RANGELAND RECOVERY POTENTIAL: SOIL SEED CONTENT AND SEED VIABILITY

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♦ PROJECT SUMMARY

The objectives of this project are to 1) evaluate the viable seed bank within grazed and relict pinyon-juniper and blackbrush/Indian ricegrass communities, 2) assess the ability of these communities to recover following a disturbance using their respective seed banks as indicators of recovery potential, and 3) address the suitability of using seed banks to monitor and predict community level composition changes in response to various intensities of grazing.

Sampling of the seed bank within grazed and relict pinyon-juniper and blackbrush/Indian ricegrass communities was conducted during the 1990-91 field seasons in conjunction with a multi-year site characterization study. Soil seed bank data were collected from a 50 X 50 m plot randomly located within each of the selected grazed and ungrazed sites. An ungrazed pinyon-juniper community could not be located during the 1990 field season. However, soil samples were collected in 1991 from an ungrazed pinyon-juniper community located on the South Block.

Because of the possible interactions between seed reserves, perennial vegetation and granivorous rodent populations, collection of soil samples for analysis of seed reserves were stratified according to the vegetation matrix of the pinyon-juniper community (Nelson and Chew 1977). Samples were collected from under the canopies of the dominant trees (UC=under canopy) and from the exposed interstitial spaces between plants (EX=exposed). Ten random soil samples were collected from under the canopy of the nearest suitable tree for each of the major species (*Pinus edulis* and *Juniperus osteosperma*), and from the center of the exposed area nearest to the sampling point. Suitable was defined as a tree that was not less than the average size for that species. Average size was subjectively determined. Samples of UC were collected from an area mid-way between the stem of the individual and the edge of the canopy. Consequently, ten soil samples were collected from EX and 20 from UC (10 for *P. edulis*, 10 for *J. osteosperma*) for each grazing regime. For the blackbrush/Indian ricegrass communities, twenty-five randomly located soil samples were taken from exposed areas within each grazed and relict community (4 grazing regimes X 25 samples = 100 soil samples for the blackbrush\Indian ricegrass community type).

At each randomly selected soil sampling point, a 20 X 50 cm frame was placed and all of the soil within the frame to a depth of 3 cm was collected, placed in a paper sack, air dried and stored at room temperature. The majority of the seeds are generally concentrated in the top 3 cm of soil (Koniak and Everett 1982). Samples were collected from early-May to late-June of 1990 and 1991. The samples were sieved through a 2 mm screen and any remaining non-vegetative material was discarded.

Any propagules too large to pass through the screen were identified and collected. The soil was thoroughly mixed and divided into approximately two equal portions. One portion was used immediately in germination tests conducted in an outside greenhouse. The remaining portion was moistened and stored in plastic bags and maintained for 10 weeks at 1-3 C.

The soil samples were uniformly spread to a depth of 1 cm on top of 2 cm of a sterile vermiculite-peat moss mixture in a standard seeding flat. Flats were randomized on a greenhouse bench and were watered as needed. The greenhouse is being maintained at approximately ambient environmental conditions with a 12 h photoperiod. Seedlings were identified and removed as they emerge. Unidentifiable seedlings are being grown to maturity and collected for identification. After 10 weeks, the samples that were placed in cold storage were removed and returned to the greenhouse for germination tests as described above.

Germination trials (stratified and unstratified) for the soil seed bank samples collected during the 1990 field season are complete. Trials for samples collected during the 1991 field season are currently being conducted in the USD greenhouse. Standard analysis of variance procedures were initially considered as a method of evaluating significant differences in seed bank composition and density among ungrazed (relict), lightly grazed, moderately grazed, and heavily grazed sites within each community type. However, preliminary analysis indicated that the data deviated significantly from a normal distribution. Consequently, the Kruskal-Wallis test (Zar 1974), a nonparametric test often called an analysis of variance by ranks, will be used.

A total of 10 species have emerged from soil samples collected on Grand Bench during the 1990 field season (Table 1). Seedling densities was highest on soil samples collected from the ungrazed relict site at the south end of Grand Bench (Figure 1). Stratification reduced the number of emerging plants by about one-half. Only two species of graminoids, six-weeks fescue (*Festuca octoflora*) and sand dropseed (*Sporobolus cryptandrus*), emerged during the germination trials. They were, by far, the most common species emerging from soil samples collected from all four sites. Mean densities for wallflower (*Erysimum asperum*) and *Lepidium montanum* (no common name) were highest on the heavily grazed site.

Nine species of seedlings have been identified from soil samples collected from pinyon-juniper communities on the Orange Cliffs (Table 1). No graminoids were recorded during the germination trials. Freemont goosefoot (*Chenopodium fremontii*), wallflower and desert eucrypta (*Eucrypta micrantha*) were the most common seedlings emerging from soil samples collected from the Orange Cliffs during the 1990 field season (Figure 2). Densities of goosefoot and desert eucrypta were highest on soil samples collected from the heavy grazed site. Seedlings densities were highest from nonstratified soil samples collected from under the canopies of pinyon pine compared to seedling densities on stratified samples taken from exposed areas.

The extant vegetation was poorly represented in the soil seed bank evaluated in this study. Similarly, species which had emerged from soil samples collected in 1990 were poorly represented in the 1990 survey of the extant vegetation. However, several species, which had emerged during the 1990 germination trials, were recorded in the 1991 survey of the extant vegetation. This trend was true for both the blackbrush/Indian ricegrass (Grand Bench) and pinyon-juniper communities (Orange Cliffs).

Although the seed bank of a community is often considered as the primary source of propagules during progressive or retrogressive succession, it may not accurately reflect the recovery potential of these communities. A germinating embryo is dependent upon a limited supply of stored food reserves for growth and development until it becomes photosynthetically independent. During this developmental period, the young seedling is susceptible to herbivores, pathogens and environmental stresses. In vegetative regeneration, the vascular tissue of the parent shoot extends into the developing shoot and provides a mechanism by which assimilates produced in the established portions can be quickly translocated to newly initiated shoots. Vegetative growth and regeneration in perennial grasses is called tillering. New tillers arise from activation of axillary buds located at the base of the sheath. If the secondary tillers develops normally, it will produce subsidiary tillers (complete with axillary buds) in acropetal succession that may, in turn, also initiate shoots. Consequently, the production of tillers with their associated axillary buds provides a continuous source of meristematic tissue which can lend potentially immortality to the plant.

Table 1. Plant species and their growth patterns which have emerged during greenhouse germination trials from soil samples collected from Grand Bench and the Orange Cliffs during the 1990 field season.

Species	Growth Pattern
Grand Bench	
Erysimum asperum (Nutt.) DC.	Biannual or Short Lived Perennial
Festuca octoflora Walter	Winter annual
Hymenopappus filifolius Hook	Perennial
Lepidium montanum Nutt.	Perennial or Biannual
Malacothrix glabrata (DC. Easton) Gray	Winter annual or Biannual
Plantago patagonica Jacq.	Annual
Oenothera caespitosa Nutt.	Perennial
Sphaeralcea parvifolia A. Nels.	Perennial
Sporobolus cryptandrus (Torr.) Gray	Perennial
Streptanthella longirostris (Wats.) Rydb.	Annual or Winter Annual
Unknown Dicot	
Orange Cliffs	
Astragalus nidularius Barneby (?)	Perennial
Chenopodium fremontii Wats.	Annual
Descurainia pinnata (Walter) Britt.	Winter Annual
Erysimum asperum (Nutt.) DC.	Biannual or Short Lived Perennial
Eucrypta micrantha (Torr.) Heller	Annual
Festuca octoflora Walter	Annual
Gutierrezia sarothrae (Prush) Britt. & Rusby	Perennial
Oenothera caespitosa Nutt.	Perennial
Sphaeralcea coccinea (Nutt.) Rydb.	Perennial
Unknown Dicot	

The production of new tillers is seasonal and very much affected by environmental conditions (Jewiss 1972). In some cases, dormant axillary buds may accumulate in great numbers creating a "bud bank" very similar to the seed bank. Indian ricegrass (*Oryzopsis hymenoides*) is the dominant species on many of the relict sites in GCNRA that are considered to be in a climax successional stage. The plant is also found on grazed sites, but in reduced numbers. Further, the plants that are found in grazed areas tend to be in a decadent stage with very little green tissue. In this case, the bud bank may be extremely valuable in maintaining or improving the status of Indian ricegrass in the community should favorable conditions return. However, the viability of this bud bank is unknown.

A research grant from the University of South Dakota General Research Fund has provided us with the opportunity to evaluate the potential role of the axillary bud bank of Indian ricegrass during succession. This investigation was carried out in conjunction with the seed bank study. The general approach of this study involved collecting crowns of

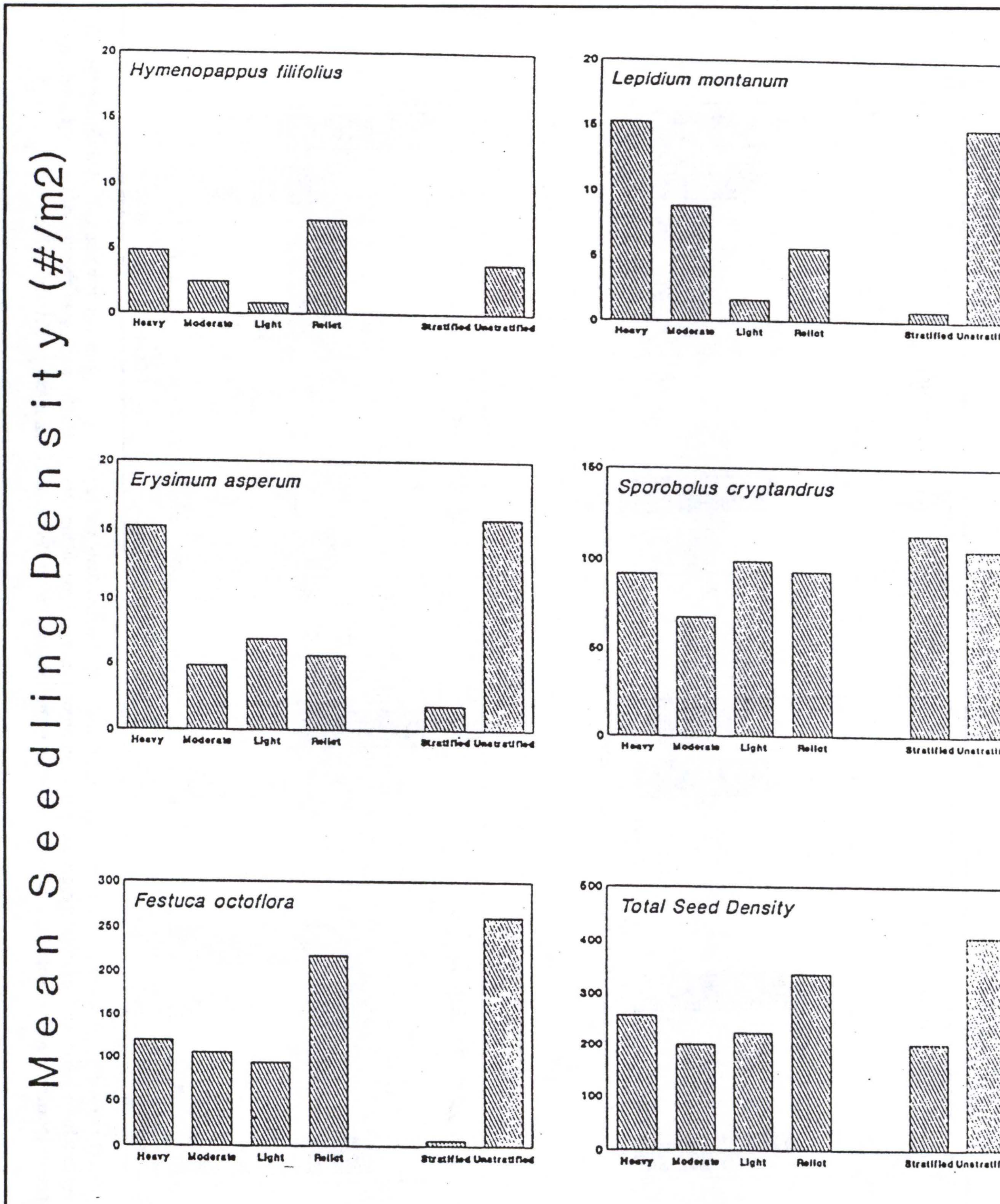

Figure 1. Mean density of seedlings of the major species and total density (# of individuals per m^2) emerging from soil samples collected during the 1990 field season from heavy, moderate and lightly grazed, and ungrazed relict blackbrush/Indian ricegrass communities on Grand Bench, and mean density of emerged seedlings in response to stratification.

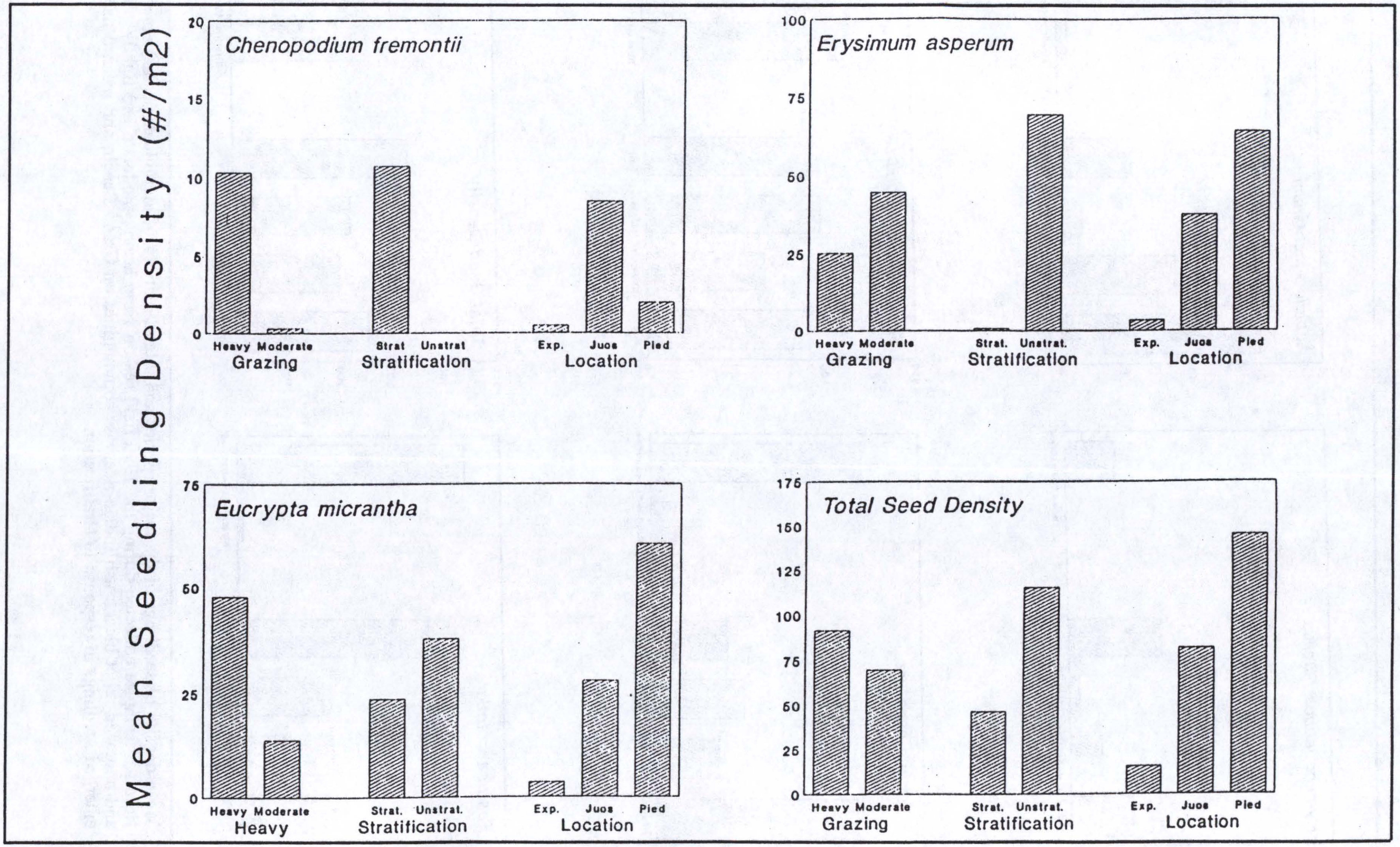

Figure 2. Mean density of seedlings of the major species and total density (# of individuals per m^2) emerging from soil samples collected during the 1990 field season from heavy and moderately grazed pinyon-juniper communities on the Orange Cliffs, and mean density of emerged seedlings in response to location (Exp.=Exposed, Juos=*Juniperus osteosperma* and Pied=*Pinus edulis* canopies) and stratification.

Indian ricegrass plants on lightly grazed sites within the blackbrush/Indian ricegrass community type. Approximately one-half of the collected plants had no green tissue present while the other half had at least five tillers with green tissue. Collected crowns were moistened, placed in open, plastic ziplock bags and stored at approximately 10-15 C for the trip to the USD campus, which took approximately three weeks.

To estimate bud viability, crowns of collected plants were planted in standard growth containers filled with a soil-vermiculite mixture. Plants were grown under ambient conditions in the USD greenhouse under a 12-hour photoperiod. Containers were watered as needed with water and a dilute Nitrogen-Phosphorous-Potassium (N-P-K) solution. The number of secondary tillers emerging from activated axillary buds were recorded weekly. Plants were be grown under these conditions for approximately three months.

At the end of the experiment no new green tissue had emerged from any of the collected plants, including those which initially had green biomass. The longevity of the axillary buds appears to be low, even for the plants which had green tissue. None of the plants seems to have survived storage and the trip to the USD greenhouse.

♦ Literature Cited

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