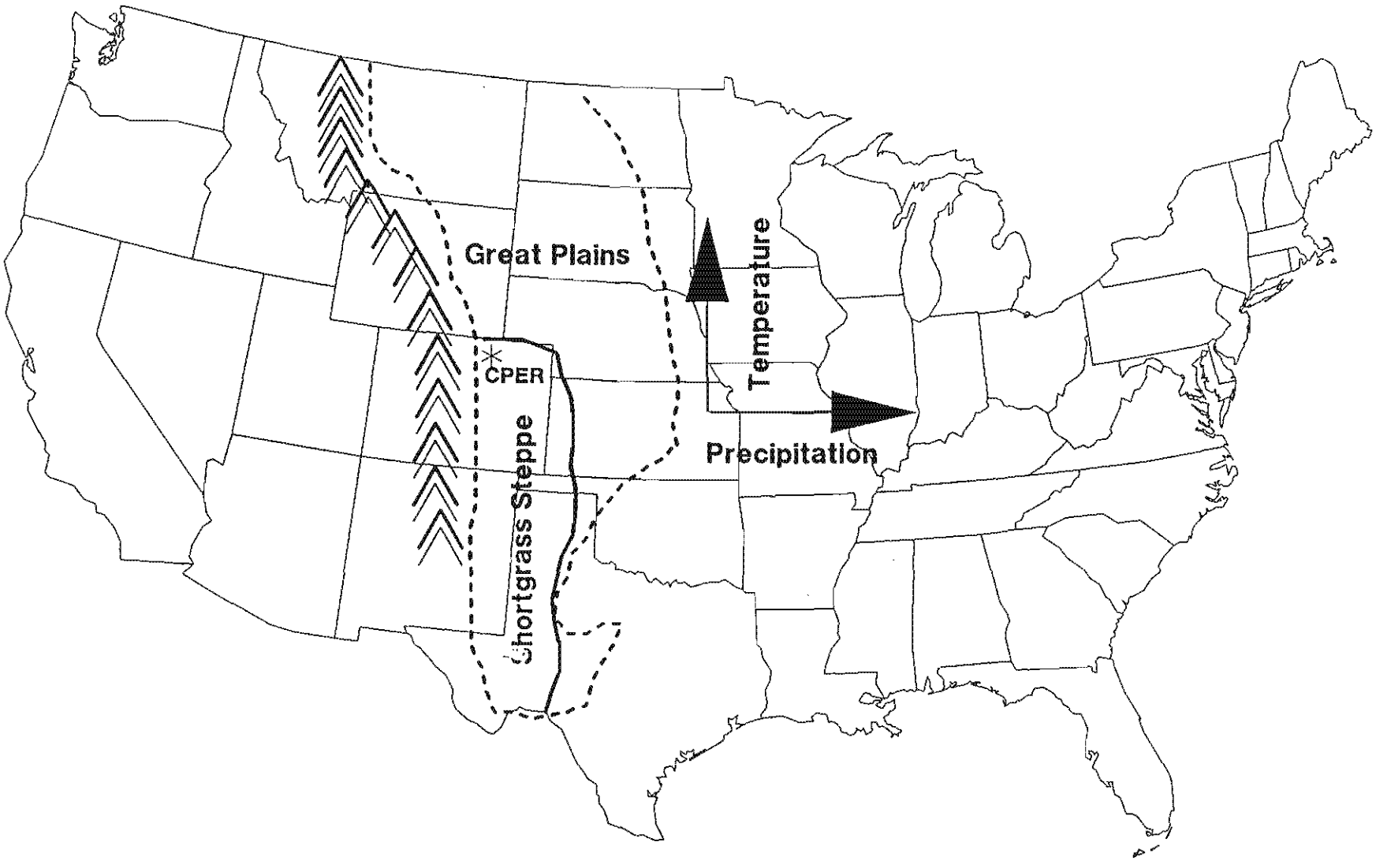
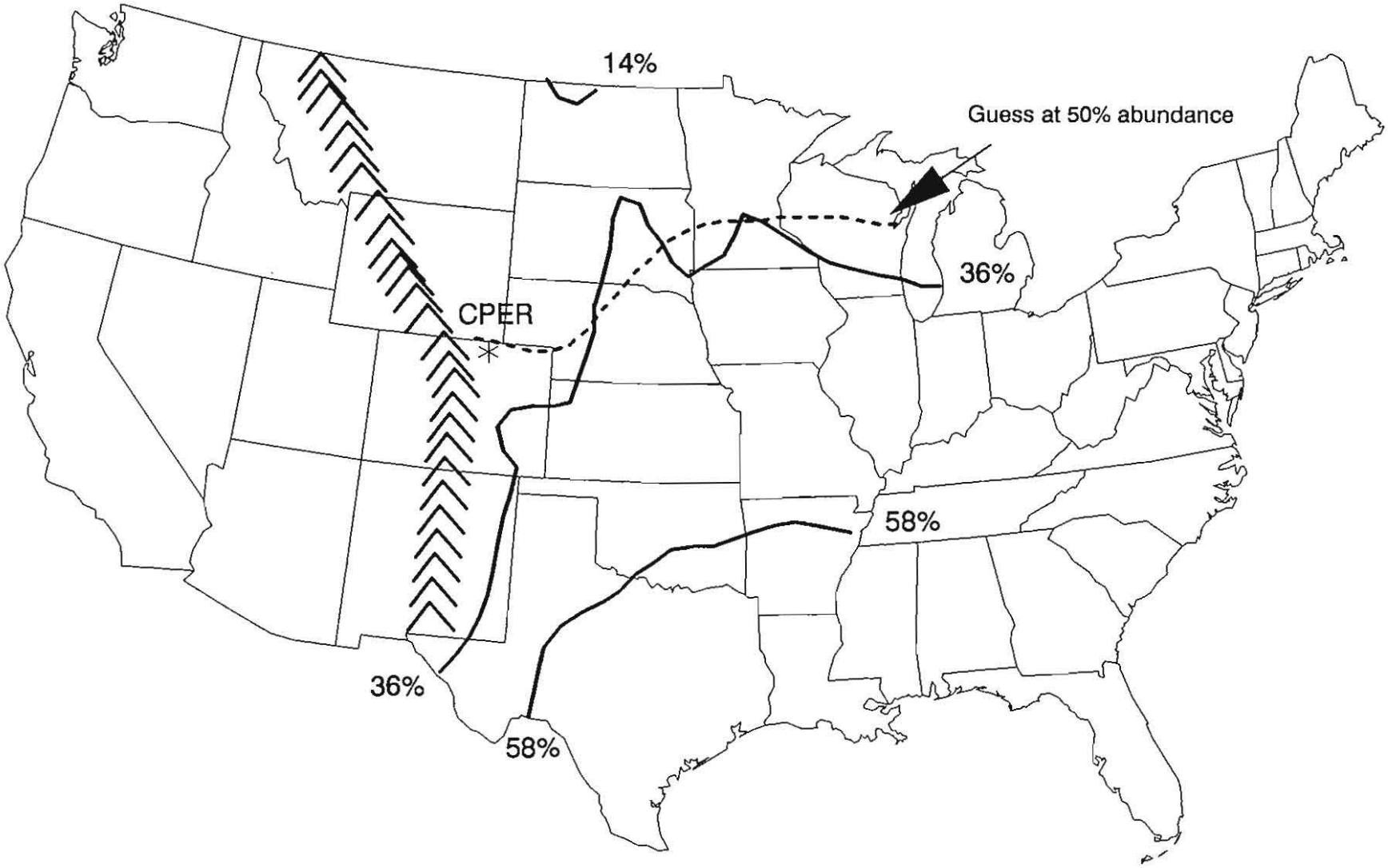
EY 501 Fieldtrip
Central Plains Experimental Range
April 25, 1992

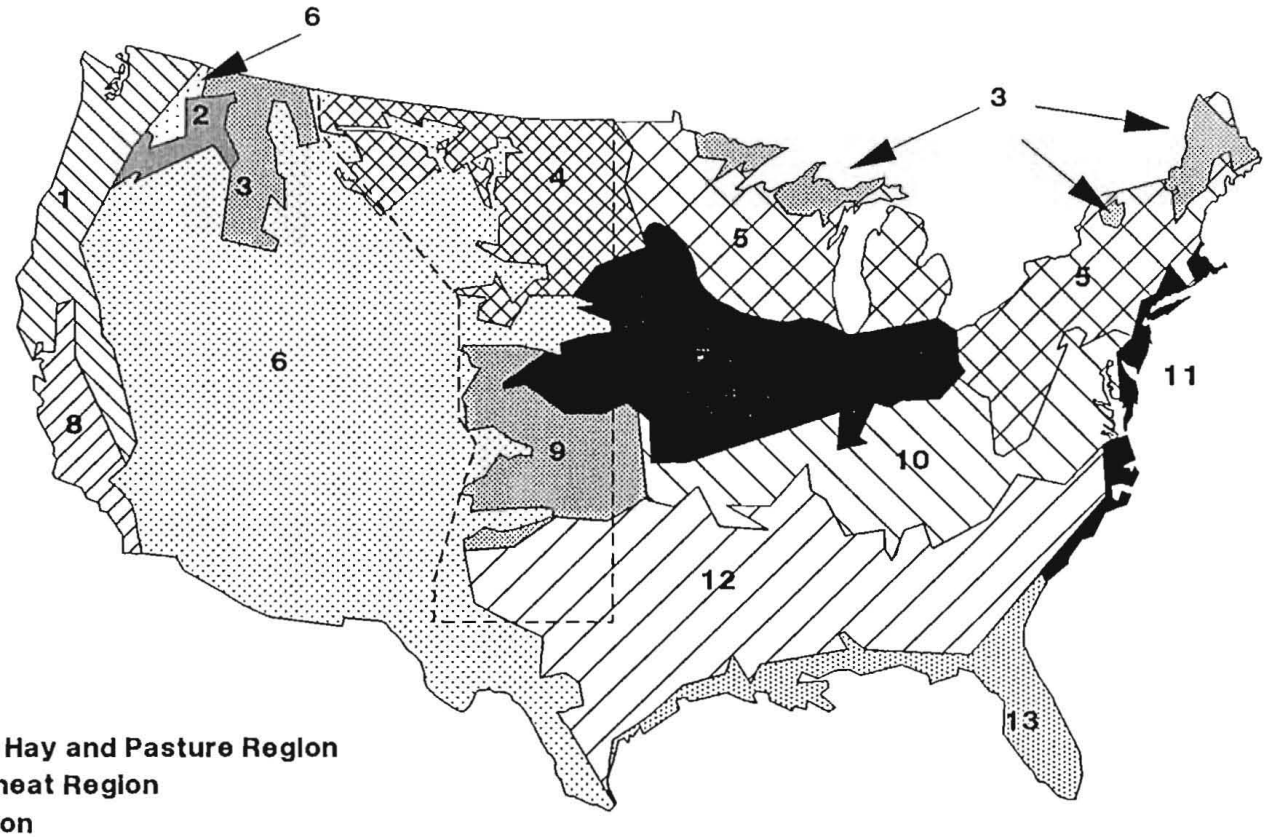
| | |
|---|---|
| Introduction: | |
| Ecology of the shortgrass steppe: The Long Term Ecological Research Program | Bill Lauenroth, Dept. of Range Science |
| Soils: | |
| Influence of plant presence, landscape patterns, and grazing. | Indy Burke Dept. of Forest Science |
| Microlandscapes: | |
| Beetle movements in a microlandscape | Tom Christ, John Wiens, Dept. of Biology |
| Gap Dynamics: | |
| In shortgrass plant communities | Debra Coffin, Bill Lauenroth, Range Sci. |
| Succession: | |
| Recovery of plant communities and soil organic matter | Debra Coffin, Bill Lauenroth Indy Burke |
| Community-Ecosystem Interactions: | |
| Influence of species composition on ecosystem processes | Mary Ann Vinton, Dept. of Forest Science |


Great Plains
Temperature
CPER
Precipitation
Shortgrass Steppe

# Frequency of C-4 grasses in the flora

[from Teeri & Stowe 1976]






1 - North Pacific Forest Hay and Pasture Region
2 - Columbia Plateau Wheat Region
3 - Forest and Hay Region
4 - Spring Wheat Region
5 - Hay and Dairy Region
6 - Grazing and Irrigated Crops Region
7 - Corn Belt
8 - Pacific Subtropical Crops Region
9 - Hard Winter Wheat Region
10 - Corn and Winter Wheat Belt
11 - Middle Atlantic Trucking Region
12 - Cotton Belt
13 - Humid Subtropical Belt

*** CPR Climate Record 1951 - 1980**

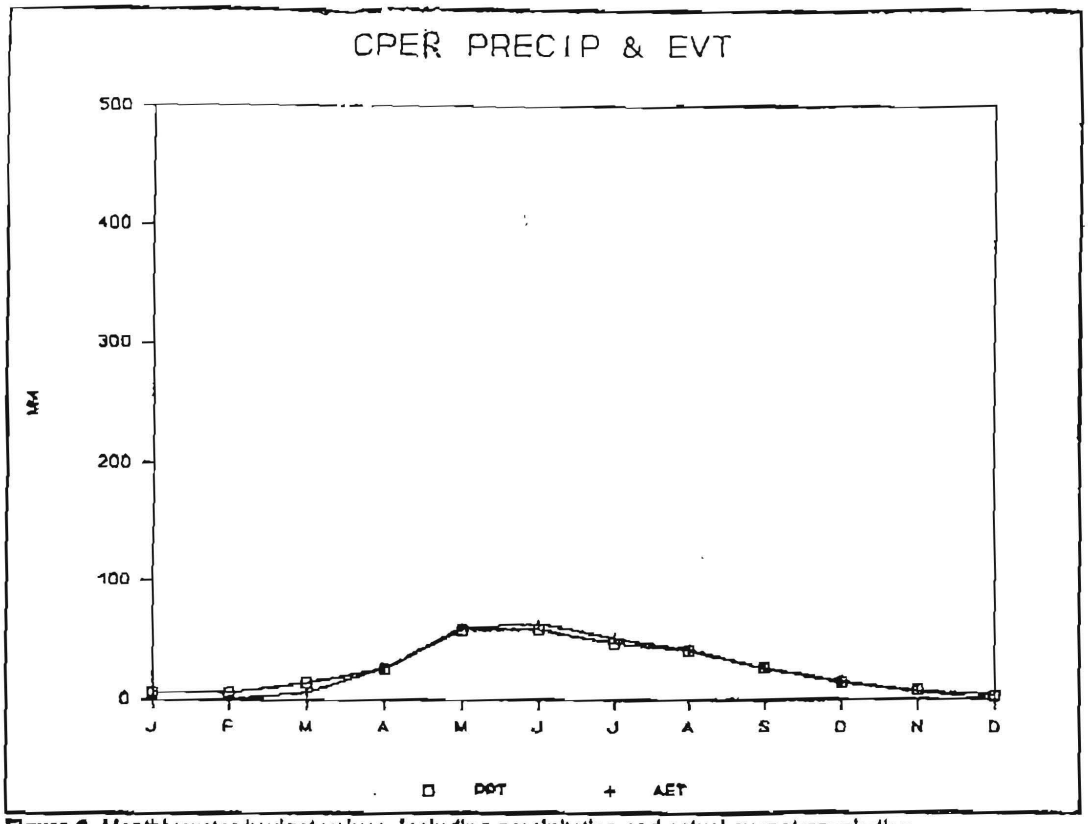



**Figure 2.** Monthly water budget values, including precipitation and actual evapotranspiration.

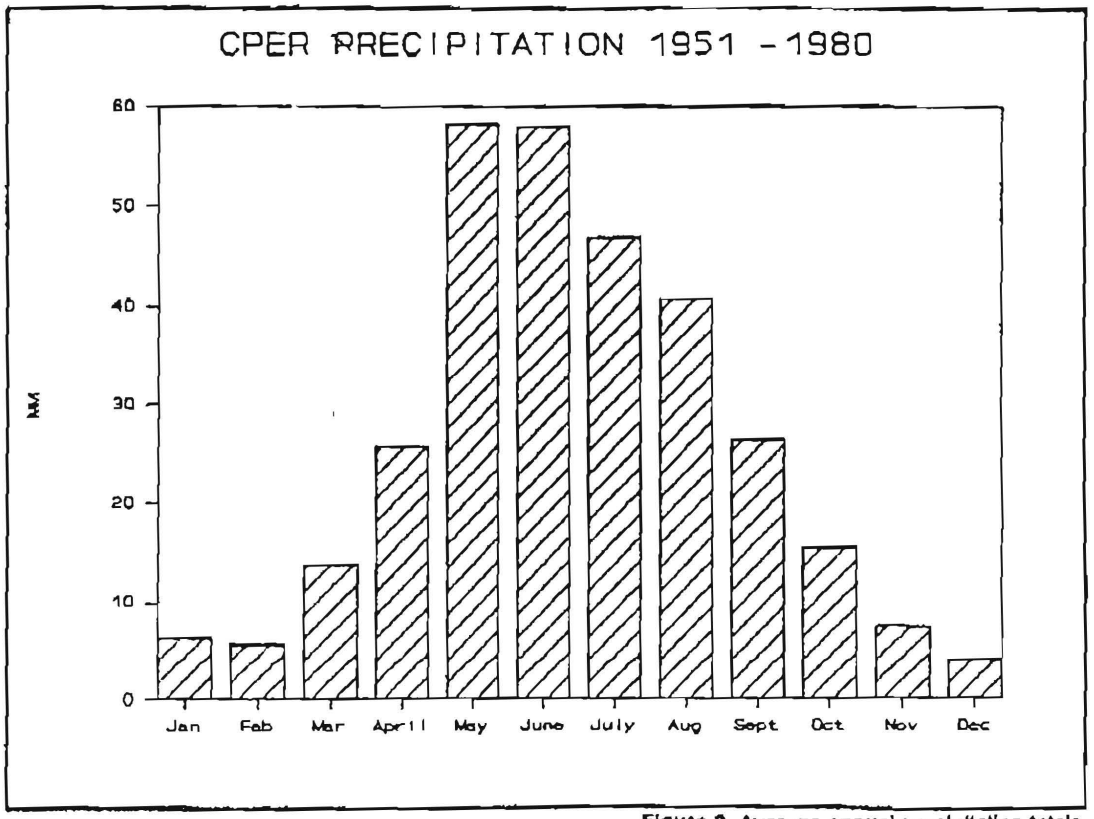



**Figure 3.** Average annual precipitation totals.

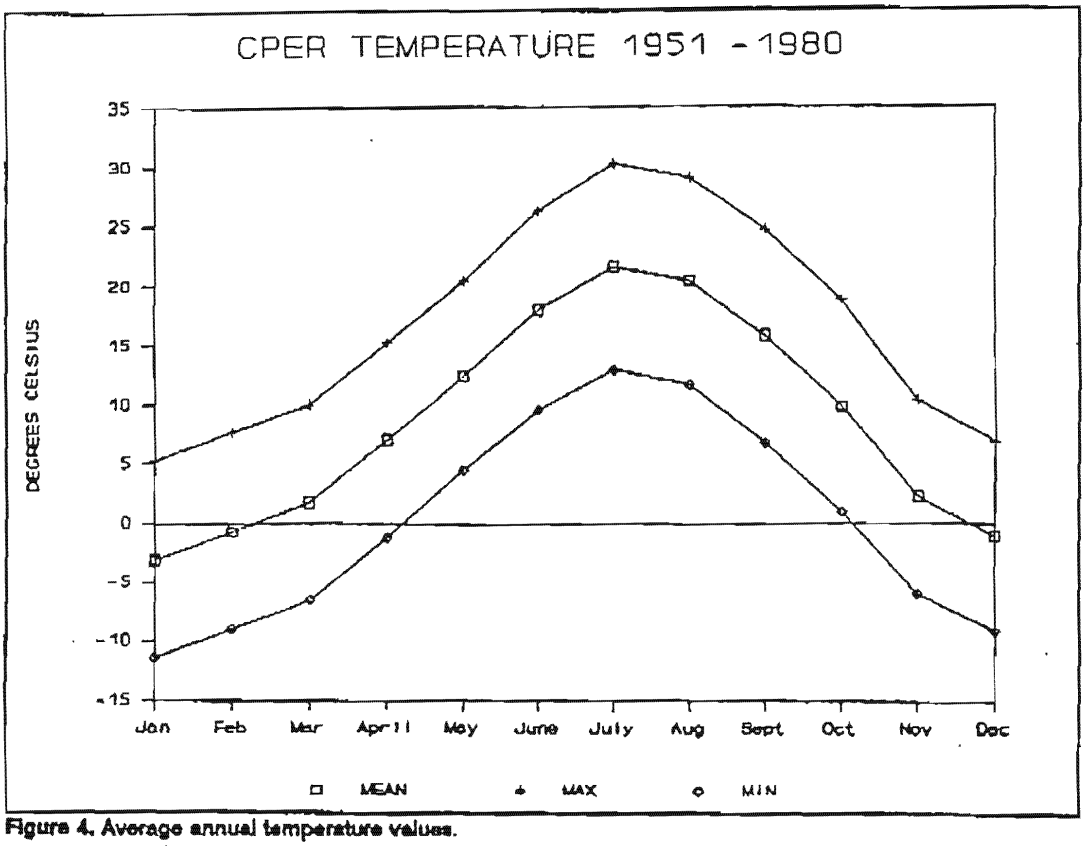
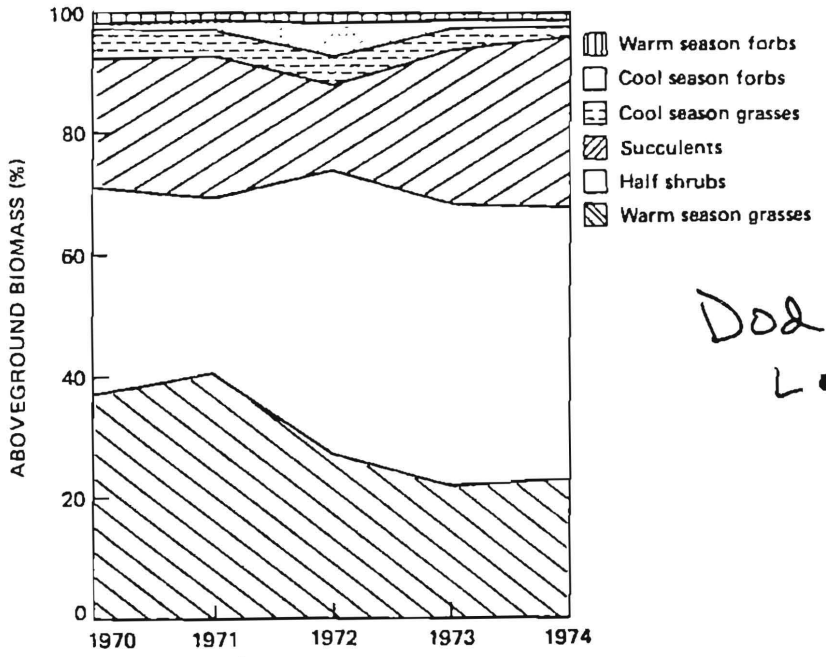



**Figure 4. Average annual temperature values.**

* Data from on-site or nearest weather station.




Dodd + Lauenroth 1979

Figure 3.1. Interseasonal vegetation changes in functional group composition for control area of ecosystem stress experiment, 1970 to 1975 (based on time-weighted mean total biomass).



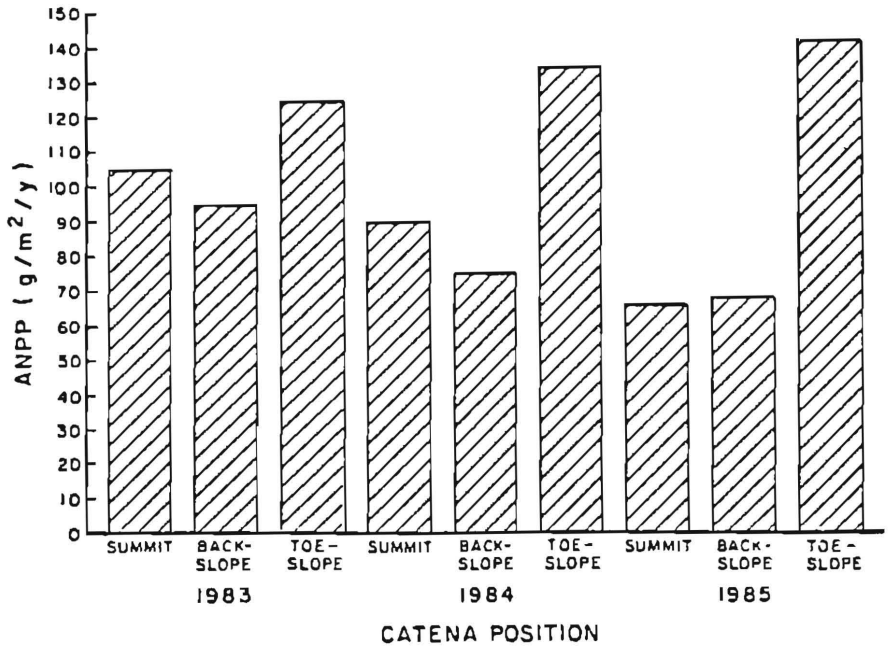



Fig. II.5. Aboveground net primary production ($g \cdot m^{-2} \cdot yr^{-1}$) at three landscape topopositions for 1983 through 1985.

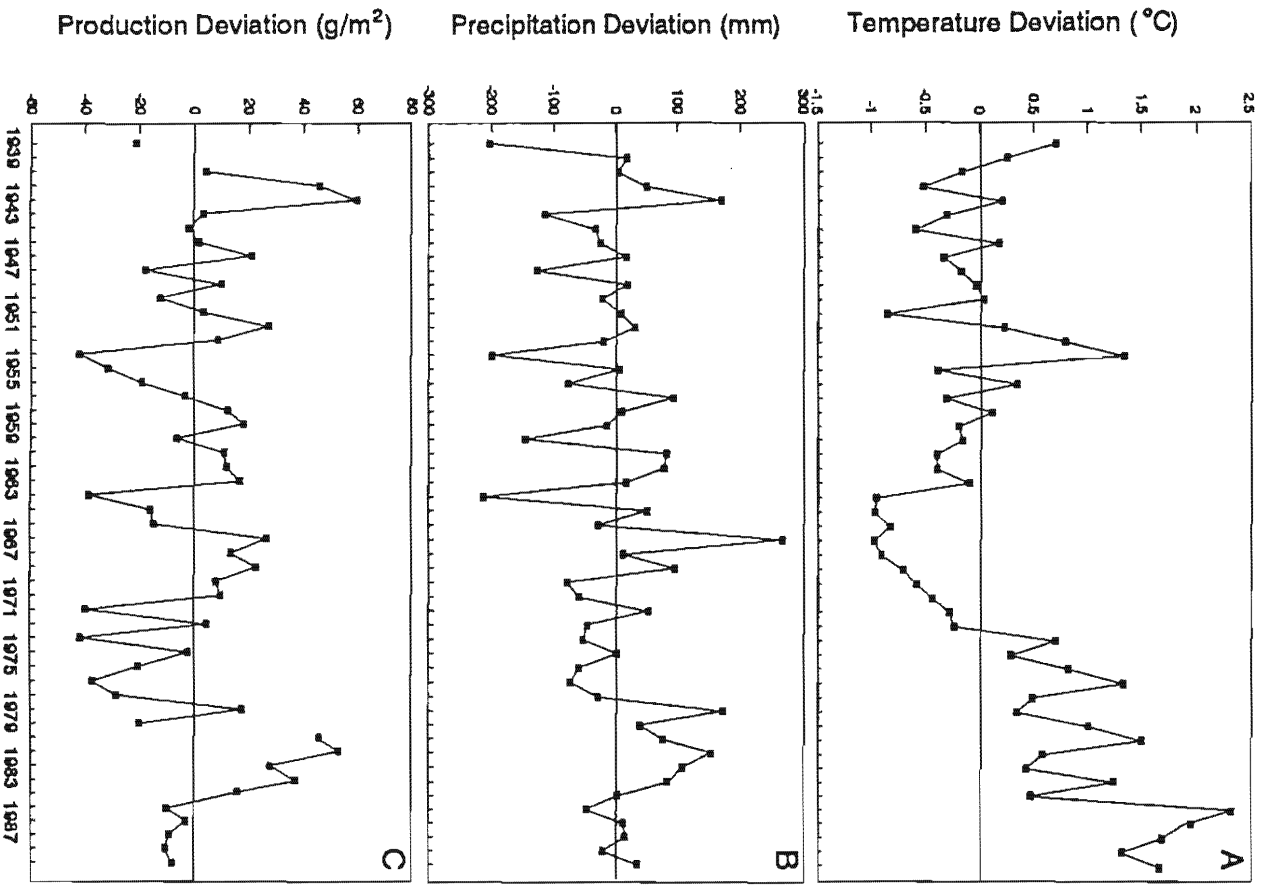
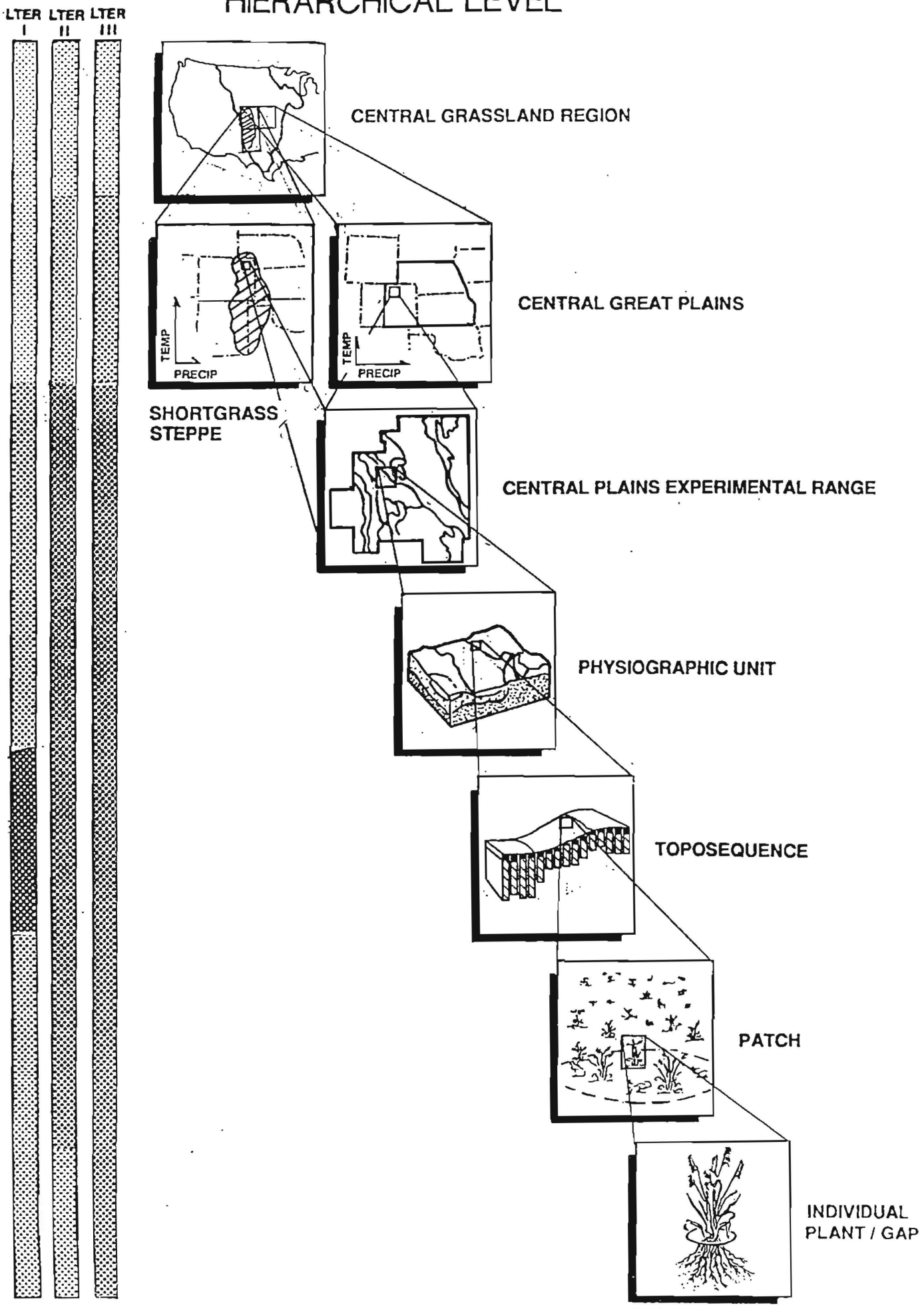



Figure 1. Deviations of annual values from the long-term average for the period 1939-1990 for temperature (A), precipitation (B), and forage production (C) for the Central Plains Experimental Range in northcentral Colorado.


LTER I
LTER II
LTER III
HIERARCHICAL LEVEL
CENTRAL GRASSLAND REGION
TEMP
PRECIP
TEMP
PRECIP
CENTRAL GREAT PLAINS
SHORTGRASS STEPPE
CENTRAL PLAINS EXPERIMENTAL RANGE
PHYSIOGRAPHIC UNIT
TOPOSEQUENCE
PATCH
INDIVIDUAL PLANT / GAP

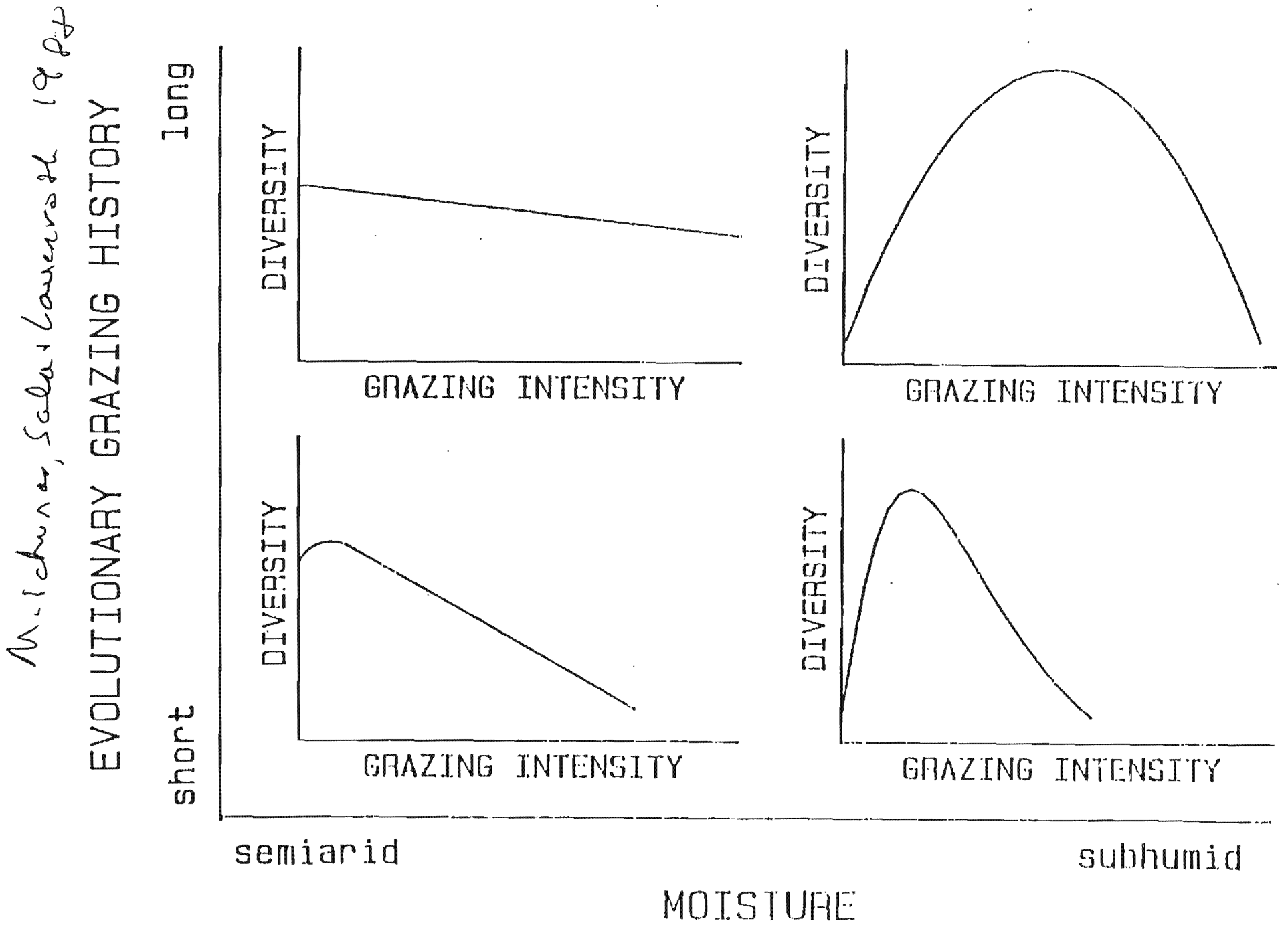

EVOLUTIONARY GRAZING HISTORY
long
short
DIVERSITY
GRAZING INTENSITY
DIVERSITY
GRAZING INTENSITY
DIVERSITY
GRAZING INTENSITY
DIVERSITY
GRAZING INTENSITY
semiarid
subhumid
MOISTURE

Fig. 2

Milchunas + Lauenroth 1989



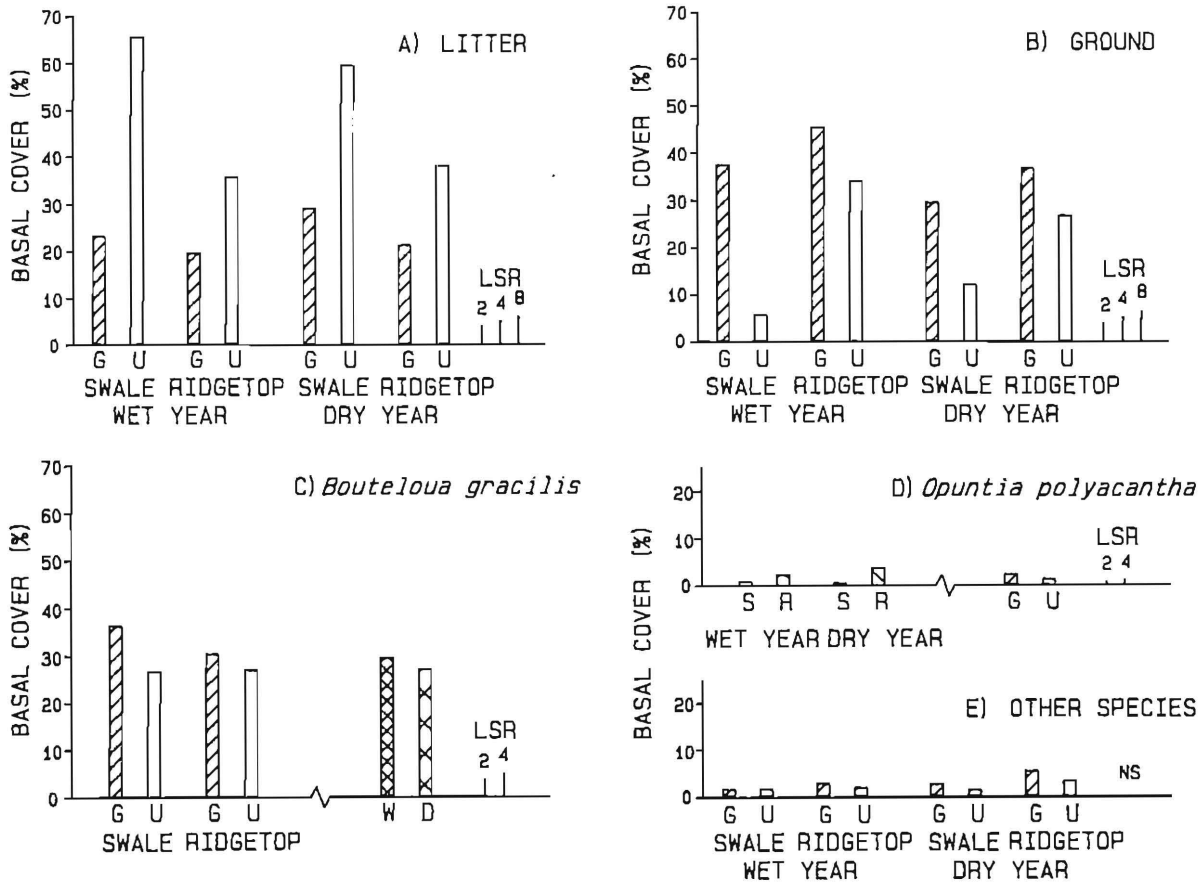



*Fig. 1.* Basil cover (%) of the shortgrass steppe on grazed (G) and ungrazed (U) swales (S) and ridgetops (R) in wet (W) and dry (D) years. USE $LSR_2$ for significance test when crossing any one treatment within the other two treatments, $LSR_4$ when crossing any two treatment categories within a third, and $LSR_8$ when comparing between all three treatment categories. A broken x-axis represents a two-way interaction followed by a main effect, or three main effects. All main effects may or may not be significant, use $LSR_2$ values to test.

Milchunas + Lauenroth 1990

**Table 2.** Densities of six opportunist-generalist species in seven plant communities of the shortgrass steppe. Values are means of all replicates and dates for each treatment. Kp = *Kochia scoparia*; Cu = *Cirsium undulatum*; Si = *Salsola iberica*; Sa = *Sisymbrium altissimum*; Cl = *Chenopodium leptophyllum*; Sh = *Sitanion hystrix*.

| | Opportunistic species density (per 10 m²) | | | | | |
|---|---|---|---|---|---|---|
| Comm. / Treatment | Ks | Cu | Si | Sa | Cl | Sh |
| Control | 0.0 | 0.3 | 0.8 | 1.3 | 2.0 | 16.5 |
| Grazed | 0.0 | 0.0 | 0.3 | 0.0 | 1.3 | 5.9 |
| Ungrazed | 0.2 | 0.7 | 1.4 | 0.2 | 3.0 | 18.5 |
| Nitrogen | 92.3 | 1.0 | 13.0 | 1.3 | 17.0 | 32.8 |
| Water | 75.5 | 8.5 | 9.0 | 0.8 | 4.3 | 4.0 |
| White Grub | 1.0 | 0.0 | 3.5 | 2.0 | 0.5 | 164.0 |
| Water + Nitrogen | 632.0 | 18.8 | 8.5 | 6.8 | 2.5 | 50.3 |

**Table 3.** Density and richness of introduced species (exotics) in seven plant communities of the shortgrass steppe during wet and dry years. Values are means of all replicates for each community.

| | Introduced Species | | | |
|---|---|---|---|---|
| | Density (per 10 m²) | | Richness (No. species) | |
| Comm. / Treatment | Wet | Dry | Wet | Dry |
| Control | 2 | 6 | 2 | 5 |
| Grazed | 2 | <1 | 2 | 1 |
| Ungrazed | 5 | 6 | 6 | 7 |
| Nitrogen | 190 | 105 | 7 | 7 |
| Water | 95 | 131 | 8 | 7 |
| White Grub | 6 | 8 | 4 | 4 |
| Water + Nitrogen | 696 | 510 | 5 | 7 |

Plant Influences on Soil Organic Matter

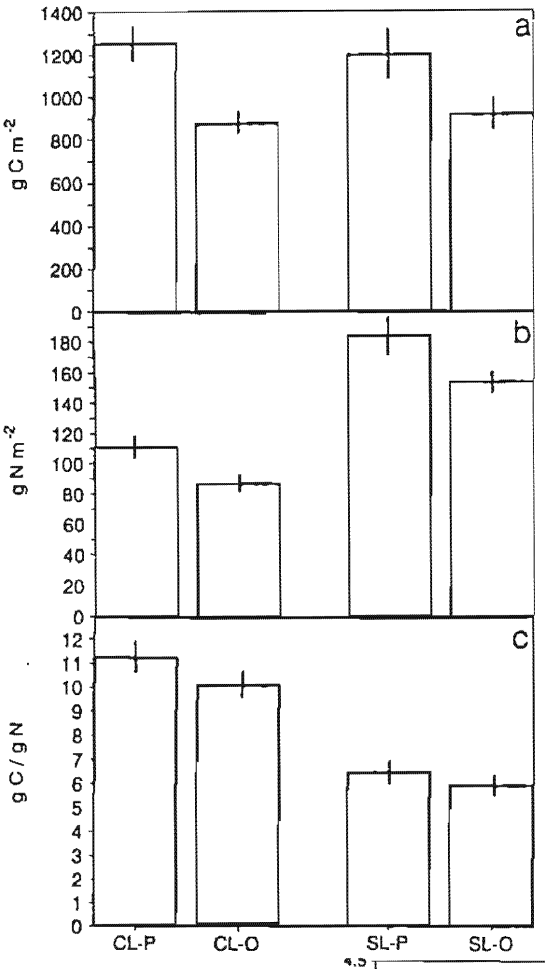



*Fig. 2.* Standing stocks of soil organic carbon (TOC) (a) and total nitrogen (TN) (b) and mass ratio of C to N in the top 0.05 m of soil (c) at two sites at the Central Plains Experimental Range. Site and microsite codes are: CL, clay loam site; SL, sandy loam site; P, plant-covered microsite; O, opening. Error *bars* represent ±1 standard error of the mean.

Hook et al 1991

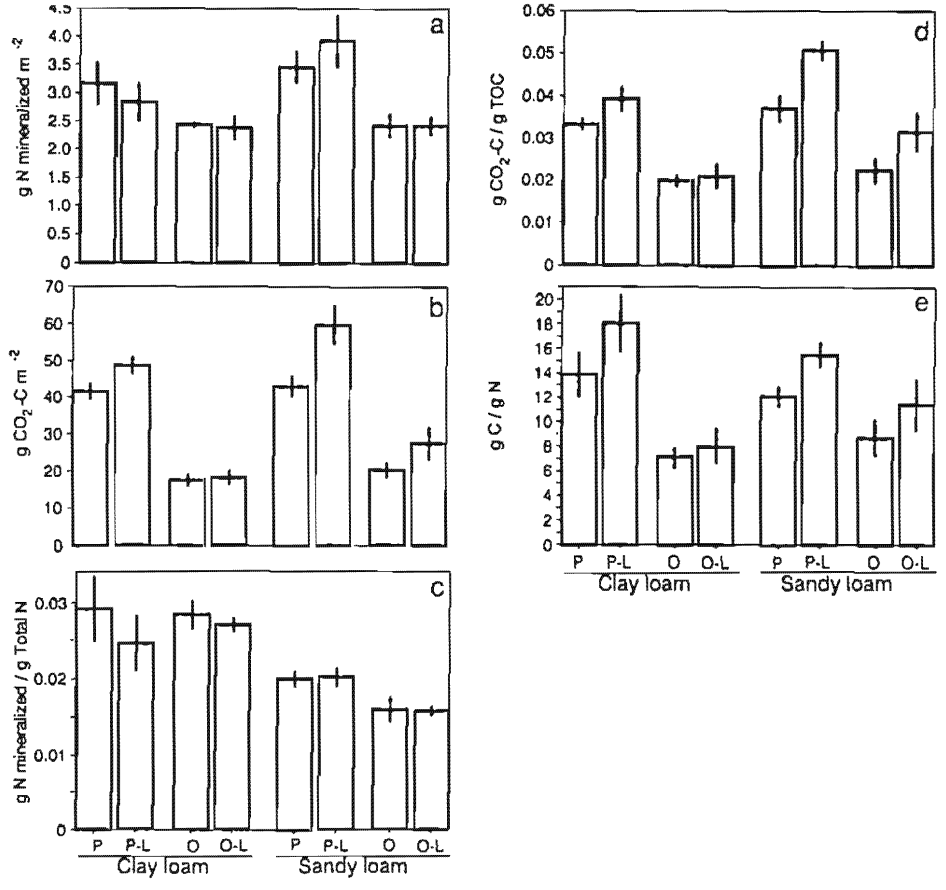



*Fig. 4.* N mineralized and C respired during 30-d, aerobic incubations of soil from 0 to 0.05 m depth at a sandy loam site and a clay loam site at the Central Plains Experimental Range: net N mineralized (a) and $CO_2$–C produced (b) during incubations; ratios of net N mineralized to total N (c), $CO_2$–C produced to total organic carbon (d), and $CO_2$–C produced to net N mineralized (e). Microsite codes are: P, plant-covered microsite; O, opening. 'L' indicates subsamples amended with additional belowground litter. Error *bars* represent ±1 standard error of the means.

Landscape, Grazing Effects on Soil Organic Matter

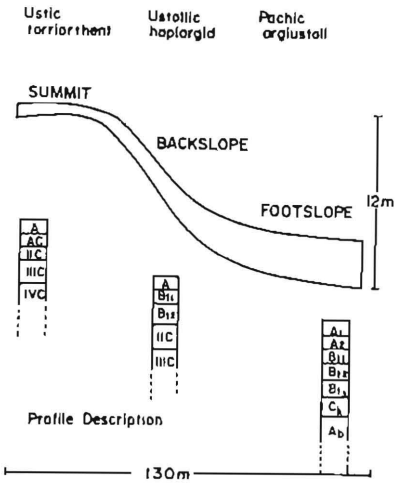


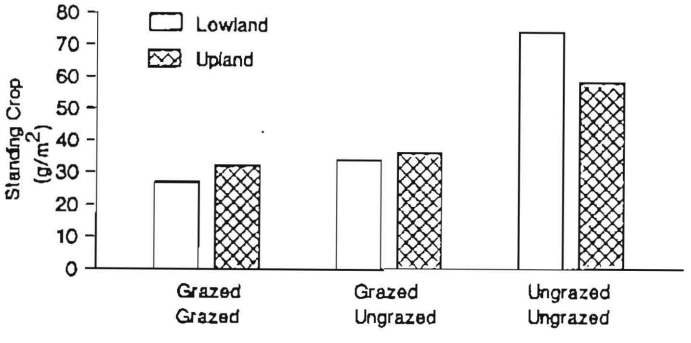

FIG. 1. Horizonation of soils and topography of a short-grass steppe catena.

Schimel et al

TABLE 3. Laboratory and in situ N mineralization rates in the surface 10 cm of catena soils.

| Position | N mineralized in situ (kg·ha·yr$^{-1}$) | % total N mineralized in situ | Lab incubation N mineralized (kg·ha$^{-1}$·6 wk$^{-1}$) | % total N mineralized in lab incubation |
|---|---|---|---|---|
| Summit | 30 a* | 4.2 a | 47 a | 6.5 a |
| Backslope | 41 b | 5.0 a | 30 b | 3.7 b |
| Footslope | 55 c | 1.8 b | 58 c | 1.9 c |

* Values within a column with the same letter are not significantly different ($P \geq .10$, MANOVA single-degree-of-freedom contrasts).




Milchunas et al, in prep

Figure 2.8 ANPP under long term grazed and ungrazed conditions. Grazed/grazed results re to plots subjected to long-term cattle grazing and grazed the year of sampling; grazed/ungra refers to plots subjected to long-term grazing but protected the year of sampling; and ungrazed/ungrazed refers to plots protected from cattle grazing for the past 50 years and protected the year of sampling. ANPP was estimated by harvesting at the end of the growing season.

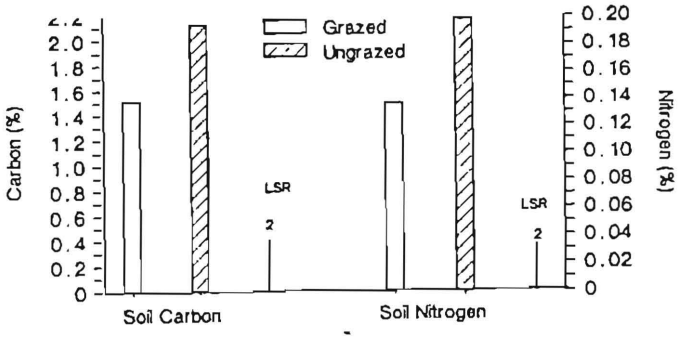
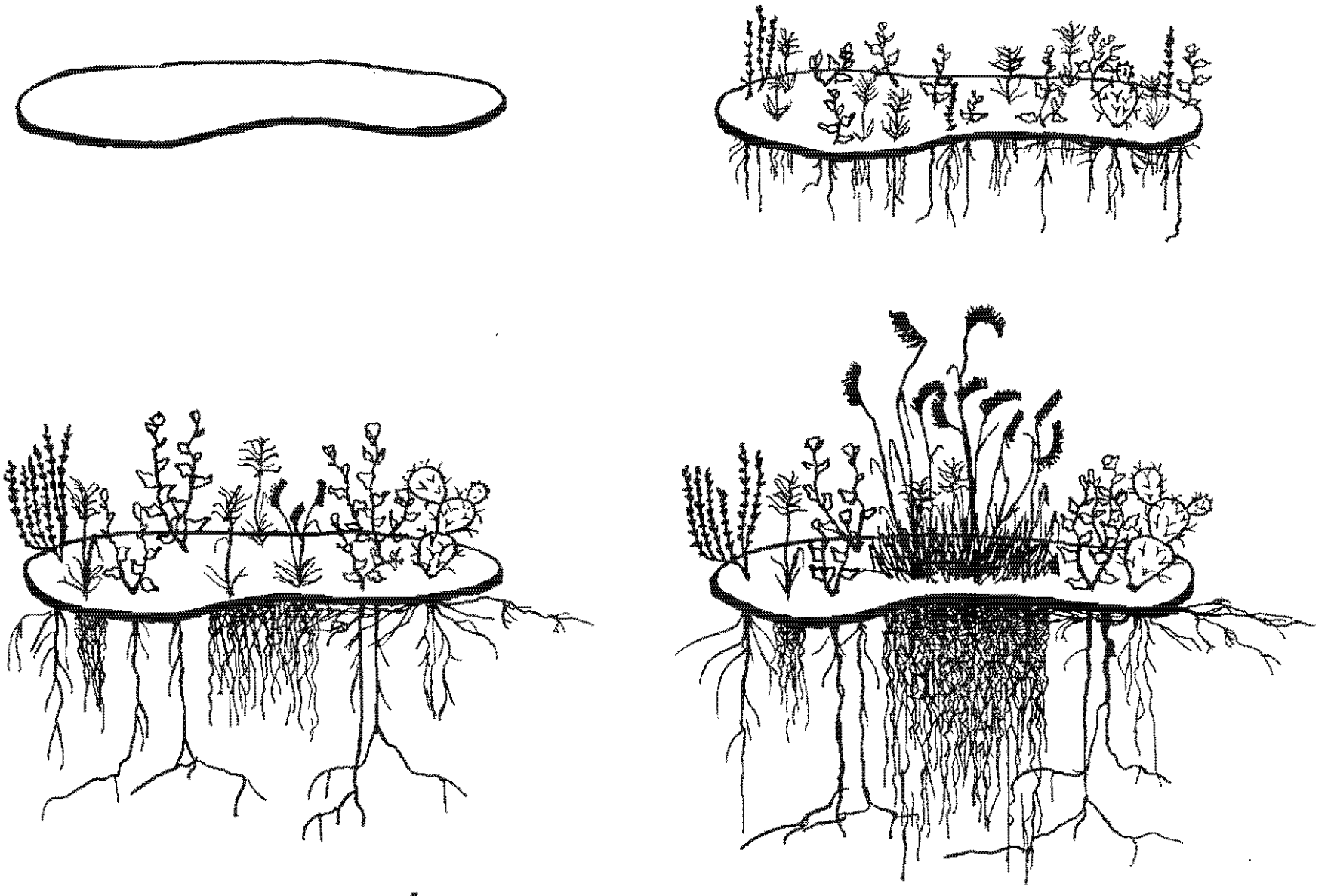



Figure 2.7 Soil organic C and N in soils in long-term grazed and ungrazed locations at the CI



Sitanion hystrix

Artemisia frigida

Bouteloua gracilis

Opuntia polycantha

Sphaeralcea coccinea

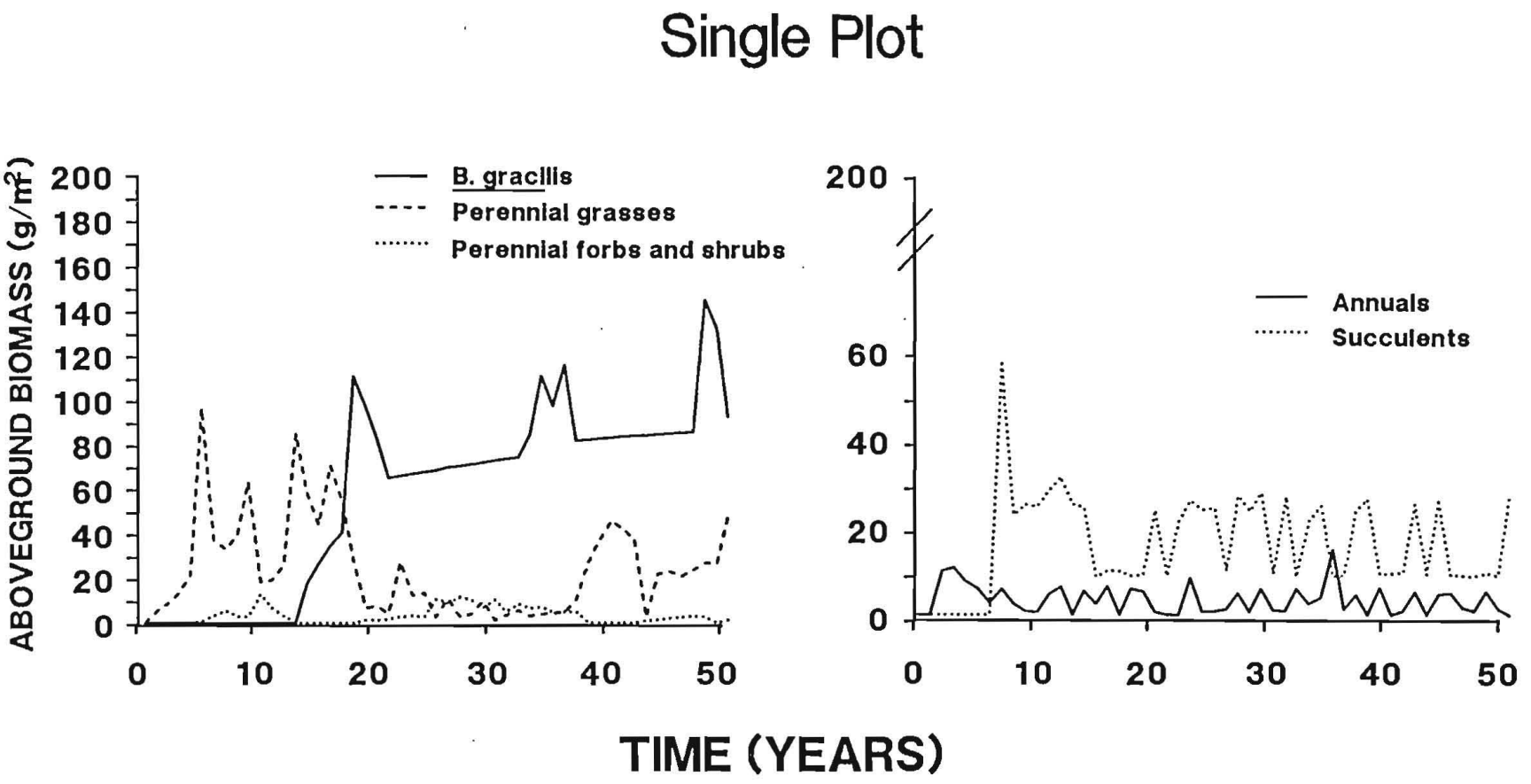



Figure 7. Lauenroth, W.K. and Coffin, D.P.

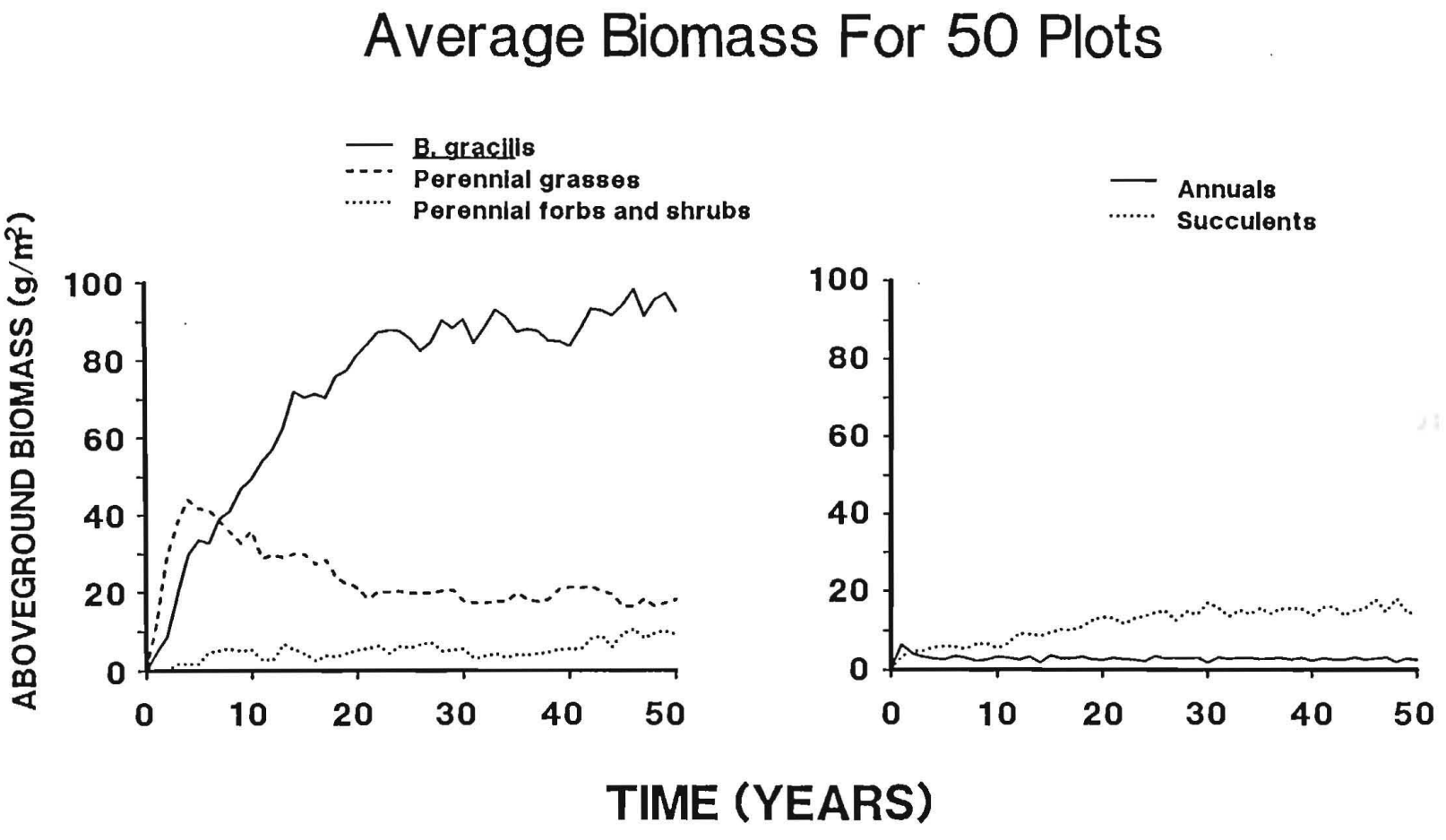



Figure 8. Lauenroth, W.K. and Coffin, D.P.

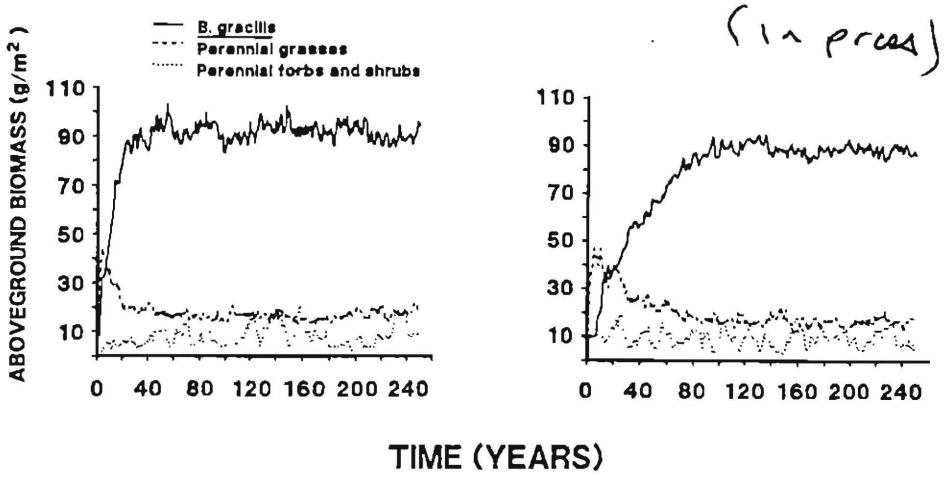



*Fig. 12.* Average aboveground biomass of 50 plots for 250 years following a disturbance for three species-groups and two conditions of seed availability for *Bouteloua gracilis*: (a) seeds always present; (b) seed availability follows a probability distribution.



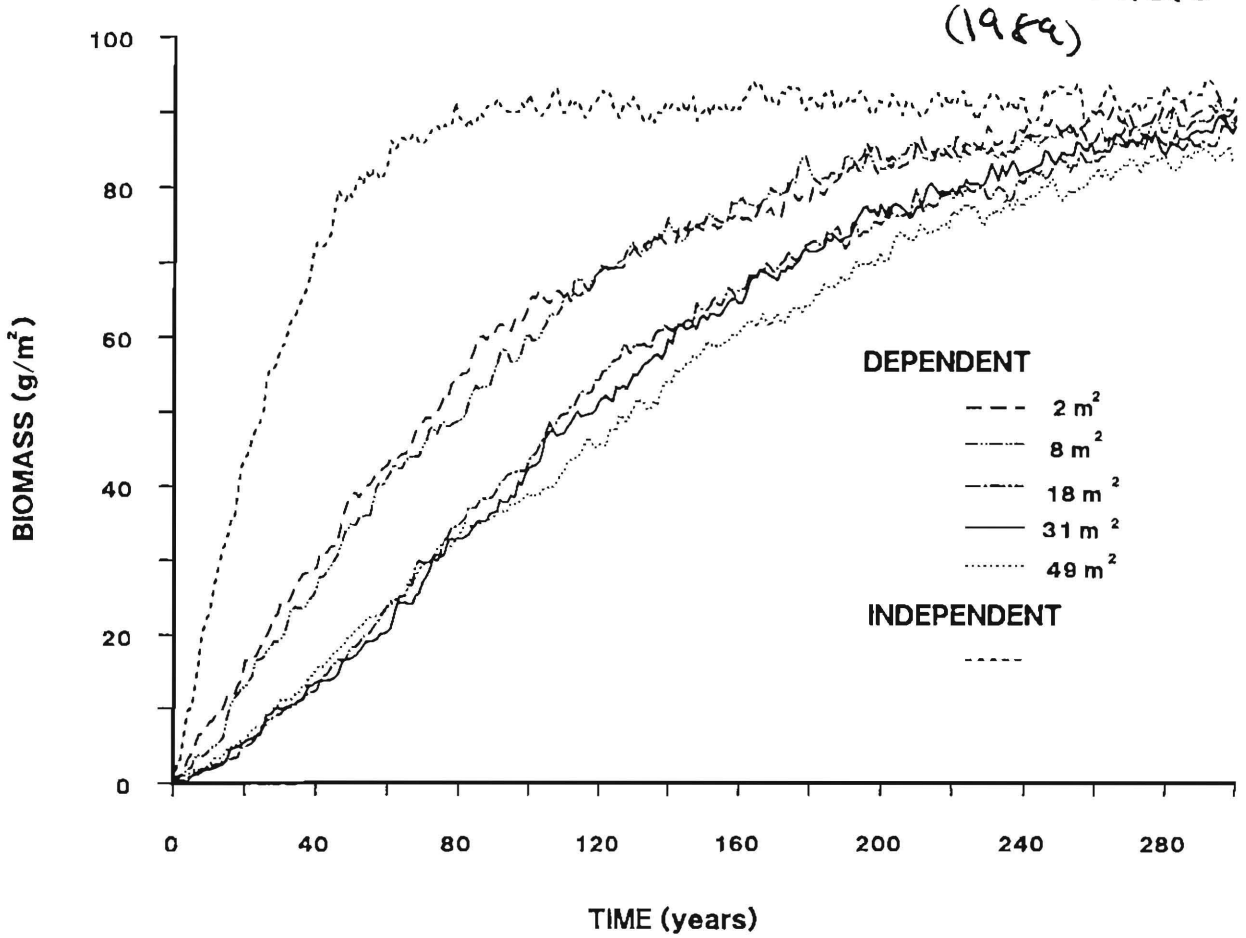
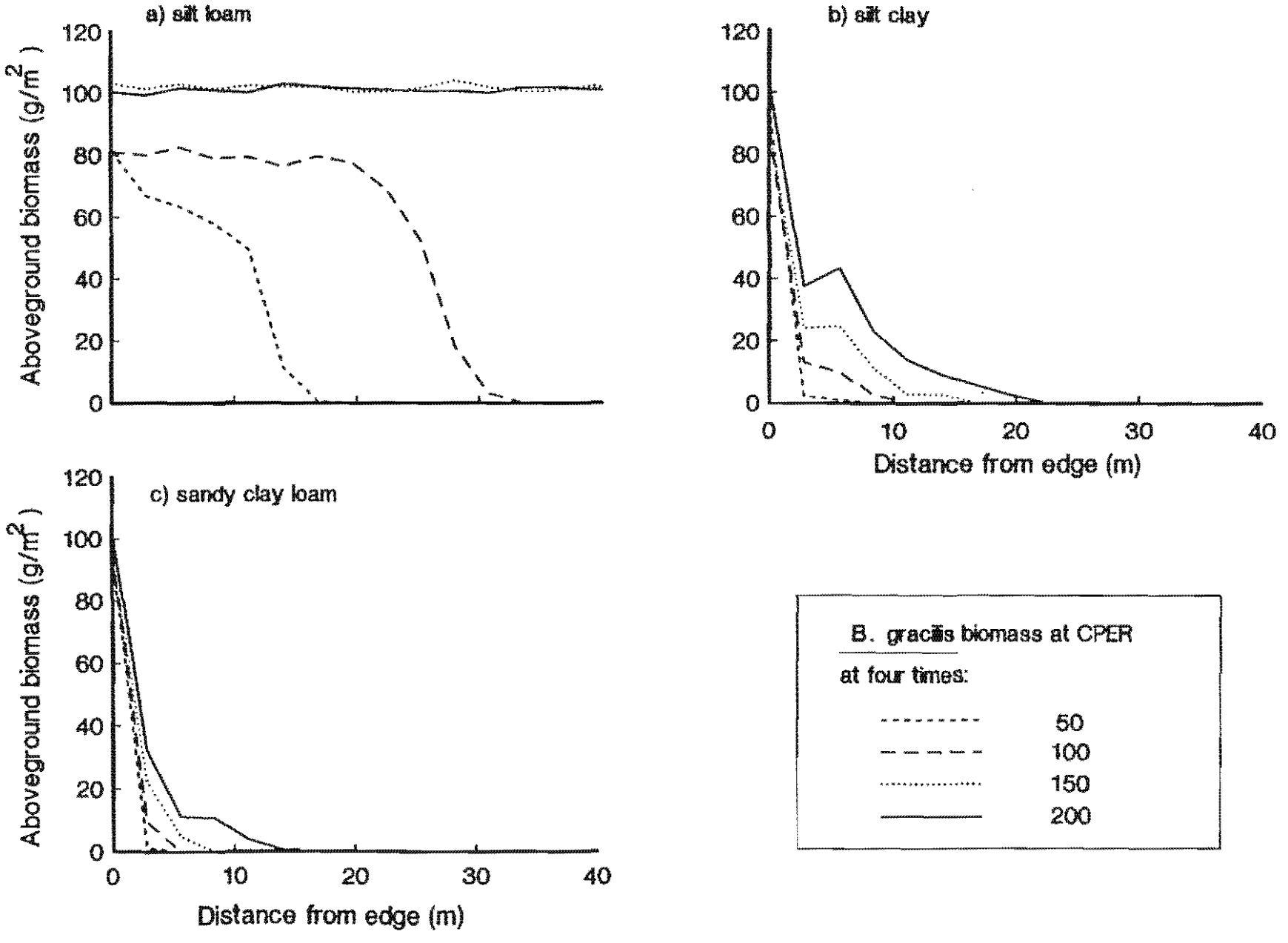
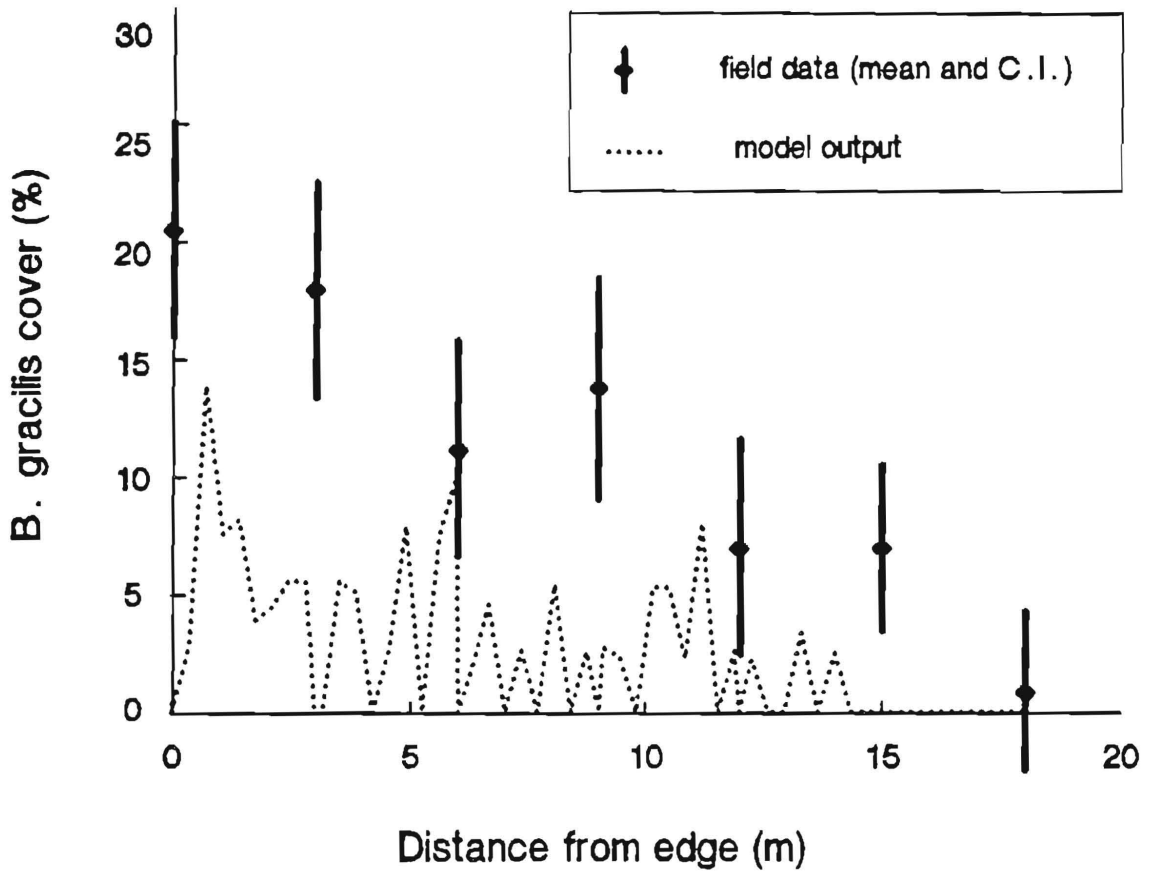



*Fig. 4.* Average aboveground biomass of *Bouteloua gracilis* for 300 years for two landscape types and five disturbance sizes. The average of the five sizes is shown for the landscapes consisting of independent plots.

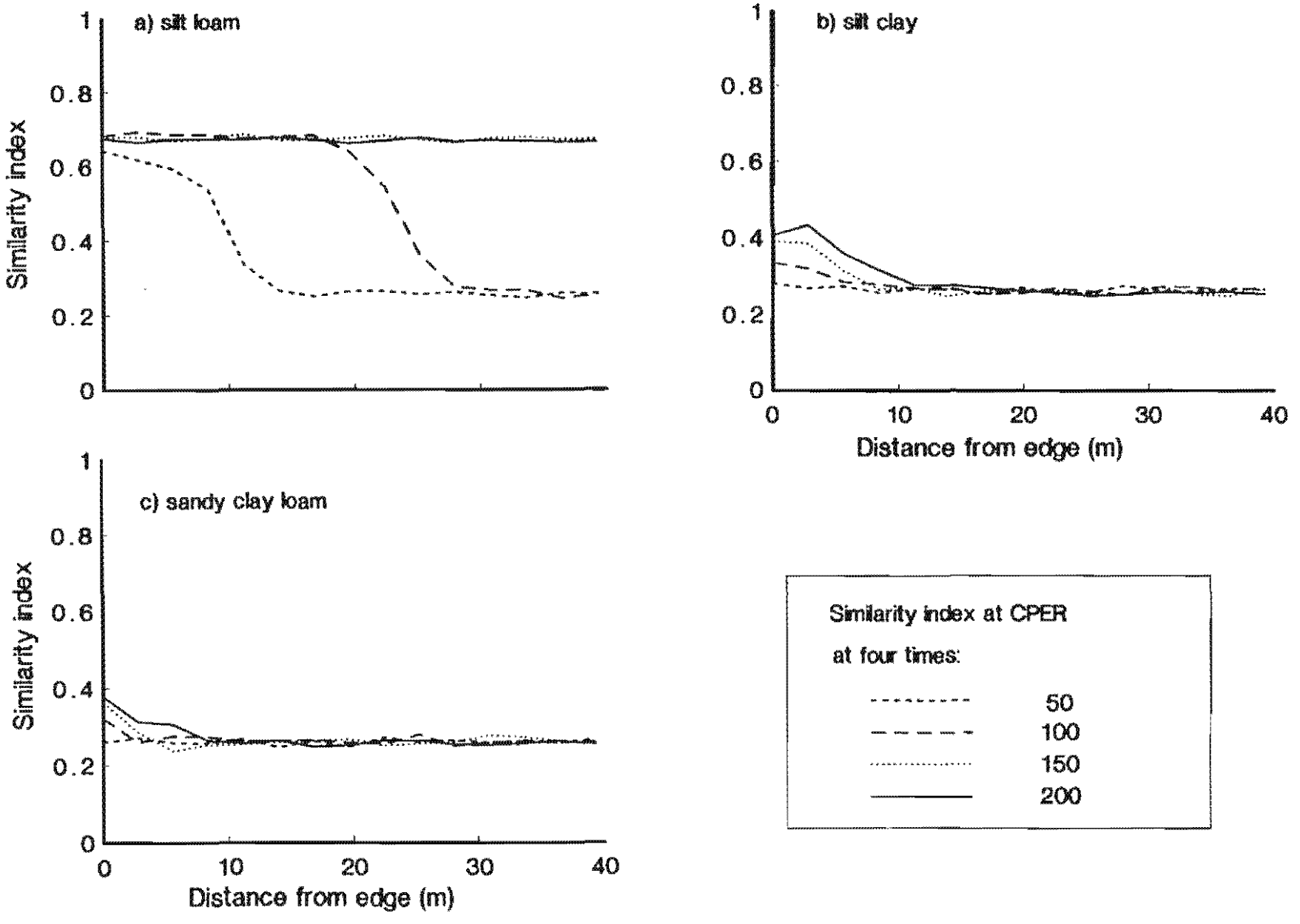
Coffin, Lauenroth & Burke (in press)



Cottin, Lauenroth & Burke (in press)

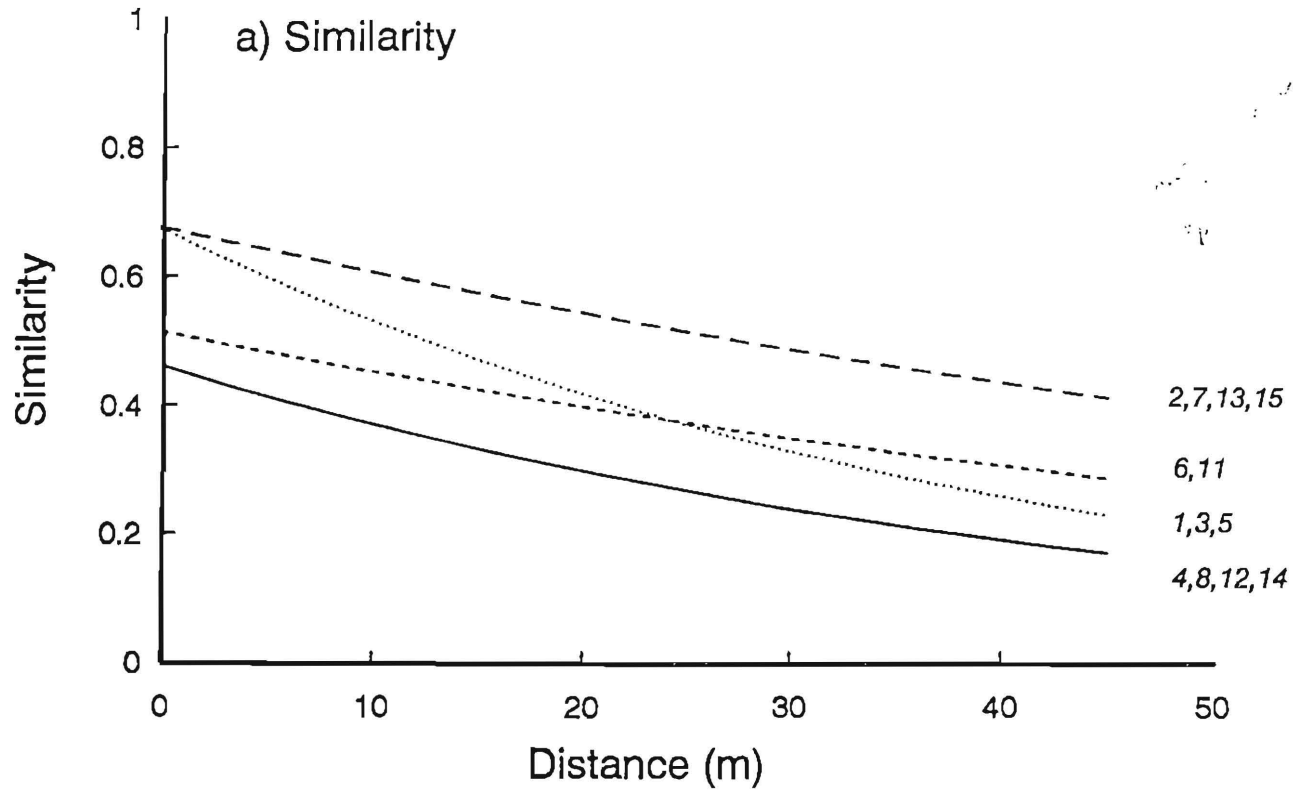


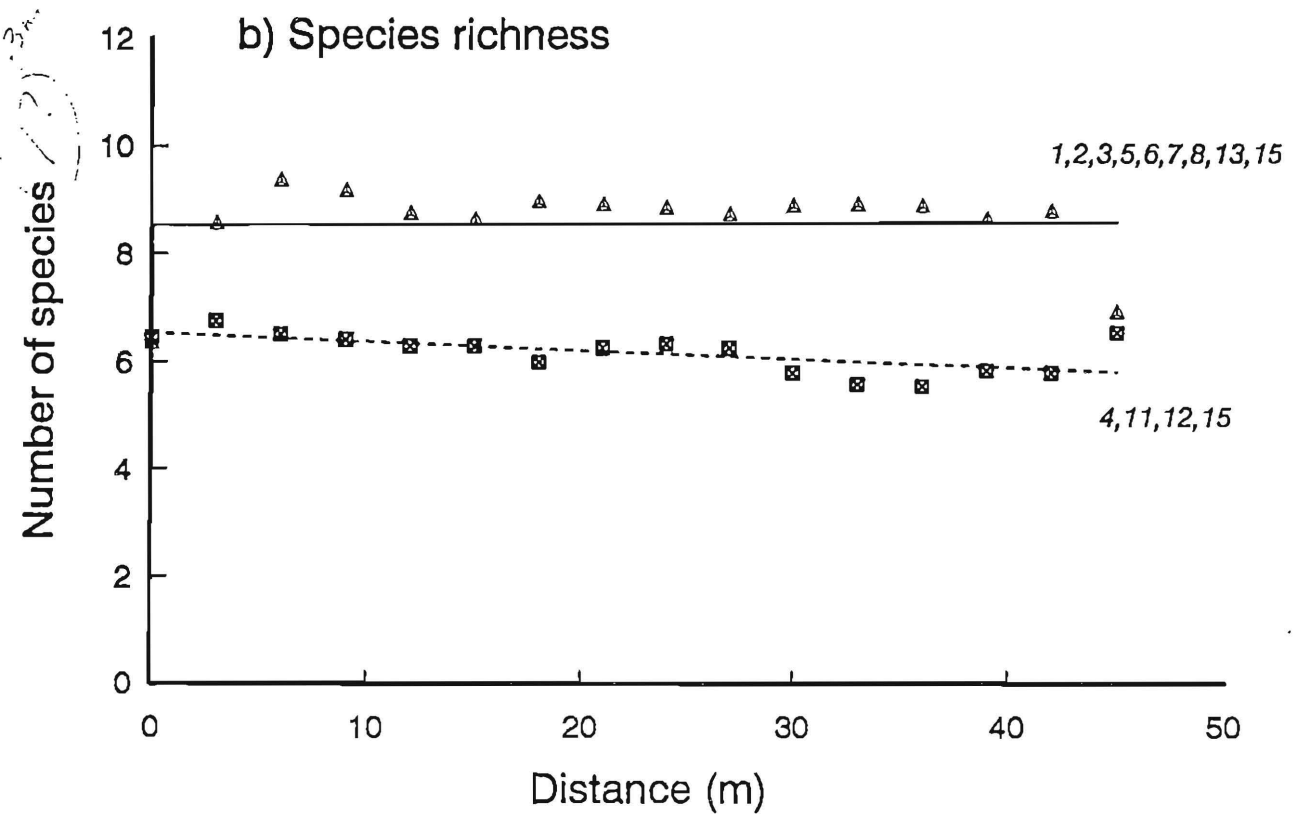
Coffin, Lauenroth & Burke (1992



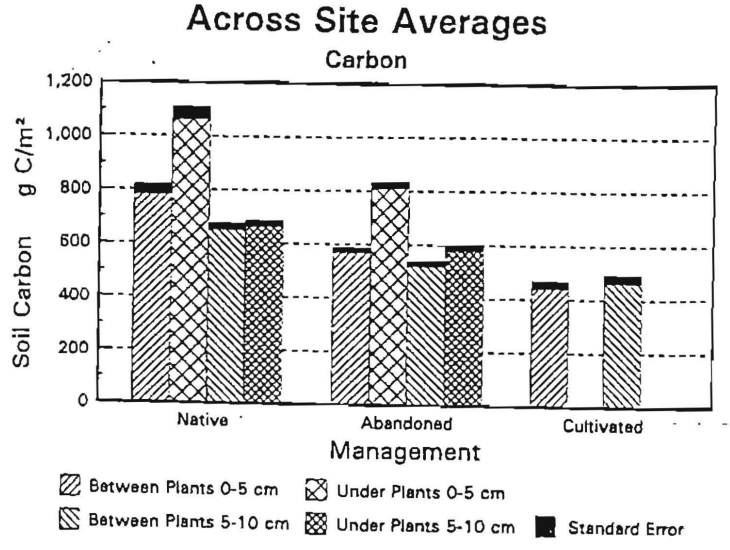
Coffin, Lauenroth, and Burke (in prep)

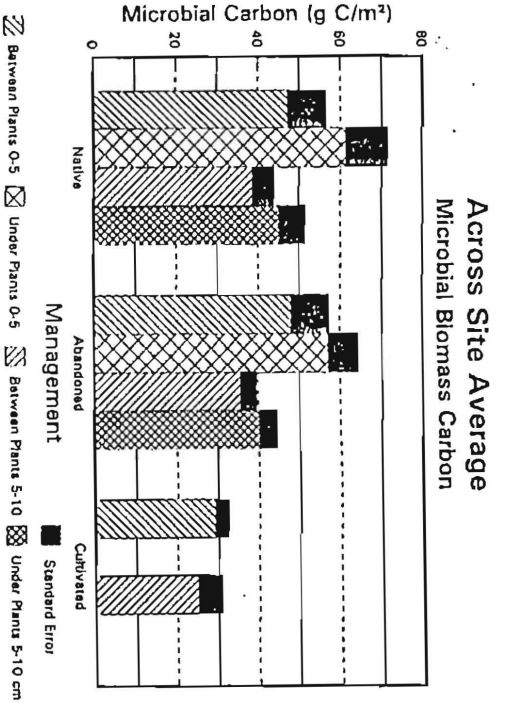
Fig. 7

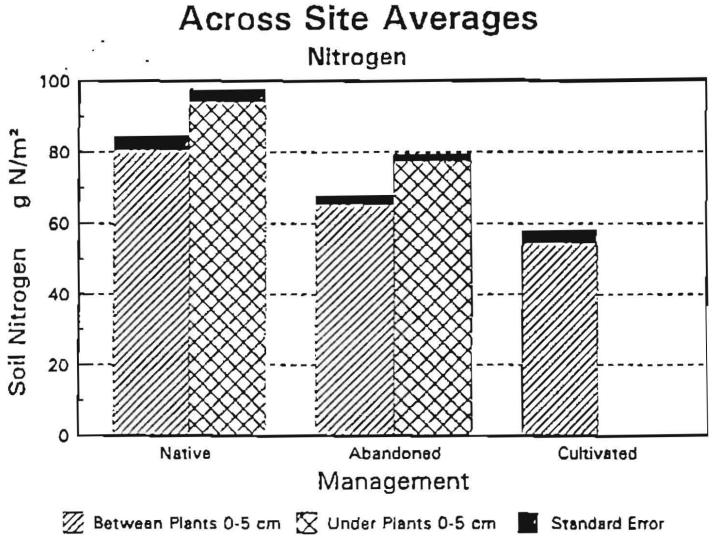


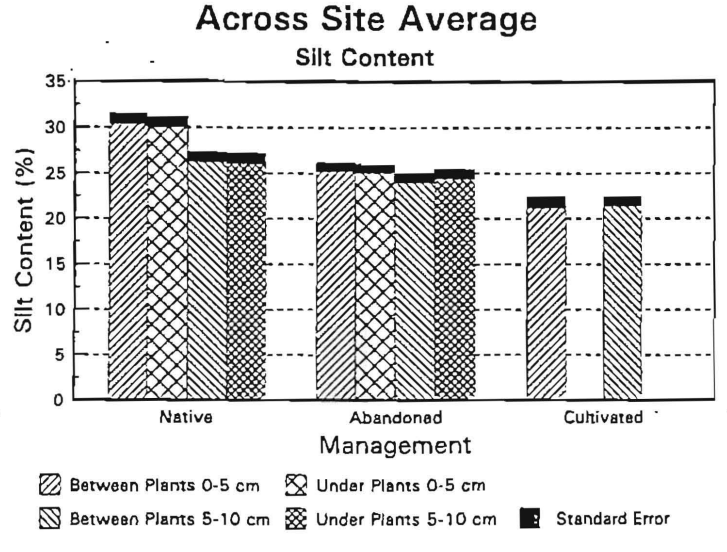



# Succession - Soil Organic Matter




Burke et al, in prep.

Community - Ecosystem Interactions

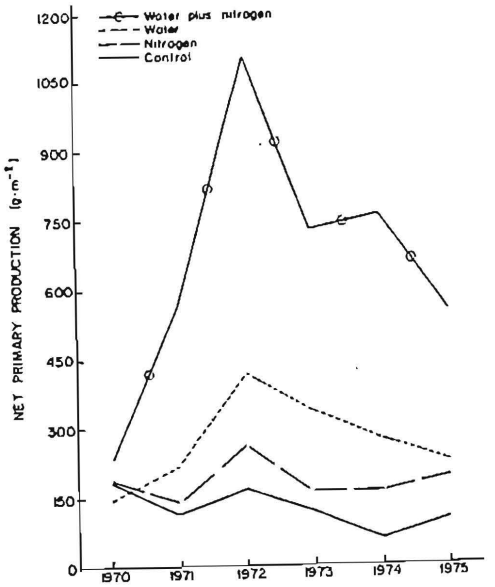



Figure 3.4. Aboveground net primary production for water and nitrogen stress experiment, 1970 to 1975.

Didd & Lauenroth

Vinton & Burke, in prep.

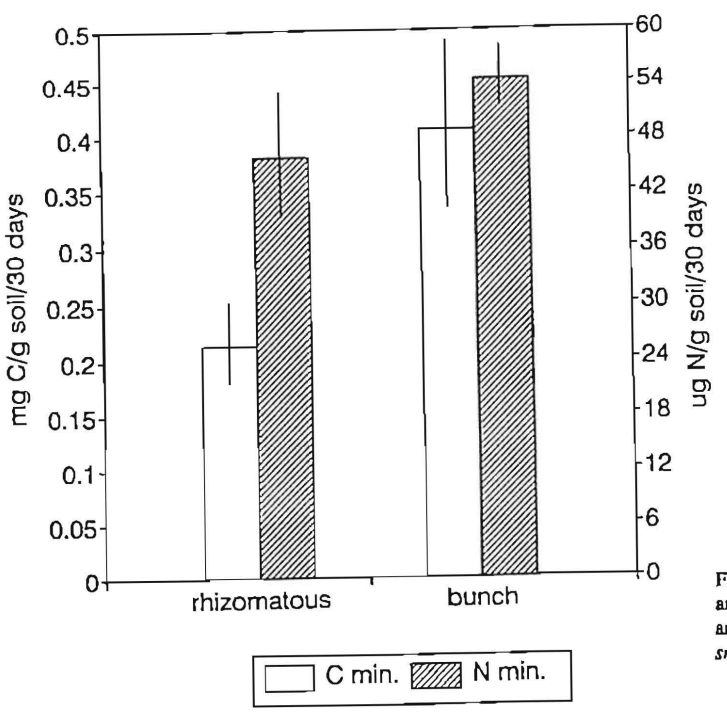



Figure 1. Potential net carbon and nitrogen mineralization in laboratory incubations of soil from under a rhizomatous grass species (*Agropyron gerardii*) and several bunch grass species (mean of *Bouteloua gracilis*, *Aristida longiseta*, and *Stipa comata*).

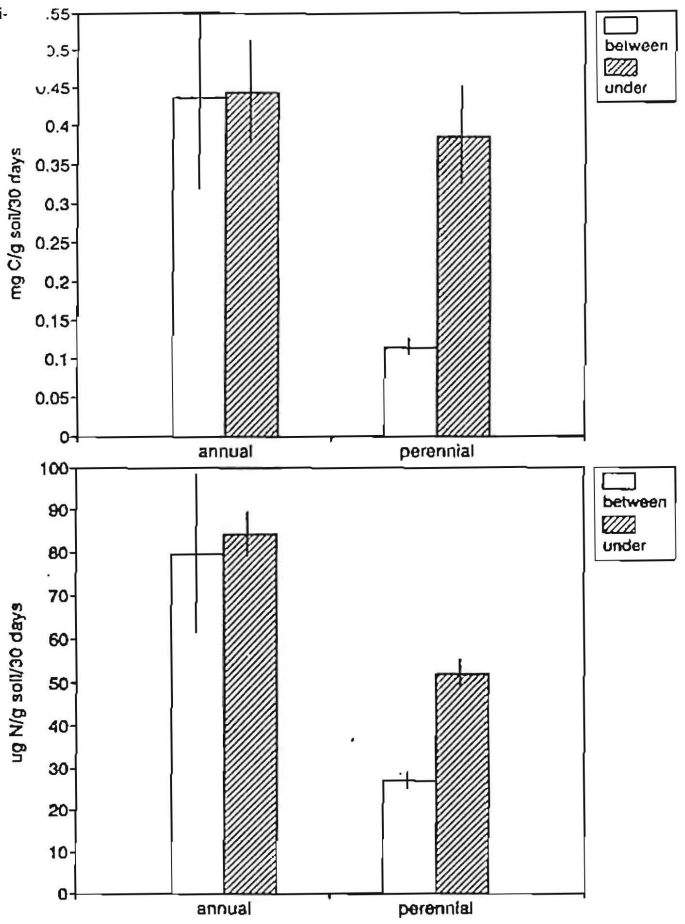



Figure 2. Potential net carbon and nitrogen mineralization rates from soil under and between an annual species and the mean of several perennial species. The annual species is *Kochia scoparia* and the perennial species are *Artemisia frigida*, *Bouteloua gracilis*, *Aristida longiseta*, *Agropyron smithii*, and *Stipa comata*.