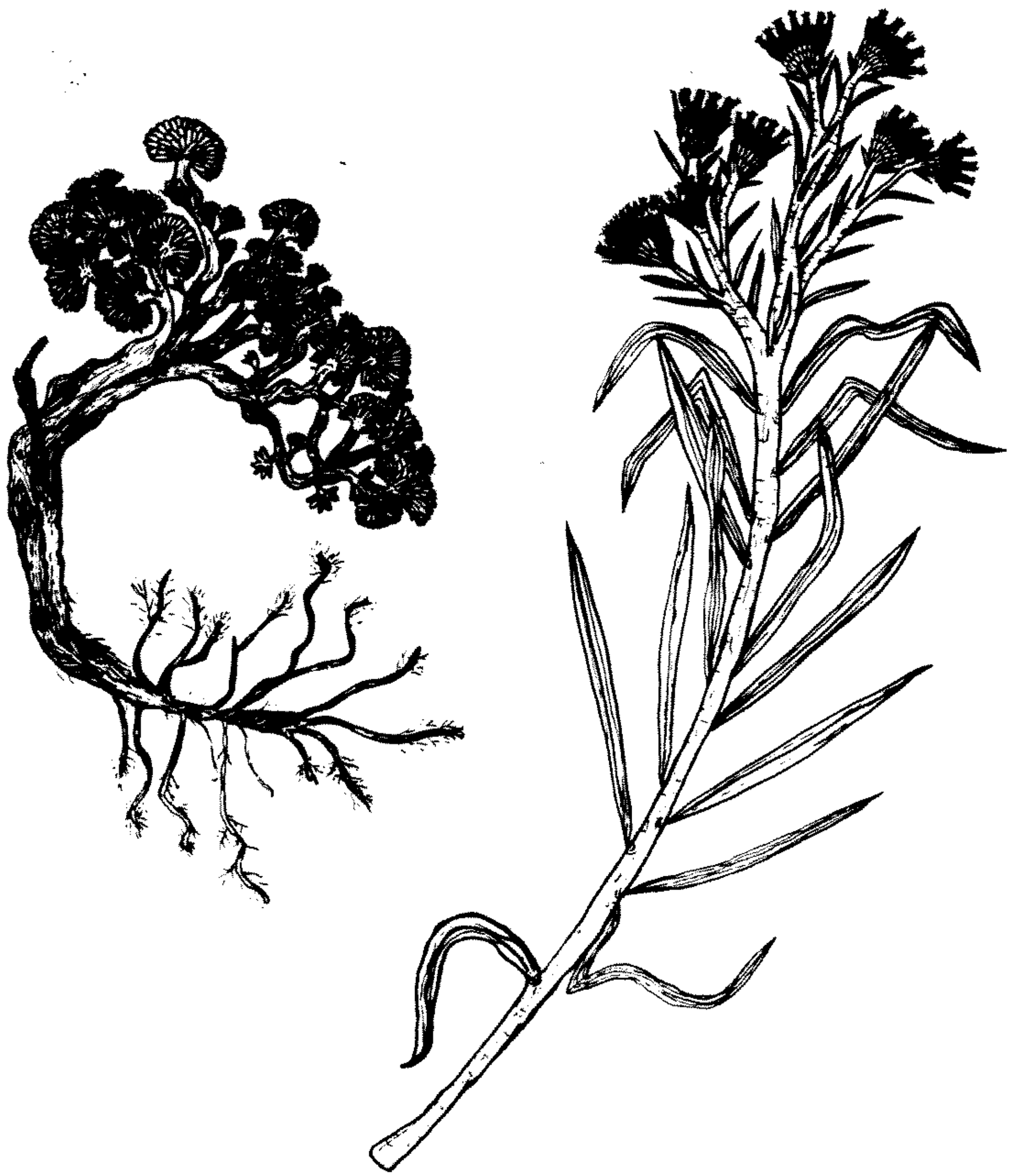

COMPOSITIONAL PATTERNS WITHIN A RABBITBRUSH (CHRYSOTHAMNUS)

COMMUNITY OF THE IDAHO SNAKE RIVER PLAIN

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ABSTRACT: Species compositional patterns of an area dominated by Chrysothamnus nauseous ssp. consimilis and Poa sandbergii were investigated south of Boise, ID. Two species associations, (1) rabbitbrush-Poa-moss and (2) lichen soil crusts, were identified. These associations correlated with sites of contrasting soil depth, light intensities, and salt concentrations. Lichen soil crusts produce few fire-supporting fuels and may function as refugia. They appear to influence the post-fire composition of the entire study area.

INTRODUCTION

The ecology of plant communities can be viewed at various spatial scales, ranging from fine-grained patterns of competition or microclimate to global distribution patterns. Depending on the size of our observational window, different factors are important in controlling the distribution and abundance of plant species. This paper gives a descriptive account of the interspecific relationships within a single plant community. The high diversity and abundance of soil cryptogams in this plant community as well as the larger more obvious vascular plants, are described.

Often, the results of plant studies conducted over the course of only 1 or 2 years merely reflect the weather conditions of those years rather than elucidating the long-term controlling biotic and abiotic factors. Cryptogams such as lichens are long-lived, persistent plants with slow growth rates. Unlike any other plants, lichens are not greatly influenced by short-term weather conditions. This makes them ideal indicators of long-term climatic and environmental factors.

Generally lichens growing as thin crusts over soil are difficult to physically preserve intact and as a result are poorly known taxonomically. Ecological studies of plants are normally preceded by taxonomic studies, but this was not the case for this study in southwestern Idaho. In fact, only a few of the taxa in the study area were previously reported in Idaho (Schroeder and others 1975).

Cryptogamic soil crusts are common in seral rabbitbrush communities and continue to exist in the later successional Artemisia communities. Most of the cryptogamic lichen taxa in the study area have worldwide distribution and are reported from many other arid biomes (Rogers 1977). Arid-zone lichen floras from various continents are very similar, perhaps because of the wide ranging dispersal of their small fungal spores (Rogers 1977).

For example, Caloplaca tominii Savicz, characteristic of the Fulgensio-Calopacetum tominii synusia found within the Artemisia/Agropyron community of the Canadian Yukon, was reported new to North American by Nimis (1981). Besides Caloplaca tominii, the Canadian Yukon plant community contains several lichen species that commonly occur in the southwestern Idaho study site. Caloplaca tominii also occurs in the Artemisia/grasslands of Russia (Savicz 1930) and northern Afghanistan (Poelt and Wirth 1968).

Studies of lichen communities that do not include associated vascular plant communities cannot produce correlating relationships or indicator values. Vascular plants and lichens read environmental factors differently and on separate time scales (McCune and Antos 1982). Each group of plants can provide information which may complement or explain something about the other. Descriptive studies such as this one are important for providing baseline data, identifying environmental indicators, and generating hypotheses. This study also attempts to evaluate the enhancement of vascular plants by cryptogams. In North America, there have been several phytosociological and floristic studies in arid habitats including those of Looman (1964a and 1964b), Anderson and others (1982), and Nash and Moser (1982).

STUDY AREA

The study area was located in Ada County south of Boise, ID. Elevation was 2,780 ft (848 m). The area is presently in a seral stage dominated by Chrysothamnus nauseosus ssp. consimilis and Poa sandbergii. Chrysothamnus nauseosus commonly resprouts after fires. Potential

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vegetation for the site is Artemisia tridentata ssp. wyomingensis/Agropyron spicatum habitat type (Hironaka and others 1983). This study area has an uncommonly high frequency of rabbitbrush, yet other nearby disturbed areas are dominated by cheatgrass and lack any shrub cover.

The soils in the study area were derived from basaltic parent material and loess over alluvial and lacustrine sediments. These soils fit the Chilcott and Sebree complex series which occur on nearly level or gently sloping positions (USDA 1980; Barker and others 1983). The Chilcott soil is a fine, montmorillonitic, mesic Abruptic Xerollic Durargid (USDA 1980). The Sebree soil is a fine-silty, mixed mesic Xerollic Nadurargid (USDA 1980). Mean annual precipitation is approximately 10 inches (25 cm). The site contained numerous randomly occurring natric, (slick) spots which contain shallow Sebree soils of poor drainage and a very low percentage of vascular plant cover. Natric spots are areas of high salt concentrations in the soil (Barker and others 1983).

The area has a history of environmental disruptions. Historically, it was impacted by travelers using the Oregon Trail (Yensen 1980), and presently it is grazed by sheep and cattle in both the spring and winter. Since the area is near Boise, ID, which is a large city, human disturbance includes assorted off road vehicle use, target shooting, rodent hunting, and bird watching. The Snake River Birds of Prey Natural Area is also nearby.

METHODS

Sampling Methods

Sampling took place in the spring. One hundred forty plots, 20 per transect line, were placed on seven different randomly distributed transect lines within the apparently homogenous Chrysothamnus nauseosus ssp. consimilis-Poa sandbergii community. Each transect line end point was marked with a permanent wooden stake and referenced by compass bearings. Plots were 7.9 X 19.7 inches square (2 X 5 dm) and were placed one meter apart along the transect lines. All species present were recorded by Daubenmire cover classes (Daubenmire and Daubenmire 1968). Soil depth to the duripan horizon and presence of vesicular porosity were recorded for each plot sampled. (Vesicular porosity is associated with low organic matter in the soil, USDA 1980).

Nomenclature of vascular plants, mosses, and lichens follows Hitchcock and Cronquist 1973, Conard 1956, and Hale and Culberson 1970, respectively. Taxonomic concepts for the lichen Aspicilia desertorum (Kremp.), Meresh. follow Weber (1962 and 1967) and the genus Psora follow that of Schneider (1979).

DATA ANALYSIS

Species Ordination

A polar ordination was used for the species ordination; it was prepared using the computer program SWAN (McCune unpublished). Several species were grouped for analysis due to difficulty in distinguishing them at the species level when sampling. Those species groups included: (1) Large mustards-Erysimum occidentale and Lepidium perfoliatum; (2) mosses other than Tortula which included Polychidium piliferium, Ceratodon purpureus, Bryum argenteum, Bryum spp., and Funaria hygromitrica; (3) Caloplaca spp. which included Caloplaca tominii, C. citrina, C. vitellina, and Candelariella terrigena; (4) Collema spp.--Collema tenax and Polychidium albociliatum. Other incidental species present but not treated in the ordination analysis follow:

VASCULAR PLANTS
Allium nevadense
Elymus cinerus
Microsteris gracilis
Ranunculus glaberrimus
Salsola kali
Sitanion hystrix

LICHENS
Acarospora schleicheri
Dermatocarpon cinereum
Diploshistes scruposus
Lecanora pergibbosa
Lecidea glaucophaea
Lecidea uliginosa
Massalongia carnosa
Parmelia elegantula
Peltigera rufescens
Physconia detersa
Psora cernata
Psora decipiens
Psora lurida
Psora luridella
Psorotichia nigra
Tonnia caeruleonigricans

LIVERWORTS
Clevea hyalina
Riccia beyrhichiana

FUNGI
Galerina spp.
Geastrum spp.
Omopholina ericetorum
Tulostroma spp.

Subjective end-stand selection ordinated the species in species space. This ordination was done on two axes. The first axis was between a natric indicator species, Lecanora muralis, and bare non-natric soil lacking vesicular porosity. The second axis was between a small shallow-rooted ephemeral species, Draba verna, and a larger diffuse deeper-rooted winter annual, Bromus tectorum. Species of this ordination were:

1. Chrysothamnus nauseosus ssp. consimilis
2. Chrysothamnus nauseosus (dead shrubs)
3. Poa sandbergii
4. Vulpia octoflora
5. Ranunculus testiculatus
6. Myosurus aristatus
7. Draba verna
8. Lithophragma bulbiferia
9. Large mustards
10. Bromus tectorum
11. Gayophytum ramosissimum
12. Tortula ruralis
13. Other mosses
14. Lecanora muralis
15. Caloplaca spp.
16. Lecidea sp. nov.
17. Dermatocarpon lachneum
18. Thrombium epigaeum
19. Arthonia glebosa
20. Collema spp.
21. Cladonia pyxidata
22. Aspicilia desertorum
23. Texosporium santi-jacobi
24. Bare non-natric soil

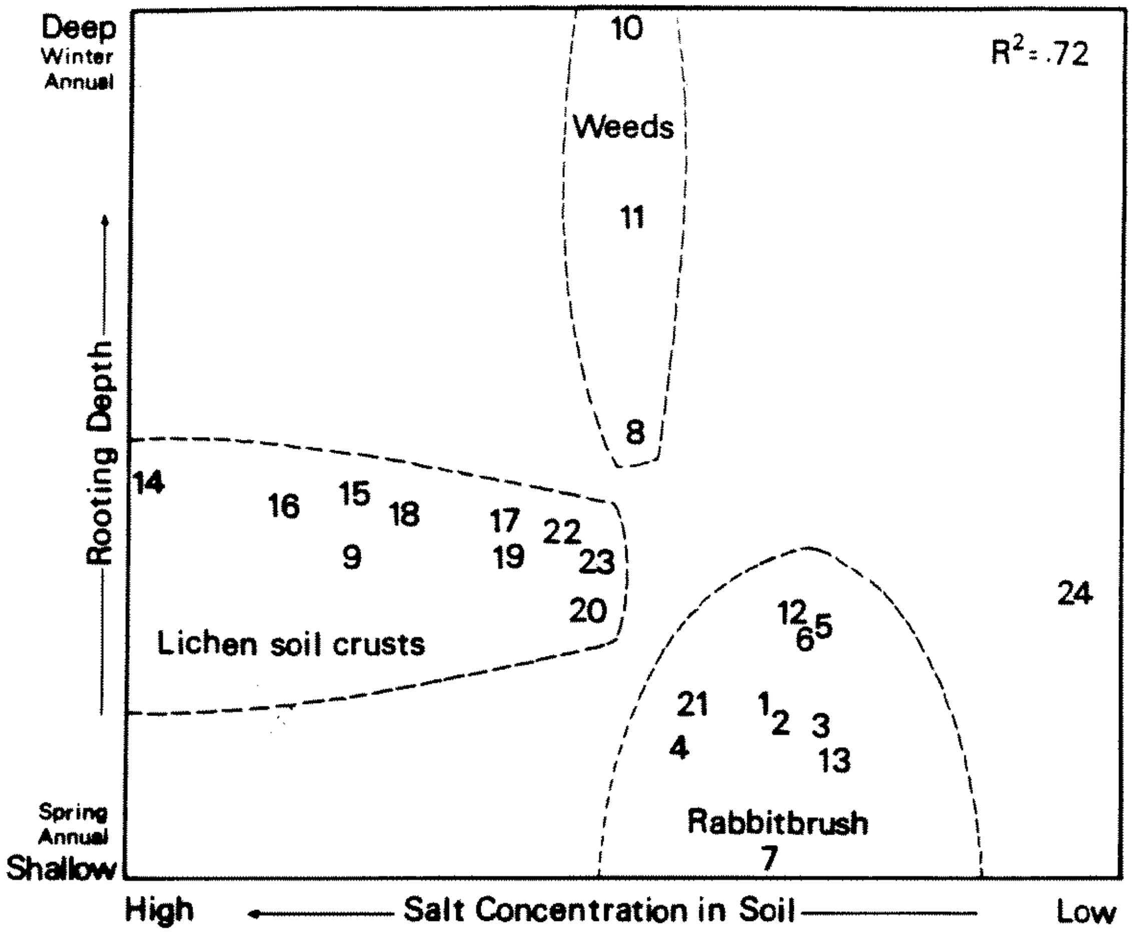

Figure 1.—Polar ordination of a rabbitbrush community.

RESULTS AND DISCUSSION

Discussions below are related to the ordination of species in Figure 1. The ordination of species suggests that the rabbitbrush community had two distinct species groups (1) the rabbitbrush-Poa-moss group and (2) the lichen soil crusts group. This ordination provides a helpful graphic representation of species similarity. This graphic presentation of the community structure allows for interpretation by both continuum and discrete ecological points of view. The other species cluster was composed of the weedy species. The weeds occurred centrally in the ordination showing that they have little site preference. In the field these weedy species obscured the pattern of the more site specific species.

Relationships Between Species Groups

The two species groups were predominantly separated by the first axis of the polar ordination (fig. 1). This axis was related to contrasting salt concentrations and resulting soil characteristics and represented a complex of factors associated with shallow natric soils. Shallow, natric or high sodium, soil sites accumulate silts and salts from local internal drainage. Sodium molecules bind the silt particles together, sealing the soil surface, preventing water penetration and creating standing water. These sites are called slick spots (USDA 1980). Water is lost by evaporation that concentrates the salts. Vascular plants' higher metabolic oxygen requirements preclude them from occupying such flooded anaeorobic sites. The shallow soil depth 1 to 4 inches (2 to 10 cm) and the duripan horizon restrict root penetration. Lichen soil crust species have low metabolic requirements making them tolerant of periodic flooding. Lichens lack roots and thus are not hindered by the shallow soil depth. Soil properties that characterize conditions of poor aeration appear to control the distribution of these species groups. This is similar to the reasons for the distribution pattern of big and low sagebrush, *Artemisia tridentata* and *A. arbuscula* (Hironaka and others 1983). These soil relationships point out that botany does not stop at the surface of the ground. The shallow natric soil sites lack shrubs and have little to no vascular plant cover. This results in little competition for light, moisture, nutrients, or space.

The second axis of the polar ordination was also related to soil depth. This axis appeared to separate vascular plant species which have roots and not the lichen species.

Relationships Within Species Groups

Rabbitbrush-*Poa*-moss.--The rabbitbrush-*Poa*-moss group occurred on the deeper non-natric soil, which was by far the more productive site. This rabbitbrush group contained only one lichen species, *Cladonia pyxidata* which occurs in many other more moist vegetation types. *Cladonia pyxidata* appears to be closely allied to this species group. All the moss species were closely associated with rabbitbrush, as was *Poa sandbergii*. One moss species, *Polychidium piliferium*, occurred on the dead portions of the short-lived perennial, *Poa sandbergii* clumps. In addition, seedlings of *Poa sandbergii* were most commonly found growing in beds of the moss *Tortula ruralis*. Several small shallow-rooted ephemeral annuals also occurred in these moss beds.

Lichen soil crusts.--The lichen soil crusts group was on the shallower, less productive, natric soil site. This group contained few vascular plants, only the large mustards *Erysimum* and *Lepidium*. These mustards are salt tolerant and mature in late spring and summer after the natric sites lose their standing water. This site lacked vascular plant cover sufficient to carry a fire.

One lichen, *Texosporium santi-jacobi*, a monotypic genus, is noteworthy for its uncommon ornamentation and large spore size (30 to 45u). It is one of the few narrow North American endemic lichens, it is a disjunct from the Mohave Desert of California. There is no apparent reason for this disjunct pattern. This is the only known population in Idaho despite intensive searching in southwestern Idaho.

The lichen species most narrowly defined spatially occurred close to *Lecanora* muralis. The narrowly defined (salt-tolerant) species were those lacking asexual fragmentation. In contrast, lichen species capable of asexual reproductive fragmentation were more broadly defined, such as, *Arthonia glebosa*, *Caloplaca tominii*, and *Collema* spp. These latter lichen species were more similar to the rabbitbrush species group and some could be considered weedy species. Rogers (1977) reported a similar species of *Collema* to be a pioneer species in arid Australia. Lichens which reproduce by fragmentation are often better indicators of environmental conditions because they lack sensitive "seedling" stages of growth. Seedlings often require very different conditions than do mature plants.

These natric sites produce few fire-supporting fuels and may function as fire refugia for those species occupying the site. Weedy lichen species surviving within the natric sites then may reinvade the burned rabbitbrush-*Poa*-moss sites. The study area's species richness and abundant lichen cover may characterize this mottled pattern of natric sites as refugia from fire. The refugia provide the plants necessary for rapid reinvasion. Refuge sites also may provide firebreaks and cool spots in fires which promotes the resprouting of rabbitbrush. Supporting this concept is the fact that large *Lecanora muralis* individuals on the natric sites were estimated to be over 60 years old (annual increment 2 to 3 mm) (Hale 1974), yet the area burned only 17 years ago (BLM fire records).

This fire refugia concept suggests that the compositional pattern of species is fire dependent. Therefore, the presence of refugia sites appears to influence the postfire species composition of the entire study area.

Grazing by sheep and cattle may also affect the relationships among species groups. The lack of vascular plants on the open natric sites may be the result of livestock use of the easier accessed open areas. Also, compaction and trampling by livestock may encourage the crustose growth form of lichens. The study site does have a heavy cover of cryptogams. In contrast, Rogers and Lange (1971, 1972), Rogers (1974), and Anderson and others (1982) report less lichen cover on heavily grazed areas. The heavy lichen cover on this site may reflect the importance of natric spots in promoting lichen growth. It appears that dispersal sites are more important than the grazing pressure on the influence of lichen cover in this sagebrush/grassland habitat type. The natric sites also had heavier textured silty soils which have been reported to be favorable for lichen cover (Anderson and others 1982).

CONCLUSIONS

The lichen soil crusts group is apparently a climax edaphic group. If plant succession were allowed to occur without major disturbances, the rabbitbrush-*Poa*-moss species composition would change while the lichen soil crusts group would not.

Rabbitbrush stands appear to be favorable for lichen growth because they lack leaves in the winter and early spring; this allows penetration of sunlight to the soil surface. Rabbitbrush stands also collect blowing snow, and increase soil surface temperatures and humidity on sunny winter days.

This community was composed of a rabbitbrush-*Poa*-moss species group and a lichen soil crust group. The species composition pattern of this rabbitbrush community appears to be determined by fire and edaphic conditions. The edaphic pattern contained slick spots which act as fire refugia for lichen species. These slick spots also influence fire behavior, resulting in cooler fires which promote rabbitbrush resprouting. Thus, slick spots influence species composition on both slick and nonslick spots. In contrast, areas nearby which lack slick spots burn hotter and are dominated by cheatgrass.