

Climate Change, Biodiversity, and Native Plant Restoration in the Sagebrush Steppe: The Vegetation Diversity Project

Michael M. Borman

INTRODUCTION

The Vegetation Diversity Project is administered within the Pacific Forest and Basin Rangeland Systems Cooperative Research and Technology Unit at Oregon State University (OSU) in Corvallis. The Cooperative Research Unit was initially established in November 1991 by the Bureau of Land Management's (BLM) Oregon/Washington State Office to address BLM's research needs primarily within Oregon and Washington; however, the Vegetation Diversity Project is a multi-state research effort encompassing the Great Basin and Columbia/Snake River Plateau regions. In November 1993, the Unit was transferred to the newly created National Biological Survey as a part of the Department of Interior's consolidation of all biological research personnel into a single agency.

Management of the majority of public rangeland in the Great Basin and Columbia-Snake River Plateau falls under the authority of the Bureau of Land Management. The flora of this land ranges from highly diverse native plant communities to deteriorated lands dominated by exotic annuals. Approximately nine percent of the BLM's 78 million acres of public land in this region is degraded to such a degree that changes in land management alone will not result in significant improvement. The BLM intends to restore native plant communities on these deteriorated lands, but current revegetation techniques used to establish introduced perennial grasses are often unsuccessful in establishing native plants.

On lands where native communities exist, the BLM desires to maintain and to enhance native plant diversity. Encroachment of highly competitive exotic forbs and annual grasses in native plant communities raises concern among managers over the appropriate management to maintain native communities. Coupled with these concerns are impacts on vegetation of the documented increase in CO₂ and of predicted global climate change.

The BLM therefore recognizes the need for research to understand and solve these problems and for the results of this research to be transferred to land managers. The Vegetation Diversity Project (VDP) has been initiated to address these needs.

Problem Analysis

In February 1993, we completed a problem analysis that includes a literature review and identifies research needs (see last page for citation). Input to the problem analysis was provided by BLM management personnel and university and federal research scientists who are active in or have an interest in restoration of rangeland systems in the Great Basin and Columbia/Snake River Plateau regions. A problem analysis (Pike and Borman 1993) was

and sent to BLM State and District Offices, appropriate university and federal research organizations, and other organizations and individuals who indicated an interest.

The Great Basin and Columbia Plateau region consists of two major ecosystems: the sagebrush ecosystem, generally located in the northern half of the region; and the salt-desert shrub ecosystem, located in the southern half. These ecosystems differ greatly in their compositions of plant species and in their climatic and soil conditions. Therefore, techniques developed in one ecosystem may not be directly transferred to the other ecosystem.

In the Problem Analysis, we propose to initially concentrate studies in the Wyoming big sagebrush communities of the sagebrush ecosystem, because: (1) these communities represent a large amount of the BLM lands in Oregon, Idaho, northeastern California, Nevada and Utah; and (2) the low precipitation within these communities limits the success of standard revegetation methods. Shadscale (*Artriplex confertifolia*) communities of the salt-desert shrub ecosystem were given the next priority for study. These communities are a major component in four of the five participating states. Since the shadscale communities differ greatly from sagebrush communities, studies of shadscale communities will be initiated when the project reaches full funding. Similar studies to those proposed for sagebrush communities would be conducted on this new suite of species and environmental conditions. Low sagebrush communities would be given the lowest priority and studies in them are less likely to be initiated.

Research needs fall under five major areas of investigation: (1) long-term monitoring of vegetation diversity; (2) competition and establishment; (3) plant materials and seed technology; (4) maintenance of desired native vegetation; and (5) special status plants. Under each area of investigation a series of high, medium and low priority studies were identified. The priorities are being used as a guide in preparing requests for proposals, and in selecting and funding studies through the duration of the project.

Initial Efforts

The current funding level for the Vegetation Diversity Project is approximately one-third the level projected as necessary to adequately address the research, demonstration, and technology transfer requirements within the proposed ten-year time frame. Funding levels will determine the number and scope of studies conducted. Under the initial funding level, we have been able to initiate nine studies from among the high priority studies identified in the Problem Analysis. Dave Pyke is collaborating with researchers from Utah State University (USU) on a related study funded by the National Science Foundation. Technology transfer has also been budgeted and is funding participation in this field day, a newsletter, and will contribute to other outreach efforts. Oregon State University was awarded a cooperative agreement with the BLM to conduct this research on the basis of a competitive proposal. Research projects have been initiated by Dave Pyke and Mike Borman, from within the Vegetation Diversity Project, and by researchers at or associated with Oregon State University. The following research proposals have been approved and have been, or will soon be, initiated:

(1) TITLE: Establishment and reproduction of medusahead (*Taeniatherum caput-medusae*) on clay and loam soils.

SUMMARY: Medusahead, an exotic annual, was formerly suspected of being a problem plant that was restricted to clay soils, but is now thought to be expanding on loamy soils. This study will compare seedling establishment and reproduction of medusahead on two soil types occupied by a diverse native plant community. Treatments will include severe spring defoliation of the native plants and disturbance of the soil surface. Dave Pyke is the principle investigator and Heather Miller is a M.S. level graduate student conducting the study.

(2) TITLE: Competition between squirreltail (*Sitanion hystrix*) and medusahead (*Taeniatherum caput-medusae*) on clay and clay loam sites.

SUMMARY: The intensity and importance of competition between the native perennial grass, squirreltail, and the exotic annual grass, medusahead, are being evaluated in the sagebrush steppe of eastern Oregon. Population dynamics, growth analysis, and impacts on soil moisture of various densities and proportions of the two species are being assessed. The information is needed to determine if squirreltail may replace medusahead in low input restoration efforts. Mike Borman is the principle investigator and David Clausnitzer is a M.S. level graduate student conducting the study.

(3) TITLE: Comparative demography of three sensitive and morphologically similar species of *Astragalus*.

SUMMARY: The milkvetch genus has many species listed or being considered for listing as threatened or endangered of extinction. The demography of three that occur as endemic species in the northern Great Basin, *A. peckii*, *A. mulfordiae*, and *A. oniciformis*, will be examined. Reproduction, seedling and adult survival will be compared. Responses to wildfires and subsequent revegetation effects will also be compared for *A. mulfordiae* and *A. oniciformis*. Dave Pyke is the principle investigator.

(4) TITLE: Population risks of native perennials and of an exotic annual grass in desired and degraded plant communities: the role of grazing and climate.

SUMMARY: Long-term demographic monitoring plots were established in 1993 to determine the impact of late-winter and of spring grazing and of annual climatic fluctuations on the population dynamics of native Great Basin shrubs and grasses and of exotic annuals. Seed longevity, seedling establishment and survival, and adult survival and reproduction will be examined at sites in eastern Oregon and southern Idaho. Dave Pyke is the principle investigator and Mark Martinez is a Ph.D. level graduate student conducting the study.

(5) TITLE: Effectiveness of using a strip tiller for reseeding lands dominated by exotic annuals.

SUMMARY: This project will be applied research evaluating use of a strip tiller, with and without an atrazine treatment at 1/2, 3/4, and 1 pound application rates, in conjunction with a standard drill for establishing perennial grasses in cheatgrass monocultures. The project will be a cooperative effort between the VDP and BLM's Intermountain Greenstripping and Rehabilitation Project. Mike Pellant (BLM Idaho State Office) is the

Project Leader and Mike Borman is the principle investigator of the study.

(6) TITLE: Compare the responses of shrubs, forbs, and grasses when nutrients become available in patches or pulses as opposed to uniformly.

SUMMARY: This study addresses the question of why sagebrush becomes the overwhelming dominant on sites in the absence of grazing and fire. It compares the ability of sagebrush, rabbitbrush, thickspike wheatgrass, medusahead and cheatgrass to compete for nutrients as they become available. Work is being conducted in northern Utah. Martyn Caldwell (USU), Dave Pyke (VDP), and John Stark (USU) are the principle investigators. Funding is provided by a grant from the National Science Foundation.

(7) TITLE: Changes in plant community dynamics caused by elevated CO₂ and altered precipitation.

SUMMARY: Studies will examine the response of desirable native plants (such as sagebrush, needlegrass) and undesirable exotic annuals (such as medusahead, cheatgrass) to shifts in precipitation from winter to summer and to increased levels of CO₂. This will be part of the USDI Global Change Research Program. William C. Krueger will be the principle investigator. Four OSU faculty (R.F. Miller, W.E. Winner, L.L. Larson, and G.L. Kiemnec), one USDA-ARS Research Scientist (T. Svejcar), and three graduate students will conduct the study.

(8) TITLE: Quantification of vegetation diversity on intact and deteriorated rangelands: Experiment 1 - Plant diversity on sagebrush steppe rangelands varying in ecological condition.

SUMMARY: This study will initially examine the usefulness of BLM's Ecological Site Index and Soil and Vegetation Inventory and Monitoring (SVIM) data sets for describing vegetation diversity on intact and degraded rangelands. Field studies will also determine the importance of temporal measurements within years and between years for descriptions of the plant diversity on intact and degraded sagebrush ecosystems. W.C. Krueger is the principle investigator. L.E. Eddleman (OSU) is the principle investigator and Pat Dysart is a Ph.D. level graduate student conducting the study.

(9) TITLE: Quantification of vegetation diversity on intact and deteriorated rangelands: Experiment 2 - Below-ground diversity.

SUMMARY: This study will examine the diversity of mycorrhizal fungi associated with intact and degraded sagebrush rangelands. It will examine the importance of mycorrhizal inoculation of perennial grasses during restoration of native plants on degraded lands. This study will also initiate a pilot study on the importance of microphytic crusts (lichens and mosses) for native plant restoration and maintenance on sagebrush rangelands. W.C. Krueger is the principle investigator. D.A. Perry (OSU) and one graduate student will conduct the study.

(10) TITLE: Seed dispersal by large herbivores: Opportunities for vegetation change on rangelands.

SUMMARY: There is a need for effective methods to enhance germination and

establishment of desirable species on Wilderness Areas and WSAs, where drill equipment is not allowed and in other areas where drill equipment is not feasible. The use of livestock as a dispersal agent has been suggested in the literature and is being tried in other ecosystems, but not in the Great Basin with Great Basin species. This study will examine the ability of desirable native species and of undesirable species to be ingested, pass through the digestive system of various livestock species and remain viable. W.C. Krueger is the principle investigator. M.L. McInnis and M. Vavra (OSU) are the Principle Investigators and Amaya Lowry is a M.S. level graduate student conducting the study.

Information gathered from these studies and from studies conducted by BLM district personnel will be transferred to land managers using a quarterly update, demonstration sites, field days and field day reports, computer software, and through publications in nontechnical journals such as *Rangelands*, and in peer-reviewed scientific journals.

LITERATURE CITED

Pyke, David A., and Michael M. Borman. 1993. Problem Analysis for the Vegetation Diversity Project. Tech. Note OR-936-01. U.S. Dept. of Interior, Bureau of Land Management, Pacific Forest & Basin Rangeland Systems Cooperative Research & Technology. Unit, Corvallis, OR. 100 p.

The Problem Analysis will be mailed upon request as long as copies are available.