



Responses of steppe plants to gradients of water soil texture and disturbance in Montana, U.S.A.
by Stephen John Harvey

A thesis submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in
Biological Sciences

Montana State University

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Abstract:

The response of steppe plants and vegetation to water availability, soil texture, and disturbance at 194 sites in Montana, U.S.A. was investigated. The stands were plotted on axes indexing effective precipitation (water storage capacity above the Bk horizon), integrated soil texture (depth to the Bk horizon), and disturbance (percentage of total cover contributed by disturbance species. 1) Analysis of the water gradient shows: a) *Distichlis striata*, *Sarcobatus vermiculatus*, and *Atriplex nuttallii* indicate the driest sites while *Festuca idahoensis*, *Artemisia tripartita*, *A. nova*, *Tetradymia canescens*, and *T. spinosa* indicate the moistest sites; b) *Agropyron smithii* dominates the driest sites, *A. smithii*-*Stipa comata*-*Bouteloua gracilis* dominate sites with effective precipitation of 1-4 cm, *Agropyron spicatum* dominates sites with effective precipitation of 4-10 cm, and *Festuca idahoensis* dominates sites with effective precipitation of 10-15 cm; c) species which appear to span the whole gradient include some which probably contain ecotypic differentiation (e.g. *Artemisia tridentata*), some which depend on climatic fluctuation, and some which depend on disturbance to reduce light competition under moist conditions or water competition under dry conditions, and d) shrubs are important where effective precipitation is 0-6 cm, disappear where it is 6-8 cm and reappear in the 8-15 cm region, probably because of fire effects, 2) Analysis of the soil texture gradient shows *Phlox hoodii* as an indicator of clay-rich soils. Four woody plants (*Juniperus scopulorum*, *Pinus ponderosa*, *Symphoricarpos occidentalis*, and *Artemisia cana*) have greater cover on coarse soils; the correlation may be due to reduced grass competition or lower fire frequencies. 3) Analysis of the disturbance gradient provides lists of species which indicate heavy disturbance, moderate to heavy disturbance, and very light to heavy disturbance; the strategy of all is apparently to disperse well, but the former are apparently more competitive than the latter. The data also suggest that relic communities are more easily found in moist habitats than dry habitats; this may be due either to greater landscape diversity or lower variance in precipitation in moist environments. Land managers will find the results useful in establishing range condition, in determining site water regime, and in planning reclamation within the water gradient limits.

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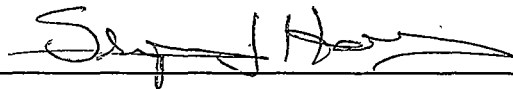
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