WESTERN COORDINATING COMMITTEE ON REVEGETATION AND STABILIZATION OF DETERIORATED AND ALTERED LANDS

WCC-21

Annual Report 2001 - 2002

ALASKA

Agricultural and Forestry Experiment Station
University of Alaska Fairbanks

2002 WCC21 Progress Report

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INTRODUCTION

This report summarizes the revegetation research projects at the Agricultural and Forestry Experiment Station (AFES) of the University of Alaska Fairbanks from July 1, 2001, to June 30, 2002. Current AFES revegetation research is shifting from monitoring earlier studies to survey of mycorrhizae on disturbed lands, both natural and mined.

ONGOING PROJECTS

1. Abandoned Coal Mined Land Revegetation Monitoring (D.J. Helm, AFES; N. Moore, Plant Material Center; B. Novinska, B. McMillen, Division of Mining and Water Management)

   Slow-release organic fertilizers are being investigated to slow development of seeded vegetative cover to encourage natural colonization. Three different organic fertilizers (Biosol, Fertil-Fibers, and Humi-zyme) are being compared with traditional mineral fertilizer (control) applied to overburden materials as well as with a topsoil. All plots were seeded with the same grass seed mix at the same rate. After 3 years, growth is best on the topsoiled plots and the mineral fertilizer (control) has resulted in cover at least as good as the organic fertilizers. Of the organic fertilizers tested, Biosol is the only one where grass cover has remained steady or increased for the dominant plant species and now has similar seeded cover to the AControl@ (mineral fertilizer). None of the treatments have significant colonizers, either desirable or undesirable (Aweeds@). Potential disadvantages of this slow development include possible erosion, delayed time for organic matter buildup, and possible colonization by undesirable species.

2. Ectomycorrhizae on Disturbed Lands in Southcentral and Interior Alaska: A

Comparison of Regional Similarities and Differences (D.J. Helm, AFES, McIntire-Stennis Forestry Research Program)

Ectomycorrhizal fungi (EMF) range from generalists to specialists and may be associated with specific plants and/or substrates. Selection of appropriate fungi or mixes for inoculum in revegetation are important for success. The primary objective of this project is to compare ectomycorrhizal communities in early successional sites across a latitudinal gradient in Alaska to determine whether there are similarities in EMF morphotypes (appearance of fungus-root structure) to assess feasibility of a common inoculum or strategy for revegetation. Materials are being collected from sites ranging from the Kenai Peninsula to the Brooks Range, including deglaciated, burned, and mined sites. Roots or soil/litter cores were collected by substrate from two primary locations during summer 2001: Exit Glacier in Kenai Fjords National Park and the FrostFire prescribed burn in the Caribou-Poker Creek Research Watershed northeast of Fairbanks.

3. Vegetation Studies at Usibelli Coal Mine (D.J. Helm, AFES)

   Final observation of these test plots on six growth media (three mineral substrates (sandstone, A+B horizons, and a mix of sandstone + A+B horizons) with and without an organic mat intermixed) occurred in August 2001 before they were mined during winter 2002. A standard seed mix was tested on all six growth media while several individual species were tested on the sandstone and AB materials. One half of each plot was fertilized in 1991 only, and half was not fertilized for 4 yr but was reseeded and fertilized in the fifth year (1995). Results have varied across years with best grass cover initially on sandstone, then AB materials. As the grass is dying, more natural colonization is occurring on the sandstone material, resulting in better community development.

   In addition to the main fertilizer plots, a fertilizer frequency study was initiated in 1995 at the toe of the main plots with treatments during year 1; years 1 and 2; years 1 and 3; and years 1, 2, and 3. On average, vascular plant cover was greater in the thrice-fertilized plots at the end of 5 years compared to the year 1 only and years 1 and 3.

   (Primary funding by Usibelli Coal Mine, Inc.)

4. Inoculated Woody Seedlings: A New Alaskan Crop for Alaskan Revegetation. (D.J. Helm, AFES, and David Ianson, ARS)

   Currently most seedlings for large-scale plantings in Alaska are grown in Canada or the contiguous 48 using seed collected near the Alaskan site. Our smaller greenhouses cannot compete with the large-scale greenhouses. If local Alaskan greenhouses could produce woody seedlings inoculated with local mycorrhizal fungi from soil transfer, they would have a value-added product to compete with larger greenhouses outside Alaska. The overall objective of a series of projects that have been performed over the last 12 years has been to learn how to facilitate mycorrhizal formation on plants for revegetation or landscaping. The overall objective of this

particular project, the next step, is to determine whether the geographical source of inoculum is important for seedling inoculation in greenhouse before outplanting. This is the next step in synthesizing the previous studies into a new crop: seedlings inoculated with mycorrhizal fungi for revegetation or landscaping. The seeds collected the first year did not germinate so will be recollected in 2002. (Funded by USDA, New Crop Opportunities)

5. Evaluation of Field Techniques to Describe Vegetation on Forest Inventory Plots. (D.J. Helm, AFES, and Bert Mead, USFS)

   While this project is oriented toward the USFS Forest Inventory plots, the same sampling techniques are potentially useful for monitoring revegetation and restoration efforts. One of the big issues with inventory and monitoring is the reproducibility of techniques among users to insure that the numbers are comparable. The USFS Anchorage Forestry Science Laboratory initiated a study to test five different techniques for reproducibility among six observers in two forest types in southcentral Alaska: overall community estimates, ocular estimates in quadrats, horizontal-vertical profiles, rooted frequency, and points. Two general methods of evaluating reproducibility were considered: standard deviations and components of variance. Standard deviations and coefficients of variation (standard deviation relative to mean) were evaluated to determine the precision among observers. Components of variance were analyzed to determine the percentage of total variance attributable to observers. Most techniques had an observer effect over half the time when viewed with standard deviations and almost all the time when viewed with hierarchical components of variance. This has implications for what can be concluded validly from vegetation cover data. (Funded by US Forest Service)

ARIZONA

TUSCON PLANT MATERIALS CENTER (PMC)

2002 WCC-21 PROGRESS REPORT

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INTRODUCTION

The Tucson Plant Materials Center (PMC) cooperates with city, state and federal agencies to achieve the goal of conserving natural resources in the Sonoran and Mojave deserts of the southwestern United States. The Tucson PMC provides plant materials related information for land improvement and protection, pollution control, wildlife enhancement and the improvement of our natural resources. Our current priorities include soil erosion control on rangelands, critical areas and retired farmland; controlling wind erosion and promoting low water use ornamental vegetation; water quality improvement through agroforestry, erosion control along streamcourses using native riparian species such as cottonwood and willow; winter cover crops for cotton rotations such as legumes, annual grasses and grains. These priorities are based on existing needs and are more clearly defined in the Long Range Plant Materials Plan which is updated annually by the State Conservationist's PM Advisory Committee. The Tucson PMC also receives direction from a plant materials advisory group made up of specialists in agronomy, range management, biology and plant materials which makes recommendations to the State Conservationist.

COMPLETED PROJECTS

1. Vegetative Rehabilitation of Mined Lands on the Cyprus-Tohono Mine Site (Mark Pater, Tucson Plant Materials Center, Bernard Siquieros, Cyprus-Tohono Corporation)

   The project goals were to develop successful, cost-effective techniques for native plant establishment to improve harsh visual impacts created by the open-pit mining process. This project focused on collecting data for various native plant species which are indigenous to the site. Evaluations and data collection provided

information on plant propagation and establishment techniques for use on mine processed materials capped with overburden material.

2. Propagation and Establishment of Culturally Significant Plant Materials on the Cyprus-Tohono Mine Site. (Mark Pater, Tucson Plant Materials Center, Bernard Siquieros, Cyprus-Tohono Corporation)

   This project was aimed at obtaining germination and propagation requirements for saguaro cactus (*Carnegia gigantea* [Engelm.] Britt. & Rose), beargrass (*Nolina microcarpa* Wats.) and soaptree yucca (*Yucca elata* Engelm.). The beargass and soaptree yucca are two culturally significant species used by the Tohono O'odham to make traditional baskets. The saguaro is also highly regarded by the Tohono O'odham in that it not only provides food and shelter for many insect and animal species, but also for the O'odham.

3. Maggie Tank Hay Seeding - Using Grass Hay Bales. (Mark Pater, Tucson Plant Materials Center, Kim McReynolds, University of Arizona Cooperative Extension, Willcox, Arizona)

   The Maggie Tank Hay Seeding project is located on private land within the Sheep Canyon grazing allotment. The allotment is approximately 12 miles south of Bowie, Arizona in Cochise County. The following people are involved in the project: Larry Humphrey and Ted McRae - BLM; Kim McReynolds - University of Arizona Cooperative Extension; Mark Pater - NRCS Tucson Plant Materials Center; Hugh Peterson - Ranch Manager. This project was designed to facilitate revegetation of deteriorated rangeland. Some natural revegetation had been occurring on the allotment over the past 10 years. However, there are areas that were not showing any significant response to improved grazing management. The idea was to use the cattle as a tool to plant grass seed by trampling around the area where hay was thrown out.

4. Improving the production and soil protection of rangeland in the arid, semi-arid and deserts of the US. (Mark Pater, Tucson Plant Materials Center, Carleton Edminster, USFS, Rocky Mountain Experiment Station, Ron Bemis, NRCS, Douglas Field Office)

   The Borderlands Ecosystem Project area covers nearly 1 million acres in southeastern Arizona and southwestern New Mexico and includes the San Bernardino, southern San Simon and Animas Valleys. Much of the region supports semi-desert grass-shrub ranges and woodlands that are vital for livestock growers and local economies. This vegetation type occupies a strip of 50 to 100 miles along the United States-Mexico border in Arizona, New Mexico, and west Texas (Martin 1975). Elevations generally are from 3,000 to 6,000 feet. Precipitation, depending on geographic location along a northwest to southeast axis, ranges from 8 to 20 inches annually. In order to better understand and quantify the effects of different management practices on encroachment of woody species in grasslands and savannas, a multiple year research study is being implemented that considers the effect of several management strategies on ecosystem processes, function and

composition. Other partners, in addition to the Rocky Mountain Experiment Station and Coronado National Forest included the Natural Resources Conservation Service (NRCS), the Whitewater Draw Natural Resource Conservation District, Arizona State Land Department, Malpai Borderlands Group, Hidalgo Soil and Water Conservation District, Animas Foundation, and U.S. Fish and Wildlife Service at the San Bernardino National Wildlife Refuge. The objective of the research study is to evaluate the impacts of a number of management treatments on components of the rangeland ecosystem: soils, vegetation, wildlife, and livestock. In Arizona, study locations include the San Bernardino National Wildlife Refuge (NWR), the Malpai Ranch, and the Sycamore Ranch. Locations on both the Malpai Ranch and the Sycamore Ranch include land leased from the State of Arizona. In New Mexico, the locations include the George Wright pasture of the Gray Ranch and a location north of Rodeo on the Roos Ranch. Study areas are easily accessible for logistical reasons and enhanced value for demonstration and learning. The focus of this study is not eradication of woody species, but rather a reduction of woody species density to improve range and watershed condition and promote development of a viable and productive perennial grass component. A successful treatment would be expected to produce a savanna condition with more widely scattered woody species and improved herbaceous cover, condition and productivity. Past efforts to mechanically control mesquite in the area have focused on either lifting of individual plants and root systems or root plowing and shearing. These treatments result in significant soil disturbance. An alternative mechanical treatment using a Marden duplex drum brush cutter (roller chopper) is being proposed for much of this study. While the brush cutter will not kill plants, it should be effective in breaking down crowns and breaking up the soil surface while incorporating some of the crown organic material into the upper soil layer and minimizing further soil disturbance. The treatment also reduces the transpiring leaf surface area of the mesquite plants. Mechanical treatment will be combined with and without native species seeding appropriate to each site. Sprouting of woody species is expected, however, establishment of an herbaceous layer should allow effective use of prescribed fire to control sprouts in the near future. Herbicides will not be used as part of this study.

ONGOING PROJECTS

1. Riggs Flat #2. Bruce Munda, Tucson Plant Materials Center

The goals of this field planting are to promote the use of improved conservation plants for range seeding, evaluate the adaptation of experimental plant lines for use in northern Arizona, and obtain data to update FOTG. Riggs flat is located on the Kaibab Paiute Indian Reservation approximately 6 miles west of Fredonia, Arizona and is immediately adjacent to highway 389. Elevation is 4600 feet and is within Major Land Resource Area 35-4. Annual precipitation is 9.4 inches with 27% received during July through October and 42% received from January through May. Soil is classified as Jocity clay loam, deep and well drained, and the range site is a clay loam bottom. This site was first planted in 1986 and then replanted in 1994. The

1986 planting was a complete failure due to lack of moisture and competition from weeds, primarily cheatgrass. The site was replanted in November, 1994 using 17 grass and 4 shrub species. Based on the results of the 1994 planting, Tucson PMC personnel have installed this larger planting using HycrestII and Vavilov Siberian wheatgrass. The Tucson PMC will be evaluating their establishment with regards to competition with winter annuals and imposing two treatments (disking & herbicides). Disking and herbicide applications will be evaluated with regards to improvement, if any, with stand establishment of the two seeded species.

2. Improving the production and soil protection of rangeland in the Intermountain West and Great Basin States. Bruce Munda, Tucson Plant Materials Center; Mark Pater, Tucson Plant Materials Center; Rick Orr, Caliente Field Office.

   The identified needs for this project include: (1) Improved and enhanced basic biological information on plants having rangeland applications, and (2) Development of improved plant materials for special rangeland applications. Proposed actions include: (a) continue to work with Caliente FO and BLM to conduct seeding and plant succession studies on burned watersheds with the objective to control Pinyon and Juniper and replace them with an adapted mixture of grasses, forbs and shrubs for watershed improvement, livestock forage, and wildlife habitat improvement.

PUBLICATIONS AND PAPERS

Mineland Revegetation Trials, 1995-1999 Final Report. Mark Pater, USDA-NRCS Tucson Plant Materials Center; Bernard Siquieros, Cyprus Tohono Corporation; Bruce Munda, USDA-NRCS Tucson Plant Materials Center; Harry Buck, USDA-NRCS Tucson Plant Materials Center.

Saguaro Cactus – Cultural Significance and Propagation Techniques in the Sonoran Desert. *In:* Native Plants Journal, Fall 2000 issue. Mark Pater, USDA-NRCS Tucson Plant Materials Center; Bernard Siquieros, Cyprus Tohono Corporation.

CALIFORNIA

UNIVERSITY OF CALIFORNIA

2001/2002 WCC-21 PROGRESS REPORT

Prepared by

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INTRODUCTION

This report summarizes restoration research in the Department of Botany and Plant Sciences, the Department of Entomology, the Department of Environmental Sciences, and the Center for Conservation Biology, University of California, Riverside; and the USDA Forest Fire Laboratory, Riverside. The research is/was funded by the Metropolitan Water District of California, The National Science Foundation, and the U.S.D.A. Forest/Range/Crop/Aquatic Ecosystems Research Program, and the Environmental Protection Agency. Experiments are being carried out primarily in parks and conservation reserves in vegetation types that are threatened by development. This includes especially coastal sage scrub vegetation, oak savannas, and Mojave desert areas. These vegetation types are being lost to urbanization and contain many threatened, endangered, and sensitive plant and animal species, and are the subject of many restoration and mitigation studies.

COMPLETED PROJECT

Seed Certification Program for Restoration in Southern California (Arlee Montalvo, Department of Botany and Plant Sciences, University of California Riverside).

We have completed a native seed certification program for the state of California. The program was initiated in conjunction with the MWD Diamond Valley Lake Reservoir landscaping and restoration project to assure quality control of seed collection and knowledge of site of seed collection. The program is voluntary, but seed buyers may request certified native seed of participating seed vendors.

ONGOING PROJECTS

Exotic weed control at the Shipley Ranch Reserve (E.B. Allen, M.F. Allen, UC Riverside, and Douglas Deutschman, San Diego State University); Animal use of restored vegetation at the Shipley Ranch (R. Redak, E. Konno, M.F. Allen, UC Riverside; Allison Anderson, San Diego Zoo)

The Shipley Ranch Reserve is a habitat mitigation reserve that was purchased by the MWD in return for the land being flooded at the Diamond Valley Lake Reservoir. It was historically grazed, but the cattle were removed in about 1990 and the vegetation has been recovering since. However, a large fire in 1993 burned much of the ranch, and native species recovery has been slow. Large areas are dominated by exotic annual grasses that were once native shrub- and forbland. Our objectives are to reduce the grass cover to allow native species to recolonize. We are using three methods, a grass specific herbicide, sheep grazing, and dethatching of grass litter to promote native species germination. The sheep have grazed in 1 ha plots for 24-48 hours in spring 1999, 2000, and 2001 using moveable electric fence. The herbicide Fusilade has been applied to one ha plots during the 1999 and 2000 spring seasons. Dethatching was done during October-November 1999 prior to the winter rainy and spring growing season. The dethatching treatment allowed the recolonization of many annual plants, including many exotics. The density of endangered Stephen's kangaroo rat quadrupled in the dethatched plots, indicating its preference for low-statured and sparse vegetation, compared to the surrounding denser grassland. Native insects had reduced cover after grazing but not in the other treatments. However, the insects recovered in the grazed plots in the next rainy season following grazing. Both grazing and Fusillade/dethatching decreased the abundance of exotic annual grasses as hoped, but grazing also decreased the native forbs. We had hoped to assess the recovery response of native forbs in spring 2002, but this was the driest year on record (only 10 cm precipitation in an area that averages 28 cm). There was very little germination of native annual forbs. Thus this project is ongoing, and we hope to assess the recovery of native forbs in spring 2003.

NEW PROJECT

Nitrogen Deposition Impacts on Coastal Sage Scrub and Mixed Coniferous Forest (T. Meixner, E.B. Allen, UC Riverside; M.E. Fenn, USFS).

Up to 50 kg/ha/yr of N is deposited on the natural vegetation of California, primarily nitrate originating from automobile emissions. The impact of N deposition is different on different vegetation types, depending upon their rate of productivity, rate at which N accumulates or flushes through the system, and amount of N deposition. This study will compare the impacts on native plants and ecosystem dynamics in two major vegetation types, coastal sage scrub and mixed coniferous forest. A hydrologic approach is employed to determine the potential for N movement out of these systems. We hypothesize that CSS will retain N in the soils longer than forest, even if air pollution regulations were to mandate reduced N emissions. Thus the potential for restoration of

N-impacted soils will be diminished in CSS, and this vegetation is currently experiencing high rates of invasion by exotic annual grasses coupled with a decrease in native shrub cover. In addition to changes in vegetation, the soil microorganisms are undergoing change, with losses in diversity and density of mycorrhizal fungi.

PUBLICATIONS (since last report submitted 2000)

Padgett, P.E., S.N. Kee and E.B. Allen. 2000. The effects of irrigation on revegetation of semiarid coastal sage scrub in southern California. Environmental Management 26:427-435.

Padgett, P.E., L. Vasquez and E.B. Allen. 2000. Seed viability and germination behavior of the desert shrub *Encelia farinosa* Torrey and A. Gray (Compositae). Madroño 46:126-133.

Yoshida, L.C. and E.B. Allen. 2001. Response to ammonium and nitrate by a mycorrhizal annual invasive grass and a native shrub in southern California. American Journal of Botany 88:1430-1436.

Egerton-Warburton, L., E.B. Allen and M.F. Allen. 2001. Mycorrhizal fungal communities: their organization, role and conservation in ecosystems under elevated atmospheric CO^2 and anthropogenic nitrogen deposition. In K. Sivasithamparam and K.W. Dixon, eds. Kluwer Academic Press, The Netherlands.

Allen, M.F., J. Lansing, and E.B. Allen. 2001. The role of mycorrhizal fungi in the composition and dynamics of plant communities: A scaling issue. Progress in Botany 63:344-367.

Egerton-Warburton, L., R.C. Graham, E.B. Allen, and M.F. Allen. 2001. Reconstruction of historical changes in mycorrhizal fungal communities under anthropogenic nitrogen deposition. The Royal Society of London Proceedings B: Biological Sciences 1484: 2479-2848.

Cione, N.C., P.E. Padgett, and E.B. Allen. 2002. Restoration of a native shrubland impacted by exotic grasses, frequent fire and nitrogen deposition in southern California. Restoration Ecology 10:376-384.

Meixner, T., E.B. Allen, K. Tonnessen, M. Fenn, and M. Poth. 2002. Atmospheric nitrogen deposition: Implications for managers of western U.S. parks. Park Science 21:30-33.

Burger, J.C., R.A. Redak, E.B. Allen, J.T. Rotenberry, and M.F. Allen. Restoring arthropod diversity in coastal sage scrub. Conservation Biology, in press.

Allen, E.B., A. G. Sirulnik, L. Egerton-Warburton, S. N. Kee, A. Bytnerowicz, P. E. Padgett, P. J. Temple, M. E. Fenn, M. A. Poth and T. Meixner. 2002. In B.E. Kus and J. L. Beyers, editors. Air Pollution and Vegetation Change in Southern California Shrublands. Planning for Biodiversity in Southern California: Bringing Research and

Management Together: Proceedings of the Symposium, Feb. 29-Mar. 3, 2000, Pomona. USDA Forest Service Pacific Southwest Research Station, Riverside, California. In press.

IN PRESS AT LAST REPORT

Allen, E.B., J.S. Brown, and M.F. Allen. 2001. Restoration of plant, animal and microbial diversity. Pages 185-202 in: S. Levin, editor. Encyclopedia of Biodiversity, Vol. 5. Academic Press, San Diego.

Montalvo, A.M., P.A. McMillan, and E.B. Allen. 2002. The relative importance of seeding method, soil ripping and soil variables on seeding success. Restoration Ecology 10: 52-67.

COLORADO

COLORADO STATE UNIVERSITY

WCC-21 PROGRESS REPORT

MARCH 2001 to JULY 2002

Prepared by

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INTRODUCTION

This report summarizes reclamation and restoration research projects at Colorado State University for the period March 2001 through July 2002. Reclamation research has been conducted by the Rangeland Ecosystem Science and Soil and Crop Science Departments and the Center for Ecological Management of Military Lands (CEMML) with funding from the Colorado Agricultural Experiment Station, USDA, EPA, U.S. Army, and the Colorado Department of Public Health and Environment.

COMPLETED RESEARCH

None

ONGOING RESEARCH

1. Reclamation at the Summitville Super Fund Site (Edward Redente and Mark Paschke, Rangeland Ecosystem Science Department)

   This project began in the fall of 1995 and involves a greenhouse phase and a field phase. The objective of the project is to test reclamation alternatives for stabilizing acid generating waste rock material at an elevation of 11,000 feet.

2. Effects of Biosolids Application on Erosion Control and Ecosystem Recovery Following the Buffalo Creek Fire, Colorado (Ken Barbarick and Edward Redente, Soil and Crop Science and Rangeland Ecosystem Science Departments)

   This project was begun in the spring of 1997 and the objective is to determine appropriate organic matter and nutrient inputs from biosolids to facilitate post-burn ecosystem recovery in a forested system southwest of Denver.

3. Metal Toxicity Thresholds for Important Reclamation Species in the Western U.S. (Edward Redente, Mark Paschke, and Ken Barbarick, Rangeland Ecosystem Science and Soil and Crop Sciences Departments)

   This project began in June 1999. The objective is to establish heavy metal toxicity thresholds for approximately 35 plant species that are commonly used in reclamation work in western North America. The project involves large greenhouse screening studies and will eventually establish toxicity thresholds for a variety of grasses, forbs and shrubs for As, Cd, Cu, Mn, Pb, and Zn.

4. Integrated Control and Assessment of Knapweed and Cheatgrass on Department of Defense Installations (Mark Paschke and Edward Redente, Rangeland Ecosystem Science Department; Don Klein, Microbiology Department; Steve Warren, Center for Ecological Management of Military Lands; Northern Plains Agricultural Research Laboratory—USDA-ARS in Sidney, MT; Department of Energy Remote Sensing Laboratory, Las Vegas, NV)

   This project began in April 2000 and will extend for four years. The objective is to develop a strategy for the control, monitoring, and prediction of knapweed and cheatgrass infestations at Fort Carson in Colorado and Yakima Training Center in Washington.

5. Diffuse Knapweed Invasion Ecology: Establishment, Competition, and Interactions with the Native Soil Community (Paul Meiman, Edward Redente, Mark Paschke, Rangeland Ecosystem Science Department; George Beck, Bioagricultural Sciences and Pest Management Department; and Don Klein, Microbiology Department)

   This project began in 2001 and will continue for three years. The objective is to evaluate conditions under which rangeland systems either resist or are susceptible to diffuse knapweed invasion.

6. Shrub Establishment Techniques of Coal Mine Lands in Colorado (Edward Redente and Mark Paschke, Rangeland Ecosystem Science Department)

   This project began in September 2000 and will extend for four years. The objective is to develop methods for the establishment of woody plants on coal mine disturbances in northwest Colorado. Three mines sites are included in the study and methods include strip seeding, transplanting, testing seed mixtures with relatively low-competitive grasses and forbs, soil depth, soil quality, and fencing to exclude deer and elk.

7. Evaluation of the Long-Term Effects of Biosolids on Revegetation in Northwestern Colorado (Mark Paschke and Edward Redente, Rangeland Ecosystem Science Department)

   The purpose of this study is to evaluate the long-term (20 years) effects of biosolids application on plant community development and the residual effects of biosolids application on soil fertility. This is a follow-up study of a revegetation project that compared organic and inorganic N inputs in 1977.

8. Soil Erosion Survey for Fort McCoy, Wisconsin (Steve Warren, Tom Ruzycki and Paul Block, CEMML)

   This project began in 2000 and is designed to use new-generation soil erosion modeling technology to determine the current erosion status of Fort McCoy and identify those areas currently in need of land reclamation efforts to curb excessive erosion.

9. Diagnostic Tools and Reclamation Technologies for Mitigating Impacts of DoD/DOE Activities in Arid Areas (Kent Ostler, Dennis Hansen, Daid Anderson, Steve Warren, Christopher Lee, Gene Capelle, Ruth Sparks and Mickey Quillman, Bechtel Nevada, CEMML, California State University at Dominquez Hills, Charis Corporation and Fort Irwin)

   This project began in 1998 and seeks to identify and develop cost-effective land reclamation products and technologies that can be applied to highly disturbed lands in arid areas.

10. Pilot Production and Arid Land Reclamation Using Cyanobacterial Inoculant to Establish Biological Soil Crusts (Dan Hartman, Jeffrey Johansen, Steve Warren, Mike Riley and Todd Hawkins, Engineering Technology Inc., John Carroll University, CEMML, Midwest Industrial)

    This project was initiated in 1999 and seeks to develop a cyanobacterial inoculant for use in land reclamation prescriptions on arid lands.

11. Soil Erosion Surveys of Sheridan Local Training Area (Steve Warren, CEMML)

    Beginning in 2002, this new study uses new-generation soil erosion modeling technology to determine the current erosion status of the Sheridan local training area (Wyoming Army National Guard) and identify those areas currently in need of land reclamation efforts to curb excessive erosion.

12. Wind Erosion Testing and Validation for Microphytic Inoculants (Steve Warren, CEMML)

    This study began in 1999. It evaluates changes in the erodibility of surface soils as a result of inoculation with cyanobacteria.

13. Biological Soil Crust Studies at the Nevada Test Site (Steve Warren and Paul Kugrens, Colorado State University)

    This project began in 2002 for the purpose of culturing endemic cyanobacteria and green algae for stabilization of soil caps on low-level radioactive repository sites at the Nevada Test Site.

PLANNED OR POTENTIAL PROJECTS

1. Development of an Erosion Control Master Plan (ECMP) for the Combat Maneuver Training Center (CMTC), Hohenfels, Germany.
2. An evaluation of the short-term and long-term successional dynamics of biological soil crusts following wildfire. This knowledge will assist in determining the feasibility and possible strategies to accelerate the recovery of biological soil crusts in disturbed communities.

CURRENT PUBLICATIONS AND PAPERS

Grantham, W. P., E. F. Redente, C. F. Bagley, and M. W. Paschke. 2001. Tracked vehicle impacts to vegetation structure and wind erodability of soils. J. Range Manage. 54:711-716.

Ippolito, J. A. 2001. Phosphorus adsorption/desorption of water treatment residuals and biosolids co-application effects. Ph.D. Dissertation. Colorado State University. Fort Collins, CO.

Ippolito, J. A., K. A. Barbarick, and E. F. Redente. Combinations of water treatment residuals and biosolids affect two range grasses. Communications in Soil Science and Plant Analysis 33:831-844.

Meyer, V. A., E. F. Redente, K. A. Barbarick, and B. Brobst. 2001. Biosolids applications affect runoff water quality following forest fire. J. Environmental Quality 30:1528-1532.

Newman, G. J. And E. F. Redente. 2001. Long-term plant community development as influenced by revegetation techniques. J. Range Manage. 54:717-724.

Redente, E. F., H. Zadeh, and M. Paschke. 2002. Phytotoxicity of smelter-impacted soils in southwest Montana, USA. Environmental Toxicology and Chemistry 21:269-274.

Warren, S.D. 2001. Biological soil crusts and hydrology in North American deserts. Pages 329-339. *In*: J. Belnap and O.L. Lange (eds), Biological Soil Crusts: Structure, Function, and Management. Springer-Verlag, Berlin

Warren, S.D. 2001. Synopsis: influence of biological soil crusts on arid land hydrology and soil stability. Pages 351-362. *In*: J. Belnap and O.L. Lange (eds), Biological Soil Crusts: Structure, Function, and Management. Springer-Verlag, Berlin

Warren, S.D. and D.J. Eldridge. 2001. Biological soil crusts and livestock in arid ecosystems: are they compatible? Pages 403-417. *In*: J. Belnap and O.L. Lange (eds), Biological Soil Crusts: Structure, Function, and Management. Springer-Verlag, Berlin

Zadeh, H. 2001. Successional patterns and rates of recovery of disturbed sites in Rocky Mountain National Park, Colorado. M.S. Thesis. Colorado State University, Fort Collins, CO.

COLORADO

UNIVERSITY OF DENVER

WCC-21 PROGRESS REPORT FOR 2001

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INTRODUCTION

This report summarizes the reclamation-related research conducted by Dr. Terrence Toy during the period November 2000 – March 31, 2002. During this time my research was divided between: (1) completion of the Soil Erosion textbook with George Foster and Kenneth Renard, (2) preparation of publications based upon research during my sabbatical to Brazil, and (3) participation in the development of the RUSLE 2.0 soil-loss estimation model.

COMPLETED RESEARCH

A new soil erosion textbook, entitled Soil Erosion: Processes, Prediction, Measurement, and Control, and co-authored by Terrence J. Toy, George R. Foster, and Kenneth G. Renard, was completed during the Winter of 2002 and is due to be published by John Wiley and Sons in late May, 2002. This textbook will fill a significant gap in the erosion literature.

Two additional articles were completed based on the information obtained during the sabbatical in Autumn, 1999 and in collaboration with Dr. James Jackson Griffith at the Federal University of Vicosa, Minas Gerais, Brazil. These articles are references in a subsequent section of this report.

ON-GOING RESEARCH

I am working with Dr. Daniel Yoder and Dr. George Foster on the development of the second version of the Revised Universal Soil loss Equation (RUSLE). Preliminary

versions of the software and manual has been released; final versions should be available in Autumn, 2002. My role in this project is to represent the users who are primarily engaged in the reclamation of severely disturbed lands, both mine lands and construction lands. The team is trying to make this erosion-prediction technology both technologically sophisticated and user-friendly.

This year I also continued research concerning the use of automated drafting and map-analyses software for topographic reconstruction of severely disturbed lands. The geomorphic characteristics of pre-mining landscapes, post-mining landscapes designed on the basis of geomorphic principles, and post-mining landscapes designed based on engineering practices will be compared. The purpose of this research is to examine the feasibility of reconstructing post-mining landscapes that include a strong measure of geomorphic integrity and more closely approximate “equilibrium” landscapes than those landscapes generated by current engineering practices.

I am continuing work with Dr. Waite Osterkamp of the U.S. Geological Survey on a project only tangentially related to reclamation, focusing upon tree-throw (blow-down) as a sediment-mobilizing process and sediment source in high-altitude forests. It is expected that this research will contribute to the understanding of sediment mass-balances in forests.

PLANNED OR POTENTIAL PROJECTS

The second phase of the research concerning experimental calibration of the equations to include three-dimensional hillslope morphology in erosion-prediction models still awaits funding. This could be the year! Nevertheless, at least on journal article may be forthcoming from the earlier report.

Otherwise the on-going projects listed above will fill the plate

CURRENT PUBLICATION AND PAPERS

A. Presentations

Foster, G.R. Yoder, D.C., Weesies, G.A., and Toy, T.J., The design philosophy behind RUSLE2: Evolution of an Empirical model. Presented at Soil Erosion Research for the 21st Century International Symposium, Jan, 2001 Honolulu, HI

Toy, T.J. and Griffith. J.J., 2001, Reclamation Revisited: Minas Gerais, Brazil, presented at the National Meeting of the American Society for Surface Mining and Reclamation, June, 2001.

Toy, T.J., Topographic Reconstruction of Mining Sites – Land Stabilization and Erosion Control, presented at the New Frontiers in Reclamation, Milos Conference, Milos, Greece, Sept, 2001.

B. Publications

Foster, G.R. Yoder, D.C., Weesies, G.A., and Toy, T.J. The design philosophy behind RUSLE2: Evolution of an empirical model. In: J.C.

Ascough II and D.C. Flanagan, (eds). Soil Erosion Research for the 21st Century International Symposium, Jan, 2001 Honolulu, HI. pp. 95-98.

Foster, G.R. Yoder, D.C. McCool, D.K., Weesies, G.A., Toy, T.J., and Wagner, L.E., 2000, Improvements in Science in RUSLE2. American Society of Agricultural Engineers, Paper No., 002147. (paper distributed at meeting).

Toy, T.J. and Griffith, J.J. 2001, Reclamation Revisited: Minas Gerais, Brazil, Proceedings of the National meeting of the American Society for SurfaceMining and Reclamation.

Toy, T.J., (in press) Topographic Reconstruction of Mining Sites – Land Stabilization and Erosion Control, Proceeding of the New Frontiers in Reclamation, Milos Conference.

Toy, T.J., Foster, G.R., Renard, K.G., (in press) Soil Erosion: Processes, Prediction, Measurement, and control, John Wiley and Sons, New York, NY.

IDAHO

Northwest Watershed Research Center

USDA, Agricultural Research Service

2002 WCC-21 Progress Report

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INTRODUCTION

This report summarizes revegetation and restoration research conducted at the USDA-ARS Northwest Watershed Research Center in Boise, Idaho for the period of May 1, 2001 through July 31, 2002. The focus of the NWRC revegetation/disturbed land program is to characterize establishment requirements of native grass and shrub species and to optimize restoration strategies for disturbed rangeland in the Great Basin region of the western United States.

ONGOING RESEARCH

1. *NEXRAD Meteorology for Distributing Precipitation Estimates*

   NWRC has completed evaluation of National Weather Service WSR-88D Next Generation Radar (NEXRAD) stage 1, Leval 3 radar products for the Boise radar location. This radar system produces hourly precipitation estimates on a 4 x 4 km grid across the continental US. We determined that the current algorithm for converting radar reflectivity to rainfall underestimates total rainfall by about 80%. This is primarily due to a precipitation detection function that is set too high to detect the bulk of low intensity rainfall events in the semi-arid rainfall zone. NWRC is currently evaluating these radar products at 8 other ARS watershed locations. NWRC is also pursuing an MOU with the NWS to modify the current radar algorithm to optimize detection of precipitation events in low-rainfall rangelands in the western United States.*New Modeling Approaches for Hydrothermal Germination Response.*

   Hydrothermal-germination-response models are used to evaluate potential seedlot response to temperature and water stress. Previous hydrothermal-models have only been used to develop model coefficients for ranking relative germination response.

These probit and regression models are optimized for gross comparison of seedlots and not for prediction of actual germination response under variable conditions of temperature and moisture in the field. NWRC is developing a geostatistical model for estimating instantaneous germination rate as a function of temperature and water potential. This model will be optimized for predicting potential field performance. NWRC is comparing this type of model with probit and regression models to document the improvement in prediction of actual seedlot response in the field.

COMPLETED RESEARCH

1. *Seedbed Microclimate Modeling*

   NWRC scientists, Gerald Flerchinger and Stuart Hardegree used the Simultaneous Heat and Water Model (SHAW) to estimate seedbed temperature and water content at the Orchard Field Test Site for every hour of the period October 1962 - September, 1999. A hydrothermal germination response model was developed for 6 seedlots of 3 species (cheatgrass, bluebunch wheatgrass and bottlebrush squirreltial) to predict germination under simulated planting conditions for every day of the 37-year test period. New germination indices were developed to quantify relative seedlot response taking into account simulated probabilities of seedbed temperature and moisture. These indices add an ecological perspective to relative germinability in a way that cannot be addressed by traditional laboratory tests under arbitrary treatment conditions.

PLANNED OR POTENTIAL PROJECTS

1. *Evaluation of Prescribed-Fire Impacts on Vegetation, Soil and Water Resources*

   NWRC has initiated a new research program to investigate landscape-scale prescribed-fire impacts at the Reynolds Creek Experimental Watershed. Prescribed fires are planned at the watershed for 2002, 2004, 2005 and 2007. Issues of concern are prescribed-fire impacts on invasive annual and woody species; fire impacts on runoff, infiltration and erosion; post-fire animal utilization; and streamflow and water quality impacts.

CURRENT PUBLICATIONS AND PAPERS

Hardegree, S.P., T.A. Jones and S.S. Van Vactor. 2002. Variability in thermal response of primed and non-primed seeds of squirreltail [*Elymus elymoides* (Raf.) Swezey and *Elymus multisetus* (J.G. Smith) M.E. Jones]. Annals of Botany 89:311-319.

Flerchinger, G.N. and S.P. Hardegree. The post-wildfire seedbed: modeling near-surface temperature and moisture with the SHAW model. Ecological Modeling (submitted).

Hardegree, S.P., S.V. Van Vactor, D.H. Levinson, K.R. Healy and C.L. Hanson. 2001. Accessibility and utilization of WSR-88D radar precipitation data for natural resource modeling applications. In: Abstracts of the American Geophysical Union 2001 Fall Meeting, San Francisco, CA, Dec 10-14, 2001.

Hardegree, S.P., T.A. Jones and S.S. Van Vactor. 2001. Intraspecific variability in thermal response of primed and nonprimed seeds of bottlebrush squirreltail. In: Abstracts of the 55th Annual Meeting, Society for Range Management, Kansas City, MO, Feb 15-18, 2002.

IDAHO

PLANT MATERIALS PLANTINGS

WCC-21 PROGRESS REPORT

FIELD, DSI and DEMONSTRATION PLANTINGS

Compiled by

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IDAHO DIVISION I

FIELD OFFICE: BONNERS FERRY

ID99005 Paul Headings Regar meadow brome - Field Plantings (2). Materials ordered February 22, 1999.

Field 1–pure stand of Regar. Field 2-mixed stand of Regar and alfalfa. Purpose – demonstration planting to document growth patterns, production, and forage quality. Site characteristics – MLRA E43b, silt loam soils, 5-10% slopes, north aspect, 2300 feet elevation, 24-inch precipitation zone, non-irrigated, T62N R1E NW1/4 Section 2. FY99 planted spring 1999. FY00 due to dry years 1999 and 2000 stand establishment was slow, but excellent stands in each field are establishing. Plantings average 3 tons per acre. FY01 Planting 1 - The “pure” stand of Regar Brome planting averaged 2 ton/acre. A forage analysis indicted the crude protein to be 8.75%. The forage grass for hay is fine leaves and stems. The hay feeds well to animals. In hot dry weather, the “windrows” have to be carefully harvested and cured to avoid damaging brittle leaves and stems. The crop can be “pulverized” easily. The average bale weight was 103 pounds. The owner applied 110 lbs. 40-0-0 to enhance production and will increase application rates up to 200 lbs./acre 40-0-0. There were no second cuttings since the field was planted three years ago due to poor to fair moisture conditions. Planting 2 - The Regar/Agate alfalfa mixture established well. The first cutting has grass present and makes great cattle feed. The second cutting has very little grass within the alfalfa due to slow recovery. This may be due to dry weather conditions. Also, this may be a good attribute for the producer who can sell hay with grass and no grass.

ID99015 Merle Olsen Field Planting—Regar meadow brome/alfalfa. Materials ordered April 9,1999. Site characteristics—Rubson silt loam soil, 5% slopes, south aspect, 1840 feet elevation, 24-inch precipitation zone, non-irrigated, T61N R1E Section 7. FY99 no evaluation. FY00 excellent mixed stand established. FY01 the Regar and alfalfa mixture performed well with good hay quality. This year's crop had reduced yields due to drought conditions.

ID00008 SCD Field Planting —Sherman big bluegrass. Materials ordered February 23, 2000. FY00 not planted this spring due to dry conditions. Cooperator plans to plant half of fields as dormant fall seeding the fall of 2000 and the other half as early spring seeding in 2001. FY01 the planting failed due to drought conditions - **cancel**.

ID00016 Boundary Creek WRP—cropland area planted to permanent perennial species field planting. A mix of Alkar tall wheatgrass, Greenar intermediate wheatgrass, Ranger alfalfa, birdsfoot trefoil, red clover, Sherman big bluegrass, tufted hairgrass, orchardgrass, and timothy at critical area planting rates was dormant planted on 1000 acres in late fall 1999. A 42 feet air-seeder with fertilizer attachment planted mix with 2000 units per acre of nitrogen, phosphorus, potassium, and sulfur applied 1 inch below and to side of seed. FY00 An excellent stand is establishing with some species as tall as 3-4 feet by early July. In October wild oats were present throughout stand. FY01 The permanent wildlife planting mixture established well utilizing the 42-foot air seeder. The drill was calibrated with the producer based upon 14.2 lbs. PLS/acre. A "flush" of wild oats occurred the first year. The stand was seeded the 1st week of November 1999. The "so called dormant planting" resulted in some sprouting of clovers due to a warmer than normal late fall. As a result, some mortality occurred in the clovers. An excellent stand of Alkar tall wheatgrass, Greenar intermediate wheatgrass, birdsfoot trefoil, Ranger alfalfa, Latar orchardgrass, timothy and clover exists. The Sherman big bluegrass is "spotty" due to becoming overpowered by the other species in the mix. There are some ridges in the field with quackgrass, which is good cover. The IDF&G is actively spot spraying the Canadian thistle. They plan to obtain a boom sprayer in order to treat the acreage more uniformly.

FIELD OFFICE: COUER D'ALENE

ID87004 Farragut State Park Multiple Weed Control FY91 Durar sheep fescue is the dominant plant. Hard fescue is present in only one plot. The chemical treatments appear about the same with spotted knapweed in all plots. Tansy mustard has not invaded plots. FY93 From trip report, the most effective herbicide rate was 0.5 lbs/ac Picloram. Durar, Manchar, Rubens, Tegmar, Covar, Paiute and Drummond were competing the best with spotted knapweed. On nearby native site Idaho fescue was doing very well competing with spotted knapweed when sprayed with 0.5 Lbs/ac Picloram and then fertilized. **This trial was canceled - keep this report active with no evaluations.**

FIELD OFFICE: PLUMMER

None

FIELD OFFICE: SANDPOINT

ID96029 Lee Johnson wood fiber mulch, Niner sideoats grama, Alma blue grama, annual rye, Durar hard fescue, Durar hard fescue/clover, prairie junegrass, and alpine bluegrass field plantings—tree nursery ground cover trial. Site loam soil (low to mod. permeability/high erosion potential), 5-10% slopes on SE exposure. FY96 planted 5/31/96. (1). Wood mulch is doing excellent job of weed control and no rodent activity to date - mulch was about 10 inches deep when applied. (2). Excellent stand of annual rye established, Durar hard fescue plants are very small and establishing beneath cover crop. (3). Many young Durar hard fescue plants were establishing, but very few clover plants—soil may have been too loose when seeded and clover seed may be too deep. (4). Excellent initial stand of sideoats and blue grama establishing - could not tell which species was doing the best. (5). Very few prairie junegrass plants establishing—appears some germination is occurring this fall. (6). A lot of alpine bluegrass seedlings—appears germination did not occur until fall. FY97 and FY98 no evaluations. FY99 Treatment 1: Control no cover and normal weed control—0% desirable cover with 50-80 weeds. Treatment 2: Cedar bark mulch 6-8 inches thick—100% desirable cover in rows with 5% weeds invading mulch and some evidence of rodents in mulch. Trees near cedar mulch are more chlorotic than other treatments. Treatment 3: Durar hard fescue and annual ryegrass—50-70% desirable cover with up to 20% weeds. Fescue blends provide more biomass than other seedings and good cover—almost 100% cover if mowed. Treatment 4: Durar hard fescue and Berseem annual clover—60-80% desirable cover and up to 15% weeds. Treatment 5: blue grama and sideoats grama – 20-50% desirable cover with 30-80% weeds. Clearly the worst treatment in trial. Treatment 6: Prairie junegrass—60-80% desirable cover and 10-15% weeds. A good alternative since this is a low growing cover. Treatment 7: Alpine bluegrass—50-80% cover with 5-10% weeds. Less biomass produced than fescue or prairie junegrass. The alpine bluegrass produced more of a thick sod with seedheads 6-8 inches tall. This would be a better choice for nurseries that are concerned with the shading effect of taller grasses on lower branches. It also covers the ground better once established, especially in shady areas. One potential problem is its ability to spread, including into the tree rows. FY00 and FY01 no evaluations.

ID00004 Paul Jayo Regar meadow brome field planting – irrigated/non-irrigated and hay/grazing trial. Seed ordered January 21, 2000 for delivery in early April. Site is 30-acre field with Hoodoo silt loam soil, 0-1% slopes, 32-inch rainfall zone, and 2485 feet elevation. FY00 planting was delayed due to dry spring weather. Cooperator plans to plant fall 2000. FY01 no evaluation.

IDAHO DIVISION II

FIELD OFFICE: GRANGEVILLE

ID01009 Cooperator Unknown Riparian Forest Buffer Field Planting. Serviceberry – Kendrick accession, Serviceberry—Okanogan accession, and Blanchard blue elderberry. Plants ordered May 3, 2001. FY01 no evaluation.

ID02002 Teresa Selaske Forest Field Planting. Lind Douglas fir (50 plants) and Yakima Douglas fir (13 planting) ordered July 16, 2001. Planting scheduled for March-April 2002.

ID02003 Dan Raduckovich Forest Field Planting. Lind Douglas fir (50 plants) and Yakima Douglas fir (12 planting) ordered July 16, 2001. Planting scheduled for March-April 2002.

FIELD OFFICE: LEWISTON

ID82001 Galin Buchanon Starthistle control field planting. Covar sheep fescue planted in early 1980's. FY01 good to excellent stand with 2 plants per foot squared average, excellent vigor, fair spread for bunch grass. Plants are 10 inches tall with seedheads averaging 14 inches tall and 6 inch diameter plants. Overall Covar is providing good starthistle control. Starthistle is present in plot, but not reproducing seed. Where Covar has 4 plants per foot squared, starthistle is not present. Covar is moving slowly downslope into starthistle dominated area. **Next field evaluation will be FY04.**

ID86007 Hellsgate field planting - adaptation. FY92 Rush 50%, Oahe 70%, Luna 60%, Ephraim 20%, Magnar 30%, Secar 10%, Alkar 70% and P27 50% survival. FY93 in very heavy cheatgrass infested area Nordan 10% Rush 40%, Oahe 20%, Luna 24%, Rosana 30%, Magnar 15%, Secar 20% and P27 10% survival. Rush and Luna appear to be the best species. FY94 Rush int. wheatgrass is the most vigorous followed closely by Luna pubescent wheatgrass. Magnar plants are the largest. Rodents have utilized all Secar plants and a few plants of Ephraim, Nordan, P-27, Sherman, and Rosana. The accessions that have failed include Goldar, Paiute, Delar, Appar, Bandera, Nezpar and Tualatin. Cheatgrass continues to dominate site. FY95 50% survival of Rush and Rosana; 30% survival Oahe, Luna, Magnar; 20% survival Secar; 10% survival Ephraim, P27 and Sherman. Failed species include Tualatin, Nezpar, Bandera, Appar, Durar, Delar, Paiute, and T2950-Goldar. Intermediate types are doing the best. Rush and Rosana have spread the most. Alkar has extensive die-out. Cheatgrass continues to dominate site. FY96, and FY97 no evaluations. FY98 survival/comments: Oahe 50% erratic 10-12 feet spread in some areas to dead in others; Magnar 70% some seedlings and plants are very vigorous with few weeds between plants; Rush 75% spreading vegetatively 12-14 feet wide and uniform; Rosana 60% spreading vegetatively 20-30 feet wide and spotty with many weeds; Luna 70% spreading vegetatively up to 12 feet wide and a few bare areas; and Secar 10% widely scattered plants with good vigor. 1 to

3 plants of Nordan, Ephraim, and P-27 found. All other plots are dead. FY99 through FY01 no evaluations.

ID95018 Lewiston Veterans Home willow planting. Cuttings ordered 2/95. FY95 Aberdeen willows: White willow-good vigor/slight insect damage; Laurel willow good vigor/slight insect damage; Geyer willow fair vigor/moderate insect damage; Meeker willows: 825 booth willow poor vigor/leafed out only 20% of length, 826 booth willow poor vigor/leafed out only 30% of length, 835 yellow willow good vigor/moderate insect damage, 767 subalpine willow poor vigor/top growth died sprouting from base, 833 whiplash willow fair vigor, 834 yellow willow fair vigor/sprouting at base, 836 Scouler willow fair vigor/slight insect damage. 822, 827, 819, 820, 766, 837, 848 all died. FY96 100% survival for Laurel 3/3, 836 SASC 1/1, 834 SALU 1/1, 833 SALA 1/1, 835 SALU 1/1, SAAL White 1/1. FY97 no evaluations. FY98 100% survival Laurel, White, 836, 834, 833, Geyer, 835. Laurel has best color, height, and least insect damage. FY99 and FY00 no evaluation. FY01 Laurel willow has stripped bark and is sprouting from base. Whiplash willows are dead. White and Coyote willows are doing well and are spreading. Recommend this planting be **canceled**.

ID95028 Dau Bannock thickspike wheatgrass and Rush intermediate wheatgrass field planting. Seed ordered 4/3/95. FY95, FY96, FY97, FY98 and FY99 no evaluations. FY00 40 plants per foot squared of Rush intermediate wheatgrass. Bannock thickspike wheatgrass failed. FY01 40 seedheads per foot squared, 4.5 feet tall, 3000 pounds per acre, estimate 500 pounds per acre seed production and stand is weed free. **Next field evaluation will be FY04.**

ID96009 Dau Rush intermediate wheatgrass, Luna pubescent wheatgrass, and Bozoisky Russian wildrye field planting (3 individual plantings) for star thistle control. Seed ordered 12/8/95. FY96, FY97, FY98 and FY99 no evaluations. FY00 excellent stand with 40 reproductive stems per square foot. Excellent vigor, ability to spread, erosion control, and forage production producing 3000 pounds per acre. Producer is very pleased with performance and plans to establish additional plantings. FY01 no evaluation. **Next field evaluation will be FY04.**

ID98007A Mike Miller willow planting. Aberdeen willows (Laurel, White, Streamco, Coyote, Geyer) and Meeker willows (Coyote, Yellow 3 accessions, Scouler, Whiplash 2 accessions, Booth 3 accessions, Drummond 3 accessions, Geyer 2 accessions) and Pullman shrubs (Dogwood 3 accessions). Materials ordered 2/9/98. FY98 survival Meeker willows 832 10/10, 823 10/10, 820 9/10, 826 9/10, 826 9/10, 847 7/10, 834 7/10, 827 10/10, 835 6/10, 825 10/10, 828 7/10, 822 0/10, 829 5/10, 819 ?/10. Survival of Pullman dogwoods 740 3/5, 733 5/5, 739 5/5. FY99 no evaluation. FY00 80% survival of 820 Pacific willow (local standard). 20% survival of 827 Booth willow, 828 Drummond willow, 822 Geyer willow, 829 Drummond willow and 834 Yellow willow. 10% survival of 832 Geyer willow. 823 Coyote willow, 826 Booth willow, 847 Drummond willow, 825 Yellow willow, 819 Yellow willow, 739 dogwood, 733 dogwood, 740 dogwood, and 835 Yellow willow failed. Competition, insects and browse damage are factors affecting survival. FY01 survival 822 Geyer 10%, 828 Drummond failed, 825 Yellow 10%, 829 Drummond 10%, 820 Pacific 80% (all died back to base – sprouting

about 3 feet high this years growth), 823 Sandbar failed, 832 Geyer 20%, 826 Booth 10%, 847 Drummond failed, and 827 Booth 50%. **Next field evaluation will be FY03.**

ID98007B Ed and Maxine Larson willow and dogwood planting. FY99 and FY00 no evaluations. FY01 Superior accessions are Laurel willow, which is now 15-18 feet tall with good density and being utilized for cuttings to plant on other areas of the property; Sandbar willow 9024823, which is 4-5 feet tall, spreading and competing well with other vegetation. Accessions that failed include 9024825 Booth willow, 9024826 Booth willow, 9024827 Booth willow, Streambank willow, Aberdeen Geyer willow, Aberdeen Coyote willow, and 9023740 redosier dogwood.

ID98007C Modie Park willow planting. FY99 100% survival – Booths826, Booths827, and Pacific820; 70% survival sandbar823 and Dummond829; 60% survival dogwood; 33% survival Booth825; 30% survival Geyer822 and Drummond828; 20% survival Geyer832; 14% survival Dummond847; 10% survival yellow835; 0% survival-failed yellow819 and yellow834. Site is heavily overgrown with blackberries, cattails, rush and quackgrass. West side of creek was mowed resulting in severe willow damage. Most promising willows were yellow 9024835, sandbar 9024823, Drummond 9024829 and Booth 9024826/9024827. Geyer 9024832 has glaucous stems and undersides of leaves and may be Drummond. **Next field evaluation will be FY03.**

ID98007E Victor Thulon willow planting. Aberdeen willows (Laurel, White, Streamco, Coyote, Geyer) and Meeker willows (Coyote, Yellow 3 accessions, Scouler, Whiplash 2 accessions, Booth 3 accessions, Drummond 3 accessions, Geyer 2 accessions) and Pullman shrubs (Dogwood 3 accessions). Materials ordered 2/9/98. FY99 no evaluation. FY00 site is heavily infested with reed canarygrass. Meeker willows: 40% survival 827 Booth willow; 30% survival 835 Yellow willow and 834 Yellow willow; 20% survival 825 Booth willow; and 10% survival 832 Geyer willow and 822 Geyer willow. Aberdeen willows: 80% survival Laurel willow and White willow; 40% survival Streamco willow; and 30% survival Coyote willow. All other materials failed. FY01 Aberdeen willow survival Laurel 70% (best overall), White 70%, Streamco 30%, Coyote 30%. Meeker willow survival 835 Yellow 30%, 832 Geyer 10%, 825 Booth 10%, 827 Booth 40%, 822 Geyer 10%, and 834 Yellow 30%. **Next field evaluation will be FY03.**

ID98016 Fred Kaufman Hycrest crested wheatgrass, and Vavilov Siberian wheatgrass field planting. FY98 and FY99 no evaluations. FY00 excellent stands of Hycrest and Vavilov established. **Next field evaluation will be FY03.**

ID99008 Craig Mountain (IDFG) field planting. Species include white willow, Streamco willow, Coyote willow, Geyer willow 435, Geyer willow 448, Geyer willow 483, Geyer willow 491, Snowberry, Elderberry, Dogwood 733, and Dogwood 740. FY99 Area planted is heavily dominated by native sedges. Cuttings were planted 1.25 to 2 feet deep into good perennial moisture. Failure is probably due to severe competition. Streamco, Coyote, and White willows failed. 9067483 Geyer willow 80% survival with fair vigor. 9067448 Geyer willow 50% survival with poor vigor. 9067435 Geyer willow 100% survival with fair vigor. 9067491 Geyer willow 85% survival with poor vigor. 9023733 dogwood 5% survival with very poor vigor. 9023740 dogwood 5% survival with

fair to poor vigor. FY00 no evaluation. FY01 willow survival – 483 Geyer 50%, Streamco failed, 448 Geyer 55%, Coyote failed, 435 Geyer 85%, and 491 Geyer 60%. **Next field evaluation will be FY03.**

ID01005 Greg Zenner field planting. Three acres each of Topar pubescent wheatgrass, Tegmar intermediate wheatgrass, Rush intermediate wheatgrass, Regar meadow brome, and Manchar smooth brome. Purpose – starthistle competition trial. Site characteristics: MLRA B9, Kettenback-Gwin silt loam soil with stony modifier, south aspect, 1200 feet elevation, 16-18 inch rainfall, T36N R4W NE1/4 Section 12. Seed shipped March 2001. FY01 not seeded.

FIELD OFFICE: MOSCOW

None

FIELD OFFICE: NEZPERCE

None

FIELD OFFICE: OROFINO

ID99010 Cooperator Unknown field planting. Species include Coyote willow, Geyer 435 willow, Geyer 448 willow, Geyer 483 willow, Geyer 491 willow, Snowberry, Elderberry, Dogwood 733, Dogwood 740, and Chokecherry. FY99 and FY00 and FY01 no evaluations.

IDAHO DIVISION III

FIELD OFFICE: CALDWELL

ID98021 Bill Baird Vavilov Siberian wheatgrass, Bozoisky Russian wildrye, tall wheatgrass field planting - saline bottom. Seed ordered May 14, 1998. Planting scheduled for Nov. 1998. FY99 cooperator has not planted site due to droughty conditions and he wants to give seeding best opportunity possible when he plants. FY00 and FY01 no evaluations.

ID98022 Bill Baird Rush intermediate wheatgrass and orchardgrass field planting - irrigated pasture. Seed ordered May 14, 1998. Planting scheduled for mid May through mid June. FY98 irrigated pasture planted in mid May with poor stand establishing. Bill plans to replant in spring of 1999. FY99 good stand density establishing with 5 plants per foot squared and fair vigor. Plants reached 6-8 inch height this establishment year. Nitrogen, phosphorus, potassium, and sulfur were applied. This is a very course-gravelly soil requiring irrigation every 4-5 days. FY00 and FY01 no evaluations.

ID99006 Jacy Gibbs-cooperator will complete evaluations for demo plots. Site characteristics: very warm dry summers, Cencove fine sandy loam soil, 0-2% slopes, about 2200 feet elevation, 8-10 inch precipitation, T3N R5W NE1/4 Section 10. Seed ordered February 24, 1999. Aberdeen accessions: Bannock thickspike wheatgrass, Sodar streambank wheatgrass, Goldar bluebunch wheatgrass, Appar blue flax, Magnar basin wildrye, Nezpar Indian ricegrass, Richfield Selection firecracker penstemon, Clearwater Selection alpine penstemon, Snake River Plain fourwing saltbush. Bridger accessions: Trailhead basin wildrye, Rimrock Indian ricegrass, M1 Nevada bluegrass, PI434231 plains bluegrass, 9005460 alpine bluegrass, 9078408 High Plains Sandberg bluegrass, Shoshone beardless wildrye, 9019219 bottlebrush squirreltail, Critana thickspike wheatgrass, Wytana fourwing saltbush. Meeker accessions: Summit Louisiana sagewort, Timp Utah sweetvetch, Bandera Rocky Mountain penstemon, 9040187-bottlebrush squirreltail, 9040189 bottlebrush squirreltail, 9043501 Salina wildrye, Maybell antelope bitterbrush. Pullman accessions Secar Snake River wheatgrass, Covar sheep fescue, Canbar Canby bluegrass, Sherman big bluegrass, Whitmar beardless wheatgrass, and Schwendimar thickspike wheatgrass. FY99 no evaluation. FY00 Nezpar has excellent seedling vigor, easy to transplant, remains green, and is an attractive landscape plant. Schwendimar is best thickspike wheatgrass, remains green longer, best regrowth, responds well after mowing, good dryland and limit irrigation. Goldar and Whitman stands are very poor due to cheatgrass competition. Basin wildrye, Sherman, Secar mix good weed competition. Basin wildrye, Sherman, Covar, Secar are all good landscape plants. Using Covar along one side of property for firebreak—it will be excellent. Penstemon species are very slow growing, remain green and will be good landscape plants. Appar can be a nuisance and is not very shade tolerant. Maybell is slow growing. Timp is a preferred species by rabbits resulting in difficulty establishing stand. Summary of best plants—Grasses: Secar Snake River wheatgrass, Magnar basin wildrye, Sherman big bluegrass, Nezpar Indian ricegrass, Covar sheep fescue, sand dropseed, Bannock thickspike wheatgrass, and Schwendimar thickspike wheatgrass. Forbs: western yarrow, Drummond phlox, white evening primrose, scarlet globemallow, silky lupine, Louisiana sagewort, Rocky Mountain iris, and Appar blue flax. Shrubs: native fourwing saltbush, native basin big sagebrush, Maybell bitterbrush, curlleaf mountain mahogany, Saskatoon serviceberry, Woods rose, almond, and Drummond willow. Trees: Idaho hybrid poplar, and Rocky Mountain juniper. FY01 no evaluation.

ID02001 CB River Springs Ranch WRP field planting. Vavilov Siberian wheatgrass, Bannock thickspike wheatgrass, Magnar basin wildrye, Northern Cold Desert winterfat, and Snake River Plain fourwing saltbush. Seed ordered 3/26/01 for shipment in early March 2002. Site characteristics: Felthom fine sandy loam soil, 3-12% slopes, NE aspect, 2100 feet elevation, 11 inch rainfall, cheatgrass community to be sprayed 2-3 times (spring and fall 2001) prior to early spring (2002) interseeder planting.

FIELD OFFICE: EMMETT

ID02____ Little Farms Rush intermediate wheatgrass, Vavilov Siberian wheatgrass, Covar sheep fescue, and Sodar streambank wheatgrass critical area planting. Seed ordered December 14, 1998 for delivery about August 1, 1999. FY02 seed transferred to Little Farms.

FIELD OFFICE: MARSING/GRANDVIEW

ID85043 Delamar Mine Multiple species Critical Area Treatment - Mine spoils evaluations through 1989. FY93 no evaluation. FY94 Plots were difficult to locate. The intermediate wheatgrasses and fescues were performing the best on the mine spoils. Areas with 12 inches or more topsoil over spoil material supported a good stand (nearly 100% cover) of intermediate wheatgrass. Areas with less topsoil, Durar hard fescue was doing better than other grasses. This fescue on deeper sites was very effective in filling in the interspaces between wheatgrasses. All shrubs planted were failures. Native shrubs moving into sites included western juniper, snowbrush ceanothus, bittercherry, and curlleaf mountain mahogany. These shrubs should be propagated locally and could include rocky mountain juniper in replacement of western juniper for on-site applications. The recommended seed mix includes: Luna pubescent wheatgrass 8 lbs/ac, Tegmar intermediate wheatgrass 8 lbs/ac, Covar sheep fescue or Durar hard fescue 2 lbs/ac, Appar blue flax 1 lbs/ac, Yellow sweetclover 1 lbs/ac = 20 lbs/acre total. It was also recommended that fertilizer and lime be applied based on specific soil tests. In addition, straw mulching at 1000-1500 lbs/ac, crimped with cat cleats should be applied to enhance site conditions to establish seeding. It was determined that these seeding trials have completed their usefulness and should be closed out. **This field trial is cancelled. Maintain this record, but no additional evaluations will be performed.**

FIELD OFFICE: MERIDIAN

ID99001 Brad Little Field Planting - Oust Herbicide Study (1) introduced species field plantings: CD-II (Hycrest II) crested wheatgrass, Hycrest crested wheatgrass, P27 Siberian wheatgrass, Vavilov Siberian wheatgrass, Rush intermediate wheatgrass, and Luna pubescent wheatgrass; (2) native species mix 1—Goldar bluebunch wheatgrass, Bannock thickspike wheatgrass, Magnar basin wildrye, Nezpar Indian ricegrass, and Wytana fourwing saltbush; native species mix 2—Goldar bluebunch wheatgrass, Critana thickspike wheatgrass, Trailhead basin wildrye, Rimrock Indian ricegrass, and Wytana fourwing saltbush. Seed ordered September 24, 1998. Oust herbicide was applied at 3 rates (0.75, 1.0, and 1.25 ounces per acre) in the fall of 1997 to control cheatgrass, medusahead wildrye, and other annual weeds. Following one full growing season, the eight plantings will be seeded in late fall 1998. FY99 The Oust treatments controlled annual weeds very well with .75 oz per acre rate leaving most perennial grasses and forbs alive, at 1.25 oz per acre most grasses and forbs were eliminated. Planted in December 1998. The drill seeding looked very good when completed. All

plantings are establishing poorly due to very cool spring temperatures, severe growing season drought (March through October), and very heavy grasshopper infestations. Plantings can be rowed in several areas, but grasshoppers have stripped all leaves so survival can not be determined. Some seed may not have germinated this year. FY00 this is second year of extremely dry conditions and heavy infestation of grasshoppers. It appears that no new germination occurred this year. Grasses established in 1999 came up with good vigor. Hot temperatures and no rain have resulted in plant health and vigor to be very poor. Grasshoppers have cleaned site of all growth. Overall the seedings are very poor. FY01 Study 1 (introduced species)— this was the third year of droughty conditions with spring precipitation less than 50% of normal. A few assorted locations had fairly good plant growth, but overall most stands are failures. Heavy cheatgrass and medusahead stands have reinvaded the site. The Oust herbicide treatment was a success; it does knock out the annuals and allows native perennials to express themselves. Sandberg bluegrass and bottlebrush squirreltail increased in size and vigor following the Oust applications. Seeded species would have had an excellent chance of establishing had spring rainfall been more cooperative and grasshopper infestation not occurred. Study 2 (native species)—same comments as above. This planting is **cancelled**.

ID00010 Rick Roe willow field planting. 25 cuttings each of 9067476 Coyote willow (50), 9067482 Booth willow, 9067544 Drummond willow, 9067477 Yellow willow, 9067475 Yellow willow, and 9067546 Peachleaf willow were ordered on March 1, 2000 for shipment April 10, 2000. FY00 cuttings were planted to good season-long moisture and growth is excellent. 80% survival and good vigor of all accessions. Coyote willow is 24 inches tall, Booth willow is 48 inches tall, Drummond willow is 60 inches tall, Yellow willow is 36 inches tall, and Peachleaf willow is 60 inches tall. FY01 all willows have 70% stand, are healthy, vigorous and competing well with weedy species. Height: 476 Coyote willow 3-8 feet tall, 546 Peachleaf willow 5-8 feet tall, 477 Yellow willow 5-8 feet tall, 482 Booth willow 4 feet tall, and 544 Drummond willow 10 feet tall.

ID02004 Brad Little Field Planting – BASF Plateau Herbicide Study – Seeding Trial.

Herbicide Treatment 1 – Burn + Herbicide (control – 2 ounce – 4 ounce rates). Herbicide Treatment 2 – Non-burn + Herbicide (control - 2 ounce – 4 ounce – 6 ounce – 8 ounce – 10 ounce – 12 ounce rates). Seeding Treatments – Alfalfa and Snake River Plains Germplasm fourwing saltbush will be mixed with each of the following rangeland forage grass species: Rush intermediate wheatgrass, Luna pubescent wheatgrass, Hycrest crested wheatgrass, CD-II crested wheatgrass, Vavilov Siberian wheatgrass, P27 Siberian wheatgrass, Bozoisky Select Russian wildrye, Mankota Russian wildrye, and Covar sheep fescue. Each treatment (herbicide rate – seed mix) will cover 0.12 acres in 48x110 feet plots. Seed ordered September 18, 2001 for shipment by October 12, 2001. Herbicide treatments and seeding planned for November 2001 during dormant growth period. Site characteristics – MLRA B10, silt loam to sandy loam soil, 2-6% slopes, east southeast aspect, 2900-3000 feet elevation, 11-12 inch precipitation zone, non-irrigated, T5N R1N SW1/4 of SW1/4 of Section 5.

FIELD OFFICE: MOUNTAIN HOME

ID00017 Ted Hoffman-Idaho Department of Lands Species and Planting Method Demonstration for cheatgrass-medusahead wildrye control—rangeland rehabilitation. Four planting methods including conventional tillage with double disc drill, grain drill with sweeps, Idaho Fish and Game interseeder, and Idaho Department of Lands or BLM rangeland seeder will be demonstrated. Ten species – species mixes including Luna pubescent wheatgrass, Rush intermediate wheatgrass, Hycrest crested wheatgrass, Nordan crested wheatgrass, Vavilov Siberian wheatgrass, Bozoisky Russian wildrye, Bozoisky/Vavilov mix, Cereal Rye, Secar Snake River wheatgrass/Bannock thickspike wheatgrass/fourwing saltbush mix, and Secar Snake River wheatgrass/Bannock thickspike wheatgrass/Immigrant forage kochia mix will be cross planted over planting methods. Site characteristics include MLRA B11, Chilcott-Elijah silt loam soil, 0-12% slopes, south exposure, 3480 feet elevation, 10-12 inch rainfall zone, non-irrigated, T2S R6E SE1/4 of SE1/4 of Section 16. FY01 planting completed November 2001. The conventional tillage section was not completed and was replaced with a no-till operation. Little to no emergence occurred in 2001 due to extreme drought conditions, the evaluation next year will determine if planting was a success or failure.

FIELD OFFICE: PAYETTE

None

FIELD OFFICE: SOUTH WEST IDAHO RC&D

None

FIELD OFFICE: WEISER

ID91029 Grafe Bannock and Critana thickspike wheatgrass field planting. Site is a sandy loam soil, non-irrigated, 12-14 inch ppt, 2500 feet elevation, and 4-8% slopes on west exposure. FY92 estimate 20% stand. FY93 survival is 90% for both species. The existing plants are healthy and holding their own with competition. Neither species is as vigorous as Oahe on same sites. FY94 survival is 95% for each species, good stands, and excellent vigor. This trial continues to improve, the stands are spreading and filling in open ground. Both species appear well adapted to site even considering the extended drought conditions. Total forage production is less than adjacent intermediate wheatgrass, but is more palatable. Plants are producing seed this year. The stands are starting to provide competition for annual weeds, grasses and cereal rye. I am now starting to see the value of these plants on some of our most droughty and limiting sites. FY95 Good stands for both Bannock and Critana (95% survival). Both species continue to improve over time. Cereal rye is not affecting growth. Neither thickspike wheatgrass is producing as well as Oahe intermediate wheatgrass. Both species would fit well with

similar palatability grasses in mixture (suggest Goldar or Secar bluebunch wheatgrass). FY96 good stands of both with 6 plants/ft^2 of each and excellent vigor. Growth of both species is still very good and weed competition is light. Total production continues to be less than adjacent intermediate wheatgrass. FY97 good stands (5 plants per foot), survival, and vigor for both Bannock and Critana. Growth and vigor for both does not reflect the excellent moisture year we had and stands are maintaining or declining slightly. FY98 no evaluation. FY99 good stands of both species with 90% survival and good vigor. Producing between 500 and 1000 pounds per acre in an extremely dry April through November year. Bannock is slightly taller at 18 inches than Critana at 16 inches. Heavy grasshopper damage this year. Cheatgrass invasion is slight. FY00 no evaluation. FY01 stands of both Bannock and Critana were rated poor, with 1 plant per square foot, fair vigor and 200 pounds of production per acre. Two years of drought has heavily impacted this planting and cheatgrass is invading. **Next evaluation scheduled for FY03**.

ID94025 Eckhardt Ephraim crested wheatgrass, Magnar basin wildrye, Mankota Russian wildrye, Trailhead basin wildrye, P27 Siberian wheatgrass, Manska pubescent wheatgrass, Reliant intermediate wheatgrass, Bannock thickspike wheatgrass, Schwendimar thickspike wheatgrass, Greenar intermediate wheatgrass, Sherman big bluegrass, Secar Snake River wheatgrass, Goldar bluebunch wheatgrass, Bozoisky Russian wildrye, Hycrest crested wheatgrass, Rush intermediate wheatgrass demo plots. Site is clay loam soil, non-irrigated, 10-12 inch ppt, 3000 feet elevation, and 5% slopes on NE exposure. Seed ordered July 1994. FY94 and FY95 due to drought conditions, seeding planned for spring 96. FY96 planted April 9, 1996 by hand planting and raking plots to control bulbous bluegrass competition. June 19, 1996 evaluation for establishment: Mankota poor, Manska good, Sherman very poor, Greenar good, Trailhead fair, Reliant good, Bozoisky good, Bannock good. July 8, 1996 establishment: Mankota fair, Manska good, Sherman poor, Greenar good, Trailhead fair, Reliant good, Bozoisky good, Bannock good, Goldar good, Rush excellent, Secar fair. Rush has the best stand establishment to date with Goldar next. FY97 no evaluation. FY98 first set of plots; Reliant is out producing all other plots, Greenar is second in production, Sherman hand planted plot is third in production, Sherman broadcast plot failed, T6633-P is fourth in production. Second set of plots; Bozoisky performed the best with Mankota second, and trailhead the poorest. The wildrye, thickspike wheatgrass and intermediate wheatgrass accessions have shown adaptation to this area and could play a roll in revegetating local rangelands. FY99 plots were grazed this spring and grazing preference was evaluated. Plots: Greenar and Reliant were grazed the heaviest, followed by Mankota and Bozoisky Russian wildrye. This was uniform for all replications. Thickspike wheatgrasses and all other varieties had slight utilization. Basin wildrye accessions were not utilized. Grazing preference for the larger plantings: Bozoisky Russian wildrye was used the heaviest, followed by Goldar bluebunch wheatgrass, and Rush intermediate wheatgrass used the least. Cattle are grazing Fourwing saltbush. The producer is very happy with results from these plots and uses the information to make his planting decisions. Cattle in mid May grazed FY00 the small plot species. Grazing preference was for Goldar, Bozoisky, and the intermediate wheatgrasses. The intermediate wheatgrasses are spreading into adjacent plots.

Moderate use was made on Magnar and Trailhead. Sherman was used only slightly. Fourwing saltbush was utilized and continues to get taller (20 inches tall). In the large acre sized plots adjacent to a Hycrest planting, grazing preference (mid May) in order are: 1) Goldar, 2) Bozoisky, 3) Rush, and 4) Secar. Use of Goldar was similar too slightly heavier than the Hycrest. FY01 all plots are grazed this year. Utilization was heaviest on Greenar intermediate wheatgrass and Reliant intermediate wheatgrass plots. The larger plantings showed grazing preference was highest for Bozoisky Russian wildrye, then Goldar bluebunch wheatgrass, followed by Rush intermediate wheatgrass. **Next evaluation will be spring 2002**.

ID94026 Weber Goldar bluebunch wheatgrass, Rush intermediate wheatgrass, Luna pubescent wheatgrass, Secar Snake River wheatgrass, Greenar intermediate wheatgrass, Schwendimar thickspike wheatgrass, Bozoisky Russian wildrye, Bannock thickspike wheatgrass, Delar small burnet, Firecracker and Alpine penstemon, Sherman big bluegrass, Wytana fourwing saltbush, and Rincon fourwing saltbush demo plots. Site is stony clay loam soil, non-irrigated, 16 inch ppt, 3200 feet elevation, 0-2% slopes. Seed ordered July 1994. FY94, FY95, and FY96 due to drought conditions, seeding not planted. FY97 seeded May 16, 1997 with good rains following planting. Weed competition is high. In general initial establishment was good for wheatgrasses, fair for wildryes and poor for forbs. FY98 rainfall was 150% of average this year resulting in a flush of weeds. All plots except forbs were sprayed for broadleaf weed control and were shredded to reduce overstory competition. The most successful plants include: GRASSES Rush is by far the superior plot from standpoint of vigor, total growth, and total production. Luna is rated second and Reliant is rated third. Other grasses are only marginally successful to non-existent due to possibly saturated soils and weed competition during the establishment year. FORBS Delar is doing very well and appears very hardy and adapted to wet soil conditions. Penstemons and Lupine did not establish. SHRUBS Rincon is taller (10-15 inches) than Wytana (4-6 inches). FY98 no evaluations. FY99 Weeds and saturated soils are a problem on this site. Most successful plants—grasses: Rush intermediate wheatgrass followed by Luna pubescent wheatgrass, and Reliant intermediate wheatgrass, with others only marginally successful; Forbs: Delar small burnet is performing very well and no other forbs established; Shrubs: Rincon fourwing saltbush is superior to Wytana fourwing saltbush on this site. FY00 no evaluation. FY01 following two years of extreme drought Greenar intermediate wheatgrass was the most productive and vigorous followed by Reliant intermediate wheatgrass and Luna pubescent wheatgrass. Rush intermediate wheatgrass, Mankota Russian wildrye, and Manska pubescent wheatgrass did not grow much this year. Magnar basin wildrye was superior to Trailhead basin wildrye in production and survivability. Thickspike wheatgrass and Russian wildrye accessions grew very slowly. Delar small burnet plants are not handling drought well and are dying. Rincon fourwing saltbush is better than Wytana fourwing saltbush with some plants to 18 inches in height. Weeds are infesting site.

ID95038 Skow Rush intermediate wheatgrass field planting. Site is sandy loam soil, irrigated, 2320 feet elevation, and 2-4% slopes on north to northwest exposure. Seed ordered May 1995. FY95 seeding planned for spring of 1996. FY96 this seeding was

not installed because site was inundated past recommended seeding dates. Planting location will be changed and seeded next year. FY97 planted early spring 1997. Excellent stand is establishing with 7-8 plants per foot squared and excellent vigor. Landowner sprayed in early summer for broadleaf weeds. This should turn out to be an excellent grazing trial. FY98 excellent stand and vigor. Estimate yield to be 5000 to 5500 pounds per acre or 3 to 3.5 AUMs per acre. FY99 good stand with 95% survival and excellent vigor. Production was 3500 to 4000 pounds per acre. Cattle preferred this seeding to tall fescue in adjacent field. Next evaluation will be FY2002. FY01 fair stand of Rush intermediate wheatgrass with fair vigor and about 500 pounds of production per acre following two years of extremely dry conditions. This field was grazed in conjunction with a tall fescue field and grazing preference was for Rush.

ID96024 Sutton Rush intermediate wheatgrass, Luna pubescent wheatgrass, and Oahe intermediate wheatgrass field planting. Site is loam soil, non-irrigated, 15-17-inch ppt, 3320 feet elevation, 1-4% slope on south exposure. Seed ordered March 14, 1996. FY96 planted in May into good seedbed with good weed control. Good stand establishing with about 3 plants per foot squared, each species was planted with alfalfa in alternate rows and alternating sections. FY97 good stands with excellent vigor of each cultivar. The Oahe/alfalfa stand was cut for hay and produced 1.5 tons/acre. Because of topography the Rush/alfalfa and Luna/alfalfa were not cut for hay. The entire field was grazed; grazing was uniform across all trials so preferences could not be determined. Producer is very happy with all three from standpoint of production potential when seeded with alfalfa. FY98 good stands and vigor for each species with about 7 plants per square foot. Yield for all species was about 5000 pounds per acre or about 3 AUMs per acre. Cattle are selecting Luna as first choice, then go to Rush before Oahe. The Rush was more mature than Luna when steers were put in pasture, which may account for selection choices. FY99 good stands and vigor of all three species. Entire 84 acre seeding provided 135 AUMs or 1.6 AUMs/ac. Due to later season of use; cattle prefer Luna and Oahe to Rush. Rush initiates growth earlier and is more mature when cattle are turned into pasture, which probably accounts for this preference. FY00 similar report to last year. FY01 good stands and vigor for all species. Grazing preference continues to be for Oahe, followed by Luna, and the Rush. Production is about the same for all species although reduced this year due to two years of extreme drought.

ID97023 Schwenkfelder Rush intermediate wheatgrass District Seed Increase. Site is silty clay loam soil, 14-16 inch ppt, irrigated, 2700 feet elevation, 0-2% slopes, and north exposure, T15N R2W SW1/4 NE1/4 Section 16. Seed ordered March 24, 1997. FY97 spring planted May 29, 1997 into excellent firm seedbed. By July 3, 1997 adequate rain had occurred for good germination so no irrigation was required. There were still a few seedlings emerging on this date. Cooperator plans to spray for broadleaf weeds and will fertilize this fall to prepare for seed production. FY98 excellent stand and vigor with plants averaging 60 to 72 inches in height on June 23 with seedheads up to 15 inches long. Harvested in mid August with 550 to 600 pounds per acre estimated yield. Baled forage yield was 7000 to 8000 pounds per acre. The hay is fed to range cattle early in the feeding season and utilize it readily. FY99 produced 300 lbs/ac seed this year.

Producer is very happy with production and utilizes residue to feed beef cows. Hay yield was about 3 tons per acre. Producer fertilized with 43-lbs/ac nitrogen and 104-lbs/ac phosphorus in late October 1999. FY00 no evaluation. FY01 producer decided to graze this field this year due to drought and reduced seedhead production. Vigor was reduced because of drought.

ID98019 Royce Schwenkfelder Bannock thickspike wheatgrass District Seed Increase. Seed ordered March 16, 1998 for April delivery. FY98 because of spring rains, this seeding did not go in until mid June. Seedbed preparation was excellent, but only 20% of plants emerged due to soil crusting. Additional seed was obtained and this seeding will be replanted. FY99 producer plans to plant spring 2000. FY00 no evaluation. FY01 producer has not planted due to severe drought conditions the past two years.

ID00001 Henry Green Field Planting—Native mix Secar Snake River wheatgrass, Bannock thickspike wheatgrass, Magnar basin wildrye, winterfat, fourwing saltbush, Wyoming big sagebrush. Site is Baldock silt loam soil, 10-12 inch precipitation, 2180 feet elevation, 1-percent slope, SW exposure, T10 and 11N R4W Sections 3 and 34. Seed ordered (Bannock and Magnar) on 10-6-99. FY00 seeded October 27, 1999 into very dry soft seedbed. It rained .2 inches the night of seeding and weather was been mild until early December. Winterfat still had fluff on seed so it was broadcast ahead of drill. Half of sagebrush and all of fourwing saltbush seed were mixed with grass and drilled—the other half of sagebrush will be broadcast later this winter onto snow. FY00 unable to get good evaluation this year due to droughty conditions. FY01 this is the second year of extreme drought conditions that are severely impacting plant development. Competition from annual weeds is heavy. Not enough plants to give a good evaluation.

IDAHO DIVISION IV

FIELD OFFICE: BURLEY

ID94003 Bronson Bozoisky Russian wildrye, Mankota Russian wildrye, Trailhead basin wildrye, Magnar basin wildrye, Goldar bluebunch wheatgrass (firebreaks and winter grazing). Site is sandy loam soil (weakly saline), 9-10" ppt, partially irrigated, 4800 feet elevation, 0-2% slopes. Species seeded in fall of 1994 with good seedbed. FY95 good stands of Mankota, Magnar and Trailhead; fair stands of Bozoisky and Goldar. All seedings are establishing well except in weedy areas. No seed production during establishment year. FY96 good stand of Goldar, fair stand of Mankota and Magnar, and very poor stand of Trailhead and Bozoisky. All plants that are present look good and are producing seed. There are weeds present including cheatgrass, tumble mustard, Russian thistle, broom snakeweed and sagebrush. FY97 Goldar full stand, Trailhead has improved and is spreading, Magnar is very thin, and both Russian wildryes are adapted with thin stands. FY98 good stands of Bozoisky and Goldar and fair stands of Mankota, Trailhead and Magnar. Stands are grazed in winter. FY99 Good stand and vigor of all species. All species are in same pasture and the Bozoisky is grazed closer than the other species. FY00 fair to good stand of all species. Cooperator is very

pleased with all species and prefers them over crested wheatgrass varieties. Site was grazed in spring. Cooperator states that livestock make good use of Bozoisky and Mankota in spring, Trailhead in winter, and Magnar in fall and winter. Magnar stays greener than Trailhead. FY01 this site is suffering from two years of drought. Mankota Russian wildrye has 36-inch height, fair to good stand and good vigor. Bozoisky has 20-inch height, fair stand with fair vigor. Magnar has 30-inch height and Trailhead has 20-inch height and both have fair to poor stands with fair to good vigor. Goldar has 24-inch height, fair to poor stand with good vigor

ID96012 Poulton Garrison field planting for plug nursery. Seed ordered 12/8/96. FY96 no evaluations. FY97 field has full stand with 2 plus plants/ft^2. Plants have height of 36 inches and no weeds. Stand is gravity irrigated and was fertilized with 80 pounds of N in early June. FY98 excellent stand that has improved significantly in the last year. The stand was hayed this year. FY99 good to excellent stand. The stand was 36 inches tall when swathed for hay and had 6 inches of regrowth in early September. Cooperator is very pleased with this grass. Elk are utilizing planting. FY00 planting was cut for hay and elk are utilizing it heavily due to drought conditions. FY01 due to drought conditions, this planting was hayed earlier than normal and has been heavily grazed. Production was below normal. Stand is solid with no bare spots or invading species.

ID96028 East Cassia SCD Hycrest crested wheatgrass, Sodar streambank wheatgrass, Bannock thickspike wheatgrass, and Appar blue flax field planting and Hycrest II (CD-II) crested wheatgrass, Sodar, Bannock, and Appar field planting. FY96 planting planned for fall of 1996. FY97 no evaluation. FY98 fair stand of all species except Appar, which failed. FY99 poor stands of Hycrest, CDII, and Flax. Bannock and Sodar failed. Crested wheatgrass can be rowed in very heavy stands of cheatgrass. FY00 fair stand of Hycrest and CD-II, poor stand of Bannock, and Sodar and Appar failed. Both Hycrest and CD-II are thickening up and starting to crowd out cheatgrass. Some Bannock is present, but Sodar and Appar were not observed. FY01 no evaluation.

ID96045 Bill and Rod Jones Saline Soil Demonstration. Greasewood plowed out in the spring 1995, summer fallowed, deep ripped at about 18 inches in fall, disked and packed prior to seeding. Site 1: Field 11 soil pH 8-8.5 (16 mmhos), 10-12 inch ppt. Rush intermediate wheatgrass planted 11/24/95. Site 2: Fields 9 and 10 soil pH 8-8.5 (14 mmhos), 10-12 inch ppt. Bozoisky Russian wildrye, Luna pubescent wheatgrass, Hycrest crested wheatgrass, Rush intermediate wheatgrass and Travois alfalfa seeded 11/26/95. FY97 (May 5/28/97)—the mix is looking much better than the Rush only planting. Bozoisky is establishing the best with Hycrest and Rush about equal in stand. Travois failed due to heavy rabbit use the establishment year. Site 1: (July 7, 1997) very good growth and vigor for Rush since earlier observation with 1300 lbs/ac dry matter clipped. Site 2: (July 11, 1997) clipped 1220 lbs/ac dry matter with Hycrest accounting for 40%, Rush and Luna 30%, Bozoisky 10%, alfalfa <1% and weeds 20%. Site has received excellent rain this year. FY98 Site 2: excellent stand of Hycrest and good stand of Bozoisky, Luna, and Rush. FY99 Site 1 Good to excellent stand and vigor with Bozoisky 60% of stand, Hycrest 35% of stand, Rush 3% of stand, Luna 1% of stand, and no alfalfa. Producing about 1400 pounds per acre. Site 2 fair stand and vigor.

Producing about 500 pounds per acre. FY00 site was grazed heavily this spring and no rain during summer resulted in little regrowth. Bozoisky and Hycrest are predominant with Bozoisky 10% of stand and Hycrest 40% of stand. Very little Rush and no Luna or Trevois were observed. FY01 due to severe drought conditions, this planting is suffering. Only a few Rush plants were identified in deeper soil locations. This planting is now a failure. The mixture planting inspection indicated that only Bozoisky is surviving with 30-40 inch height in deeper soils and areas that received additional runoff and 20 inch height throughout field. Dead plants are evident throughout field. Site was not grazed this year. **Cancel**

ID97004 R. Manning Field plantings/Pivot Corners (four plantings) (1). Goldar, Bannock, P27 and Magnar; (2). Secar, Schwendimar, Vavilov and Trailhead; (3). Hycrest; (4). CD-II (Hycrest II). Sites are silt loam soil, non-irrigated, 11-inch ppt, 4500 feet elevation, 2% slopes on west exposure. Seed ordered 10/17/96. FY97 Plantings 1 and 2 nothing visible; Planting 3 Hycrest - can row grass (2+ plants/ft^2), no seedhead production this year; Planting 4 CD-II - can row grass (2+ Plants/ft^2), no seedhead production this year. FY98 Planting 3 Hycrest poor spotty stand (2 plants per $foot^2$) with quackgrass and Canada thistle competition. Planting 4 Hycrest II fair stand (4 plants per $foot^2$) with many weeds present. FY99 plantings 1 and 2 were plowed out due to failure. Planting 3 has good stand and vigor with 1400 pounds per acre production. Planting 4 was grazed too hard to evaluate. FY00 Plantings were grazed too heavily to evaluate stands. FY01 land sold—planting **canceled**.

ID97005 Hawker Field planting for medusahead wildrye control. Sherman big bluegrass, Covar sheep fescue and Garnet (905308) mountain brome. Site is very stony loam soil, non-irrigated, 14 inch ppt, 5800 feet elevation, 4% slope on south exposure. Seed ordered 10/17/96. FY97 new seeding and difficult to determine establishment. FY98 good stand of Sherman and Covar establishing and fair stand of mountain brome establishing. FY99 due to severe grasshopper population, it is impossible to determine stand composition. FY00 due to drought planted species were not found – evaluate in spring 2001.FY01 site was heavily grazed early this year and no regrowth occurred.

ID97006 Gary Jones Field planting of Garrison creeping foxtail. Site is silt loam soil, irrigated, 5000 feet elevation, 0-3% slope on south exposure. Seed ordered 10/17/96. FY97 new seeding and very difficult to determine establishment. FY98 poor stand establishing with .5 plants per $foot^2$. FY99 good stand with about 4 plants per square foot and 4000 pounds per acre production. Fertilizer would benefit stand and reduce weeds. FY00 good stand with excellent vigor. Planting was hayed this year. FY01 this is a good planting. It was cut earlier than usual for hay due to shortage of irrigation water. Yield was down this year, but cooperator was satisfied with yield given the droughty conditions.

ID98005 Gary Steed Aberdeen willows - Laurel, Geyer, Streamco, White, and Coyote. Materials ordered 2/9/98. FY98 survival/height – Streamco 95%/1 foot; Geyer 100%/4 feet; Laurel 60%/2 feet; White 90%/4 feet; Coyote 85%/1.5 feet. FY99 management of this project is poor. Cattle are grazing planting area and there is a severe weed problem. The willows are very durable and most of them are still alive. FY00 Laurel,

White, Coyote, and Streamco willow have best survival and plant vigor. Plants inside fence are not grazed, but those on south end are grazed heavily. FY01 White willows 50% survival, good vigor and 36-inch height. Coyote willow 60% survival, excellent vigor and 60-inch height. White willows 30% survival, excellent vigor and 48-inch height. Geyer willow 10% survival good vigor and 36-inch height. This farm has been sold – planting **canceled**.

ID00002 Clark Ward Field Planting (Critical Area Treatment) – Vavilov Siberian wheatgrass, Ephraim crested wheatgrass, and Tegmar intermediate wheatgrass. Site is a silt loam soil, 2-4% slope, NE exposure, 4680 feet elevation, 8-10 inch precipitation, non-irrigated, T1S R24 & 25E Sections 25 and 30. Seed ordered 10-6-99. Planting will be broadcast and raked about Nov. 1, 1999. FY00 site could not be accessed. FY01 this planting was part of a 319-stream restoration project. It has been very successful with native shrub recovery excellent making evaluation of planted materials very difficult. Planting should be considered a success, but **canceled** due to difficulty in evaluation of materials.

ID00009A Warren Yadon willow field planting. 9067561 Lemmon willow (12), 9067548 Drummond willow (12), 9067436 Yellow willow (12), 9067375 Peachleaf willow (15), and 9067376 Peachleaf willow (14) were ordered on March 1, 2000 for shipment April 10, 2000. FY00 willow evaluations will be performed next year. FY01 this planting is overgrown with woods rose, stinging nettle and weeds. Cuttings are alive, but very difficult to evaluate this late in the year. Recommend evaluating earlier next year.

ID00009B Fred Bullers willow field planting. 9067561 Lemmon willow (28), 9067548 Drummond willow (24), 9067436 Yellow willow (13), 9067375 Peachleaf willow (27), and 9067376 Peachleaf willow (40) were ordered on March 1, 2000 for shipment April 10, 2000. FY00 willow evaluations will be performed next year. FY01 this planting failed – **cancel**.

ID00009C Paul Frelier willow field planting. 9067561 Lemmon willow (13), 9067548 Drummond willow (12), and 9067375 Peachleaf willow (13) were ordered on March 1, 2000 for shipment April 10, 2000. FY00 willow evaluations will be performed next year. FY01 this planting is overgrown with native vegetation. Cuttings are alive, but very difficult to evaluate this late in the year. Recommend evaluating earlier next year.

FIELD OFFICE: GOODING/FAIRFIELD

ID94022 Erdman Farms Rush intermediate wheatgrass DSI. Seed ordered 4/4/94. FY94 seeded on May 25, 1994, excellent initial establishment with plants going dormant in early summer due to no rain (record low rainfall) and greening up after being dormant for over 90 days with fall rains. Drilled two rows together (6" spacing) with 24 inches between double rows. Some mortality of seedlings due to drought. Most plants made 5-7 leaf stage before dormancy in fall. Appears to be a good stand and cooperator rated drought tolerance the establishment year as excellent. FY95 cut for seed 9/15/95 with 140 lbs/ac clean seed production. Rush stayed green longer into summer than Luna

and cooperator had to wait two weeks longer than Luna to harvest seed. Rush had green basal leaves despite very dry summer and fall in November. FY96 no seed harvested, drought tolerance of established Rush is exceptional. FY97 no evaluations. FY98 83 lbs/ac clean seed. FY99 strong winds just prior to harvest shattered seed and stand was not combined. FY00 Judy Erdman burned stand in April 2000 to reduce litter. Stand recovered well and produced seed despite dry conditions, but not enough seed for Judy to justify harvesting costs so seed was not harvested in year 2000. Rush plants remain vigorous, and light rhizomatous spreading out of original twin-rows is occurring. Very dry summer on the prairie. Stand looks very good considering it was burned in spring with no moisture thereafter to speak of until Labor Day weekend. FY01 no evaluation.

ID97011 Malad Gorge State Park Dormant field plantings a) Secar, Bannock, Nezpar, Magnar; b) Secar, Bannock, Rimrock, Trailhead; and c) bottlebrush squirreltail (9040187 and 9040189 accessions for plots). Seed ordered 1/31/97. Site is very fine sandy loam, 0-1% slopes, 3225 feet elevation, 10-inch rainfall, non-irrigated, T6S R13E NE1/4 Section 35. Sites to be planted in March 1997. FY97 no evaluations. FY98 two five-acre fields were planted in the spring of 1997 into good firm weed free seedbeds. Good spring rains in 1997 gave seedings a good establishment year. In July 1998 both stands are fully established with large seed producing plants. Both stands are dominated by Bannock thickspike wheatgrass, with Secar Snake River wheatgrass, both basin wildryes, and both Indian ricegrass accessions present in lesser amounts. Stands were so successful; cooperator harvested seed for future planting with 1000 pounds of cleaned seed combined. This is approximately 100 lbs/ac of seed in a 10-inch rainfall zone. Bottlebrush squirreltail plots were not planted in 1998. FY99 excellent stands for both plantings. Secar and thickspike wheatgrass dominate stands, with basin wildrye and Indian ricegrass present as minor components. FY00 The two 5-acre dryland plots of grass remain strong with good plant density and seed production despite a very dry year. Secar and Bannock dominate both the north and south fields, with only occasional ricegrass plants. The main difference between the two fields may be the amounts of basin wildrye persisting and/or increasing. Trailhead in the south field is readily apparent throughout the stand, but plants are not robust at this time presumably due to competition from Secar and Bannock. Comparatively, Magnar in the north field is present but much less apparent. Fields were not harvested for seed. Weeds, including cheatgrass, are controlled and not a factor in these fields. The State Park plans to graze these fields this November for a short period to reduce litter and plant residues. FY01 no evaluation.

ID98018 Bill Simon Farms Rush intermediate wheatgrass District Seed Increase. Seed ordered March 16, 1998 for mid April delivery. FY98 rush seeded in April 1998 into twin rows on 30-inch centers. The 55 acre field was formerly in alfalfa (1996 and prior) and fallowed in 1997. The 85-acre field was formerly in small grain. Excellent stands were established by the fall of 1998 with plants fully bunched and vigorous. Stands were sprayed with formula 40 2,4-D in late June or early July. Producer did not fertilize stands in the fall. FY99 approximately 25% of production was lost to shatter due to strong winds prior to harvest. The 55-acre field produced approximately 180 lbs/acre. The 85-

acre field produced approximately 110 lbs/acre. On droughtier hilltops and ridges producer noted that seed production was lacking and suggested that wider row spacing would be desirable. FY00 Rush stands remain strong and Bill Simon feels it is the best grass on the Prairie. The dry year took its toll on seed production, however. Harvested the third week of August 2000, the 85-acre field produced only 81 pounds/acre clean seed, and the 55-acre field produced 91 pounds/acre clean seed. Weeds in the 85-acre field are not a problem, since prior to seeding to Rush the field was in 2 years of wheat, and prior to that 5 years of Regar meadow brome, providing a clean field. The 55-acre field, however, was in alfalfa prior to seeding to Rush, and this field has more weeds. FY01 no evaluation.

ID98020 Bill Simon Bannock thickspike wheatgrass District Seed Increase. Seed ordered April 10, 1998 for mid April delivery. FY98 Bannock seeded on 12-inch centers. Evaluation in November 1998 indicated a slow start with weak plants at the end of the first full growing season. Weeds do not appear to be a problem, but soils are somewhat gravelly and it appears to be a difficult site to establish a stand. Field was fertilized with about 20 units of nitrogen in the fall. FY99 plants remain narrow and spindly, but fertilizer did contribute to improved plant health. Harvest of approximately 80 lbs/acre was completed early while plants were still green, but seed was mature and beginning to shatter. FY00 this is the first-to-ripen grass in Bill's portfolio, interfering with his alfalfa hay harvest on the Prairie. This year the Bannock was harvested the first week of August, and produced 110 pounds/acre clean seed, which is higher than last year's yield despite the dry year. The field was fertilized with 40 units of ammonium sulfate about May 1, 2000, and later sprayed with Formula 40 2,4-D. Cheatgrass is increasing in the field and will need to be controlled in 2001. FY01 no evaluation.

ID99007 Spring Cove Ranch – Butler Field Planting Laurel willow. Island-constructed wetland, silt loam soil, 0-2% slopes, 3100 feet elevation, T5S R12E SW1/4 Section 21. FY99 20 Laurel willows were at water edge on islands. Tree tubes (1.5 feet tall) were utilized to protect cutting from muskrats. All cutting are flourishing with about 5 to 6 feet of growth the first growing season. FY00 Laurel willows are thriving on the islands, protected by their tree tubes. Plants are vigorous and are now beginning to obtain fuller, multi-branched shape. FY01 no evaluation.

ID00005 Camas SCD (Koonce) formerly ID86010 Koonce multiple species demo plots. FY99 field evaluation determined these plots to be contaminated and planting was destroyed, site cleaned-up and fallowed during 1999, and was replanted in the spring of 2000. Plots replanted May 1, 2000. Plots will be irrigated the first growing season. FY00 plots were irrigated until mid June, then discontinued. Most of the wheatgrasses sprouted in the central and northern portions of the plot, but remained small at evaluation time due to dry season. Plot remains relatively weed-free except the southernmost 15 feet of the plot (sheep fescue area), which is a solid stand of globe mallow. The fescue is sprouted underneath the large mallow leaves. This is a particularly difficult weed to control once established. Special attention needs to be directed here in spring 2001. FY01 the plots have been subjected to two seasons of unfavorable plant growth (dry springs) and one of the lowest winter snowpacks recorded on the Camas Prairie. Still, all varieties exhibit some level of success except for the

following varieties which could not be found for observation: Durar hard fescue, Nezpar Indian ricegrass, 9043501 Salina wildrye, and Thurber's needlegrass. These varieties did not establish at all or remain yet as dormant seed due to drought. Some of the absent species may have germinated but died unnoticed due to drought. Weed competition most likely is not a factor of establishment difficulties in the plot. Possible exceptions may be in the Covar sheep fescue area that had significant amounts of common mallow in 2000 but is now under control due to spot spraying. Scouringrush is invading in the Bighorn sheep fescue and Magnar basin wildrye areas and may be a factor there. The entire demo plot was spot-sprayed in 2001 twice (last of June and first of August) with 2,4-D/Banvel. At the time of this evaluation the plot did not contain weed problems significant to grass establishment.

The wheatgrasses are performing the best. The highest performing wheatgrasses include Rush and Reliant intermediate wheatgrasses, Manska and Luna pubescent wheatgrasses, CDII and Nordan crested wheatgrasses, Bannock thickspike wheatgrass, and Pryor slender wheatgrass. Weak wheatgrass performance was observed with Arriba western, Whitmar beardless wildrye, San Luis slender wheatgrass, Critana thickspike wheatgrass, Ephraim crested wheatgrass, Douglas crested wheatgrass, and P27 Siberian wheatgrass.

Bozoisky and Mankota Russian wildrye performed moderately, but the other wildryes either did poorly (Volga Mammoth and Magnar) or did not establish (Salina and Trailhead). Manchar and Liso smooth bromes have done well considering the drought with moderate performances, but Garnet and Bromar mountain bromes and Regar meadow brome did not fare so well and have overall weak ratings. The fescues, needlegrasses, orchardgrasses, ricegrasses, timothy, and foxtail are currently performing weakly or did not establish. Sherman big bluegrass had low establishment density but the existing plants have good vigor with many seedheads produced.

ID00006 Bill Simon Bannock thickspike wheatgrass District Seed Increase. Seed ordered February 10, 2000 for mid April delivery. FY00 This new Bannock seeding in spring 2000 was installed adjacent and south of existing Bannock field under file ID98020. Bannock was drilled at 3 pounds per acre PLS on 24-inch centers. The field was helicopter sprayed with 2,4-D the third week of June. Where helicopter missed, Russian thistle prevailed this year but should diminish next year. At evaluation time on November 1, 2000, the stand was well on its way to establishment considering the dry year. FY01 no evaluation.

ID01002 Cooperator unknown willow field planting. 25 cuttings each of 9067436 Yellow willow, 9067452 Yellow willow, 9067475 Yellow willow, 9067477 Yellow willow, 9067493 Yellow willow, 9067375 Peachleaf willow, 9067376 Peachleaf willow, 9067541 Peachleaf willow, 9067546 Peachleaf willow, 9067549 Peachleaf willow, and 9067560 Peachleaf willow. FY01 no evaluation.

ID01007 Spring Cove Ranch – Butler demonstration plantings of Magnar basin wildrye, Snake River Plain fourwing saltbush, and Northern Cold Desert winterfat. Seed ordered March 16, 2001. Site characteristics: Planting 1. Vertisol soil, 11-inch rainfall,

irrigated, 3300 feet elevation, south of Pioneer Reservoir. Planting 2. Sodic soil, 12-inch rainfall, irrigated, 3500 feet elevation, near Clover Creek – Hill City Road – southern base of Bennett Mountain foothills. FY01 no evaluation.

ID01011 Bill Simon District Seed Increase High Plains Sandberg bluegrass test plots. Seed ordered in September 2001.

FIELD OFFICE: JEROME

ID99012 Tom Davis Critical Area Planting on pond embankment/dike. Hycrest crested wheatgrass and Vavilov Siberian wheatgrass seed ordered March 30, 1999. Planting planned for early April 1999. FY99 spring planting failed due to lack of rainfall. Cooperator planted (broadcast and harrowed) in November 1999 under dry conditions. FY00 good stand in areas where sprinkler semi-irrigates—poor to fair stand establishing in dry areas due to extremely droughty conditions. 2 plants per square foot, good vigor, 12-inch height. Expect stand to improve with better rainfall this fall-winter. FY01 good stand with 3 plants per foot square, and good vigor.

ID99013 Steve Hagler Critical Area Planting on pond embankment/dike. Hycrest crested wheatgrass and Vavilov Siberian wheatgrass seed ordered March 30, 1999 with delivery about Sept 1, 1999. Planting planned for late October 1999. FY99 project is still in construction stage and planting is not completed. FY01 planting not completed – **cance**l.

ID99014 Tom Davis irrigation pivot corner field planting. Vavilov Siberian wheatgrass ordered March 30, 1999 with delivery about September 1, 1999. Planting planned for late October 1999. FY00 planted (broadcast and harrowed) in November under dry conditions. Good stand in areas where sprinkler semi-irrigates—poor to fair stand establishing in dry areas due to extremely droughty conditions. 2 plants per square foot, good vigor, 12-inch height. Expect stand to improve with better rainfall this fall-winter. FY01 good stand with 3 plants per foot squared and good vigor

FIELD OFFICE: RUPERT

None

FIELD OFFICE: SHOSHONE/HAILEY

ID95010 Brossy Bozoisky Russian wildrye field planting Seed ordered 2/95. FY96 – FY98 not planted due to drought conditions. FY99 planting planned fall 1999 on wildfire burn. FY00 and FY01 no evaluations. **Cancel**

ID95011 Brossy Nezpar, 9035287, 9052861, 478833 Indian ricegrass field planting (plots). Seed ordered 2/95. FY96 – FY98 not planted due to drought conditions. FY99 plots planned for fall 1999 on wildfire burn. FY00 and FY01 no evaluations. **Cancel**

ID95012 Brossy Secar, Bannock, Immigrant, Meeker squirreltail accessions (2), Appar and Firecracker field planting mix. Seed ordered 2/95. FY96 – FY98 not planted due to drought conditions. FY99 plots planned for fall 1999 on wildfire burn. FY00 and FY01 no evaluations. **Cancel**

ID01003 Cooperator unknown willow field planting. 10 cuttings each of 9067548 Drummond willow, 9067435 Geyer willow, 9067491 Geyer willow, 9067437 Booth willow, 9067469 Booth willow, and 9067478 Booth willow. FY01 no evaluation.

FIELD OFFICE: TWIN FALLS

ID95045 CSI - Jim Wilson Blanchard blue elderberry demo planting. Plants ordered August 1995. FY96 Plants arrived in excellent condition. 7 plants planted at CSI Nursery and will be transplanted next spring. FY96 71% survival with poor vigor— plants died back in July when transplanted. The tallest plant is now about 15 inches with others ranging from 6-12 inches. FY97 71% survival (5 of 7) with fair vigor, 3-7 feet tall, and a lot of reed canarygrass competition. FY98 4 of 7 survived with fair to good vigor and 3 to 8 feet heights. FY99 42% survival with good vigor, 7-9 feet tall and 6 feet crown width. FY00 28% survival (2/7), fair vigor, 84-96 inch height, 7-8 feet crown width, 1.1 – 1.75 inch base, fruiting, rodent damage evident (muskrats or deer). FY01 cooperator is concerned about weeds and annually plants are mowed—this management is not conducive to elderberry growth or evaluation - **cancel**.

ID97008 CSI Sodar streambank wheatgrass, Rosana western wheatgrass, and Garrison creeping foxtail field planting on birms between constructed wetlands. Seed ordered 11/20/96. FY97 planting planned for fall 1997. FY98 excellent stand establishing with 30 plants per foot squared and excellent vigor. Sodar is planted on streambank, Rosana is planted on berms between cells, and Garrison is planted near shallow water. FY99 poor stand of Sodar, Rosana, and Garrison with 40% survival, good vigor, and fair ability to spread due to severe mowing and competition from other species. FY00 fair stands for each, 20 plants per square foot, 40% survival, good vigor, Sodar 24-48 inch height, Rosana 14 inch height, Garrison 12-60 inch height, heavy competition from other species in each plot. FY01 this site is completely sodded with a mix of species – planting **canceled**.

ID00007 Twin Falls SWCD/Twin Falls Highway District Drought tolerant landscape-weed control demonstration plantings. Seed ordered March 1, 2000 for late March delivery. Planting 1: Vavilov Siberian wheatgrass, Bozoisky Russian wildrye, and Ladak alfalfa. Planting 2: Hycrest crested wheatgrass, Bozoisky Russian wildrye, and Ladak alfalfa. Planting 3: Secar Snake River wheatgrass, Critana thickspike wheatgrass, Trailhead basin wildrye, Rimrock Indian ricegrass, and Wytana fourwing saltbush. Planting 4: Secar Snake River wheatgrass, Bannock thickspike wheatgrass, Magnar

basin wildrye, Nezpar Indian ricegrass, and Snake River Plain fourwing saltbush. Site characteristics: MLRA B11A, Portneuf silt loam soil, 0-2% slopes, north exposure, 3800 feet elevation, 10-12 inch precipitation, irrigated for establishment only, T11S R18E SW1/4 of SW1/4 of Section 13. FY00 due to very dry spring the planting was delayed until better planting conditions occur. FY01 site was planted in mid to late April and sprinkler irrigated in May to assist with plant establishment. Site was also mowed several times during growing season for weed control. Because of mowing, species identification was not possible – initial stand establishment for all plantings is fair with good plant vigor.

IDAHO DIVISION V

FIELD OFFICE: AMERICAN FALLS/ABERDEEN

ID95030 Roger Whitnah field planting - species: Cave-In-Rock switchgrass, Dakotah switchgrass, Blackwell switchgrass, Forestburg switchgrass, and Kanlow switchgrass. Field Planting seed ordered 4/10/95. Planted 6/23/95 on two sites. Site characteristics: soils are fine sandy loam, irrigated, 4400 feet elevation, and 2-4% slopes. Seedings: 1) Pivot Corner, 106 lbs nitrogen applied. 2) Near Windbreak-broadcast. FY95 evaluation 1) Pivot Corner—loamy sand soil, irrigated, 4400 feet elevation, 2-4% slopes, SW exposure. Blackwell 95%, Forestburg and Dakotah 80%, Cave-In-Rock 75% and Kanlow 65% survival. Blackwell is receiving additional moisture from pivot end gun. Kanlow plot was severely eroded by wind during early establishment period. Blackwell, Kanlow and Cave-In-Rock best weed competitors. All varieties appear adapted during initial establishment year. FY95 evaluation 2) Near Windbreak—silt loam soil, irrigated, 4400 feet elevation, 4-8% slopes, and east exposure. Blackwell and Dakotah 90%, Cave-In-Rock and Forestburg 80% survival. Plots are irrigated when windbreak is irrigated. All varieties appear adapted during initial establishment year. FY96 evaluation 1) Pivot Corner: Dakotah and Blackwell have best percent stand/clipped production (90%/1610 lbs) and (90%/1840 lbs), followed by Forestburg (60%/900 lbs), Cave-In-Rock (50%/565 lbs) and Kanlow (30%/310 lbs); evaluation 2) Windbreak Dakotah has best percent stand/clipped production (100%/2110 lbs) followed by Blackwell (75%/1065 lbs), Cave-In-Rock (75%/1095 lbs), and Forestburg (70%/945 lbs). FY97 evaluation 1) Pivot Corner: Blackwell had the best production with 1121 lbs/ac followed by Dakotah with 850 lbs/ac, Cave-In-Rock with 751 lbs/ac, and Forestburg with 746 lbs/ac. Dakotah and Cave-In-Rock are intermixed with alfalfa and alfalfa is dominating. Forestburg and Kanlow have filled in some the past year. Blackwell is very similar to last year. 2) Windbreak: Blackwell with 1367 lbs/ac and Dakotah with 1532 lbs/ac have the best stands, followed by Cave-In-Rock with 973 lbs/ac and Forestburg with 200 lbs/ac. Kanlow stand is very poor. Dakotah had more panicles with seed and was more mature than Blackwell in mid-August. FY98, FY99, FY00 and FY01 no evaluations. **Cancel**

ID95034 Idaho Power Company critical area planting - species: Sodar streambank wheatgrass, Bannock thickspike wheatgrass, Critana thickspike wheatgrass, and Volga mammoth wildrye. Critical area planting seed ordered 4/21/95. Site is very sandy, prone

to blowing, non-irrigated, 12" ppt, 4300 feet elevation, and 20 +% slopes on south exposure. Site was planted to spring grain in May 1995. Grain was sprayed in July so it would not go to seed. Grasses were planted in late October 1995 as dormant seeding. FY96 Some seedling establishing in spring, but additional seed may accelerate stabilization. October 1996 ordered additional Sodar, Bannock, Volga, and added Nezpar Indian ricegrass, Hycrest crested wheatgrass, and Wytana fourwing saltbush for seeding dormant Fall/Winter 1996. FY97, FY98, FY99, FY00 and FY01 no evaluations. **Cancel**

ID95040 Neil Poulson Bannock thickspike wheatgrass District Seed Increase. Seed ordered 7/3/95. FY96 no report. Additional seed provided 7/97. FY97, FY98, FY99, FY00 and FY01 no evaluations. **Cancel**

FIELD OFFICE: BLACKFOOT

Hakari brome appears to be a good plant for irrigated pastures on the Snake River Plain in Southeast Idaho. In plots at Pocatello, Hakari established easily and was ready for grazing within 75 days after spring planting. The oldest plots are three years old. It does not have a problem with winterkill. The grass greens up early and is ready for grazing between April 15 and May 1. It also stays green late into the fall. Hakari is advertised as having good nutritional value even after going to seed which gives a grass farmer a lot of options in developing an even flow of forage through the growing season. I have done no tests on this, but have let plots go to seed and then returned to cutting them at regular intervals. From the test plots I can recommend Hakari Brome as a good plant for short-term pastures. It may also be good for permanent pastures, but has not been tested long enough to make that recommendation.

Quick Establishing Grasses for Biennial Pastures

I am currently looking for a grass pasture that can be grown in a quick rotation between other crops. It could be planted in the fall to provide pasture for the next spring followed by a planting of Sudan x Sorghum. It could also be planted in the fall and provide feed the next spring and summer or it could be planted in the spring to provide summer pasture. With this in mind, a field planting of plots under irrigation was completed at Pocatello.

FY00 in mid April, plots were planted to Aroostock cereal rye, Bartissimo Italian ryegrass, and BG23 perennial ryegrass. Bartissimo and BG23 were used because of their winter hardiness and because we have a problem with ryegrasses having difficulty greening up in the spring. We want plants that provide spring feed as well as summer forage. All the plants established quickly and were ready for grazing in less than 75 days. Aroostock rye is definitely the most vigorous. However, Aroostock wants to go to seed. It had to be cut every two weeks to keep it from going to seed. This could be a big problem in pastures. All three varieties produced good quantities of forage throughout the summer and fall. They will be evaluated next spring for forage production from green up to mid June. Three plots were also planted in early October to evaluate

establishment and forage production in the spring. A special thanks is due to Barembrug for supplying the seed for these trials.

Sudan – Sorghum for Winter Feed

FY00 10 farmers planted sudan—sorghum varieties under various conditions. These fields were grazed in November and December. Some fields will not be used until February and March. Last winter the nutrition of the cows diet on fields of Granger sudan x sorghum were evaluated from fecal samples.

Granger Sudan x Sorghum

Date	Crude Protein	TDN	Dry matter eaten per day
Jan. 27	8.4%	64.6%	30 lbs.
Feb. 17	9%	63%	27 lbs.
Mar. 15	7.6%	58%	23 lbs.

Dry cows start out gaining weight on this feed. As there is less choice on what is available to eat, they just hold their weight. It is probably better to feed a partial feed of hay and let the cows pick on the last third of the time on a field.

The best production was from a field of Granger planted in mid May. It was in a field following potatoes and heavily fertilized. This field produced more than 400 cow days per acre. Two farmers planted Granger on old hay fields. They sprayed the hay with Roundup and cut it five days later. After baling the first crop of hay, they disked the field twice and then broadcast seed and fertilizer. These fields did not produce nearly as much forage, but also had one crop of hay. Of the varieties planted, Granger appears to be the best for southeast Idaho. It needs a lot of nitrogen fertilizer and possible some phosphate. It does not like an oversupply of water. This is really catching on and is reducing the hay feeding time.

FIELD OFFICE: MALAD

ID98024 Bill Hubbard Rush intermediate wheatgrass District Seed Increase. Seed ordered and shipped in April 1998. FY99, FY00 and FY01 no evaluations. **Cancel**

ID99017 Bill Hubbard Bannock thickspike wheatgrass District Seed Increase. Seed ordered April 28, 1999. FY99, FY00 and FY01 no evaluations. **Cancel**

FIELD OFFICE: MONTPELIER

None

FIELD OFFICE: POCATELLO

None

FIELD OFFICE: PRESTON

ID93015 SWCD Multiple species demo plots. Site is located behind the Preston FO. Species provided in Aug 93. FY93 50 varieties were planted. FY94 Excellent stand of Luna, Bannock (9021076), Hycrest, Greenar, 281863 int. wheatgrass, Rush, Reliant, P27, Sodar, Hycrest, Ephraim, Tegmar, Eski, Appar, Delar, Paiute, Covar, Durar, Manska pub. wheatgrass, Latar, Garrison, Regar, Manchar. Good stand of Critana, Whitmar, Newhy, Topar, Sherman, Jose, Lutana, Magnar, Trailhead, Prairieland, Mankota, Bozoisky, Alkar, Rosana, Cascade, Kalo, Retain. Fair stand of Secar, Goldar, Nezpar, 478833 Indian ricegrass, Amur, Paloma, Johnstone fescue. Poor stand of Blackwell switchgrass. No stand of Cedar, Osage Indiangrass, Roundtree big bluestem, Bandera, Rincon, Wytana, Homestead Arnold hawthorn. FY95 detailed report available. Excellent stand of Luna, Bannock (T21076), Hycrest, Greenar, 281863 intermediate wheatgrass, Rush, Reliant, P27, Sodar, Hycrest, Ephraim, Tegmar, Eski, Delar, Paiute, Covar, Durar, Manska, Retain, Garrison, Regar, and Manchar. Good stands of Critana, Whitmar, Newhy, Topar, Sherman, Jose, Lutana, Magnar, Trailhead, Prairieland, Mankota, Bozoisky, Alkar, Rosana, Cascade, Kalo, and Retain. Fair stands of Secar, Goldar, Nezpar, 478833 Indian ricegrass, Amur, Paloma, and Johnstone fescue. Poor stand of Blackwell. Failure with Cedar, Osage, Roundtree, Bandera, Rincon, Wytana and Homestead. FY96 detailed report available. FY97 and FY98 no evaluations. FY99 excellent stands of Luna, Greenar, Rush, Reliant, Hycrest, Amur, Manska, Alkar, Covar, Jose, Sherman, Tegmar, Manchar, Retain, and Latar. Good stands of Critana, 281863 intermediate wheatgrass, P27, Sodar, Ephraim, Newhy, Prairieland, Durar, Paiute, Delar, Topar, Garrison, and Johnstone. Fair stands of Bannock, Secar, Rosana, Bozoisky, Mankota, Trailhead, Magnar, Regar, and Roundtree. Poor to very poor stands of Goldar and Whitmar. Failed stands of Nezpar, PI478833, Paloma, Appar, Eski, Cedar, Lutana, Blackwell, Kalo, Cascade, Bandera, Osage, Arnold hawthorn, Wytana, and Rincon. FY00 and FY01 no evaluations - **cancel**.

ID95036 Franklin County Bannock thickspike wheatgrass and Sodar streambank wheatgrass critical area planting. Site is landfill, Wheelon/Collonston soil, non-irrigated, 14-15 inch ppt, 5000 feet elevation, 12-20% slopes on north exposure. Seed ordered 5/5/95. FY95 seed planted 5/17/95 in good clean seedbed. Fall evaluation indicated good stand establishing for both species. FY96 good stands of both species with 3 plants/ft2 and spreading. Species are providing good erosion control. FY97 and FY98 no evaluations. FY99 good stand of each specie with 3-4 plants per square foot, good

vigor, good ability to spread, and good erosion control under these conditions. Weed infestation of planting is very low. FY00 Bannock and Sodar stands are good with good vigor and 4 plants per square foot. FY01 no evaluation.

FIELD OFFICE: SODA SPRINGS

None

IDAHO DIVISION VI

FIELD OFFICE: ARCO/CHALLIS

ID80100 IDL Bradbury Flat Multiple Adaptation Evaluation every 3 years. Planted March 25, 1980. FY92 evaluation 7/7/92. FY95 evaluation 11/14/95. All evaluations available on request. FY99 Evaluations September 1999. Good to excellent stands include 7654 crested wheatgrass, P27 Siberian wheatgrass, Sodar streambank wheatgrass, AB447 crested wheatgrass, and Secar Snake River wheatgrass. Fairs to poor stands include Goldar bluebunch wheatgrass and Ladak alfalfa. Failures include: Nezpar Indian ricegrass, Luna pubescent wheatgrass, Magnar basin wildrye, Topar pubescent wheatgrass, Appar blue flax, Firecracker penstemon, Bandera Rocky Mountain penstemon, Cedar Palmer penstemon, Alpine penstemon, AB555 blueleaf aster, black-eyed susan, AB9223 fourwing saltbush, AB9421 fourwing saltbush, Delar small burnet, PI314929 forage kochia and sulpherflower buckwheat. AB585 and AB764 winterfat could not determine stand due to presence of native winterfat. **Next evaluation FY03**.

ID80101 IDL Bradbury Flat Multiple Adaptation Evaluation every 3 years. Planted November 7, 1981. FY92 evaluation 7/7/92. FY95 evaluation 11/14/95. All evaluations available on request. FY99 Evaluations September 1999. Good to excellent stands include B1574 crested wheatgrass, P27 Siberian wheatgrass, AB447 crested wheatgrass, Secar Snake River wheatgrass, AB585 winterfat, AB764 winterfat, Bozoisky Russian wildrye and Vinall Russian wildrye. Fair to poor stands include Sodar streambank wheatgrass and Immigrant forage kochia. Failures include Nezpar Indian ricegrass, Luna pubescent wheatgrass, Goldar bluebunch wheatgrass, Magnar basin wildrye, Topar pubescent wheatgrass, Bandera Rocky Mountain penstemon, Cedar Palmer penstemon, Alpine penstemon, black-eyed susan, Delar small burnet, green needlegrass, Blair smooth brome, and PI109072 orchardgrass. Appar blue flax and firecracker penstemon were found outside of seeded plots. AB922 fourwing saltbush and AB942 fourwing saltbush plants were present with low vigor. **Next evaluation FY03**.

ID82101 BLM Hole In Rock Multiple Adaptation Evaluation every 3 years. Planted late October 1982. FY92 evaluation 7/7/92. FY95 evaluation 9/95. All evaluations available on request. FY99 plots were not accessible in September 1999. **Next evaluation FY03**.

ID82102 BLM Centennial Multiple Adaptation Evaluation every 3 years. Planted late October 1982. FY92 evaluation 6/26/92. FY95 evaluation 6/20/95. All evaluations available on request. FY99 not evaluated. **Next evaluation FY03**.

ID82103 BLM Spud Alluvial Multiple Adaptation Evaluation every 3 years. Planted late October 1982. FY92 evaluation 6/25/92. FY95 evaluation 11/14/95. All evaluations available on request. FY99 evaluations September 1999. Good to excellent stands include Whitmar beardless wheatgrass, P27 Siberian wheatgrass, Secar Snake River wheatgrass, Sodar streambank wheatgrass, Immigrant forage kochia, Vinall Russian wildrye, and Bozoisky Russian wildrye. Fair to poor stands include Synthetic alfalfa, PI109012 crested wheatgrass, Topar pubescent wheatgrass and Goldar bluebunch wheatgrass. Failures include Newhy hybrid wheatgrass, scarlet globemallow, Cedar Palmer penstemon, Appar blue flax, PI109072 orchardgrass, Barton western wheatgrass, Nezpar Indian ricegrass, Magnar basin wildrye, and yellow sweetclover. Kochia is spreading outside of seeded plots and is only plant that is actively growing at evaluation date. Whitmar and Bozoisky affected by excessive litter. **Next evaluation FY03**.

ID82104 BLM Jeff's Flat Multiple Adaptation Evaluation every 3 years. Planted late October 1982. FY92 evaluation 6/26/92. FY95 no evaluation. FY99 evaluations September 1999. Good to excellent stands include Manchar smooth brome and Covar sheep fescue. Fair to poor stands include Synthetic alfalfa, Lutana cicer milkvetch, Durar hard fescue, PI1099012 crested wheatgrass, P27 Siberian wheatgrass, Greenar intermediate wheatgrass, Magnar basin wildrye, and Bozoisky Russian wildrye. Failures include Newhy hybrid wheatgrass, Hycrest crested wheatgrass, Delar small burnet, Baylor smooth brome, Bandera Rocky mountain penstemon, Cedar Palmer penstemon, Appar blue flax, Pi109072 orchardgrass, Sherman big bluegrass, Vinall Russian wildrye, and yellow sweetclover. Rodent damage evident in plots. **Next evaluation FY03**.

ID82105 BLM Round Valley Multiple Adaptation Evaluation every 3 years. Planted late October 1982. FY92 evaluation 6/25/92. FY95 evaluation 11/13/95. All evaluations available on request. FY99 evaluations September 1999. Good to excellent stands include P27 Siberian wheatgrass, Nordan crested wheatgrass, Vinall Russian wildrye and Bozoisky Russian wildrye. Fair to poor stands include Newhy hybrid wheatgrass, thickspike wheatgrass x crested, Nezpar Indian ricegrass, Secar Snake River wheatgrass, Immigrant forage kochia, and PI109012 crested wheatgrass. Failures include Synthetic alfalfa, scarlet globemallow, Bandera Rocky Mountain penstemon, Cedar palmer penstemon, Appar blue flax, PI109072 orchardgrass, Goldar bluebunch wheatgrass, Barton western wheatgrass, Topar pubescent wheatgrass, Whitmar beardless wheatgrass, Magnar basin wildrye, and yellow sweetclover. **Next evaluation FY03**.

ID82106 BLM Gooseberry Multiple Adaptation Evaluation every 3 years. FY92 evaluation 7/7/92. FY95 site has deteriorated to point evaluations would provide little future value. Some scattered plant materials still remain. **Cancel future evaluations, but maintain file for reference purposes.**

ID83100 FS Nip & Tuck Multiple Adaptation Evaluation every 3 years. FY92 evaluation 7/6/92. FY95 site has deteriorated to point future evaluations would provide little future value. Plants of Luna, Topar, Nezpar, Regar, Covar, Durar and Garrison still evident. Covar/Durar and then Regar doing best. Mountain big sagebrush and Idaho fescue are dominating site. **Cancel future evaluations, but maintain file for reference purposes.**

ID01001 Cooperator unknown cottonwood field planting. 9067408 Narrowleaf cottonwood, 9067443 Narrowleaf cottonwood, 9067484 Narrowleaf cottonwood, 9067502 Narrowleaf cottonwood, 9067537 Black cottonwood, 9067538 Black cottonwood, 9067562 Black cottonwood, 9067563 Black cottonwood, 9067568 Black cottonwood, 9067569 Black cottonwood, Robust poplar, Carolina poplar, and Siouxland poplar. FY01 no evaluation.

FIELD OFFICE: DRIGGS

ID91006 Fair Grounds Multiple Species Demo Plots. FY92 planted spring 1992 excellent survival on all species except trefoil, mountain brome and cicer milkvetch which will have to be replanted. FY93 Remont, Bromar, Lutana planted spring of 1993. Remont is not tolerant of frequent irrigation. Bozoisky exhibits poor seedling vigor, Goldar has poor plant vigor, Canbar not recommended for pure stands, Magnar not adapted to shallow soils, Newhy lacks seedling vigor, Manchar exhibits poor summer regrowth, Whitmar is not tolerant of excessive moisture, Garrison adapted to wet soils. Magnar, Bromar, Rush, and Lutana are all doing poorly. Ordered Rush, P27, Magnar, Canbar, and Bozoisky on 3/17/94 to be included in plots. FY94 all plots good to excellent stand except Lutana, Remont and Delar. These plots are all irrigated so evaluations for drought, flood, salt and acid tolerance not possible. This planting does provide excellent trials for irrigated varieties in high mountain valleys. FY95 best performers are Hycrest, Critana, Alkar, Tegmar, Luna, Greenar, Topar, Rush, Regar, Manchar, Latar, Paiute, Sodar, Newhy, Durar, Sherman, Canby and Delar. Complete evaluations are available on request. FY96 not evaluated. FY97 Durar and Delar good to excellent stands with high vigor; Regar, Amur, Manchar, Latar, Paiute good stands with excellent vigor; Rush fair stand with fair vigor; Sodar, Goldar, Cascade, Appar poor stands with fair vigor; Hycrest, Critana, Alkar, Tegmar, Luna, Greenar, Topar, Lutana, Garrison, Whitmar, Secar, P27, Bromar, Magnar, Bozoisky, Canbar, Sherman, Kalo, very poor to failed stands. All plots are subject to turfgrass encroachment. February 9, 1998 ordered Hycrest, CD-II (Hycrest II), Sherman, Newhy, Critana, Bannock, Garrison, and Bozoisky for plots. FY98 species with good to excellent stands include Amur, Rush, Manchar, Latar, Durar, Cascade, and Delar. Species with poor to fair stands include Alkar, Luna, Topar, P27, Bromar, Paiute, Magnar, Appar, and Bozoisky. Failed stands

include Hycrest, Critana, Tegmar, Greenar, Secar, Whitmar, Garrison, Lutana, Regar, Sodar, Newhy, Kalo, Sherman, Canbar, and Goldar. FY99, FY00 and FY01 no evaluations.

ID99018 SCD field planting—leafy spurge competition study. Species include Rush intermediate wheatgrass, Luna pubescent wheatgrass, Regar meadow brome, Bromar mountain brome, Durar hard fescue, Bozoisky Russian wildrye, and Climax timothy. Seed ordered April 28, 1999 for shipment about May 17, 1999. FY99 Roundup was applies on June 10th to leafy spurge plots with up to 200 stems per 9.6 square foot hoop. Grass was drilled into plots on July 1, 1999 using a Brillion drill. Evaluation of germination and establishment will be performed in the spring of 2000. Replicated plots will be installed in May of 2000. FY00 and FY01 no evaluation.

FIELD OFFICE: IDAHO FALLS

ID94020 Winterfeld Magnar basin wildrye and Trailhead basin wildrye vegetative terraces field planting. Seed ordered 3/94. FY94 planted 5/94. Good initial stand establishment with good vigor. FY95 excellent stand establishment with over 3 plants/ft^2. Plants average 24-inch height. Grouse are using basin wildrye for nesting cover. Working well for erosion control. FY96 excellent stands with excellent vigor Trailhead and good vigor Magnar. Excellent wildlife use by game birds, deer, owls, and coyotes. Both species are very good for snow catchment and field windbreaks. FY97 100% survival, Trailhead spreading a little faster than Magnar. Plant height about 96 inches for each. Cooperator notes that Trailhead is more drought tolerant and Magnar is more robust. FY98 100% survival for both species. Cut for seed this year with 140 pounds of clean seed per acre. FY99 excellent stands: Magnar 96 inches tall with little to no spread; Trailhead 84 inches tall with good spread via seed shatter. FY00 excellent stands with excellent vigor for both Magnar and Trailhead. Magnar is more robust with 96 inches height. Trailhead is spreading rapidly, is more drought tolerant, and approximately 84 inches tall. FY01 excellent stand and vigor with 96 inch height. Seed production was approximately 100 pounds per acre. Straw yield was 1.6 tons per acre.

ID95007 Winterfeld Rush intermediate wheatgrass District Seed Increase. Seed ordered 2/95. FY95 excellent stand establishing. FY96 700 lbs seed production, 1.5 tons per acre straw. FY97 400 lbs/acre clean seed production, plant height 50 inches, fertilized May 10 with 50 lbs/ac N. FY98 400 pounds per acre seed production. FY99 excellent stand in unfavorable moisture year with 435 pounds of bulk seed production per acre. FY00 excellent stand and vigor. Rush is an excellent forage grass for cattle. Seed production unknown at evaluation date. FY01 field plowed out – **cancel**.

ID95046 Winterfeld Alpine penstemon and Firecracker penstemon District Seed Increase. Seed sent 8/95. FY95 planted fall 1995. FY96 poor stand establishing for Alpine and no emergence for Firecracker, no seed production. FY97 Alpine slow establisher and susceptible to frost, no seed production. FY98 fair stand of both Firecracker and Alpine penstemon (1 plant per foot^2). Stands for both species are getting better each year. FY99 fair stands in unfavorable moisture year and no seed

production. FY00 Firecracker penstemon died due to drought and short-lived character. Alpine penstemon has good stand with good vigor and stands 24 inches tall. Seed production was unknown at evaluation date. FY01 firecracker penstemon came back, excellent stands and vigor for both species. Seed production estimated at 600 pound per acre bulk.

ID96003 Winterfeld Douglas crested wheatgrass District Seed Increase. Seed will be purchased through the Utah Crop Improvement Association. FY96 fair stand establishing during extremely dry conditions (no rain following planting). FY97 fair stand with good vigor and no seed production. Stand is improving. FY98 good stand established with 300 pounds per acre seed production. Elk and grouse are using stand. FY99 excellent stand in unfavorable moisture year with 400 pounds of cleaned seed production per acre. FY00 excellent stand and vigor. Seed production was excellent this year, but amount was unknown at evaluation date. Douglas is well suited for the Swan Valley area and is an excellent grazing species for cattle. FY01 excellent stand and vigor with 260 pounds per acre production. Douglas is tolerating drought very well.

ID99016 Winterfeld Goldar bluebunch wheatgrass District Seed Increase. Seed ordered April 15, 1999. Site characteristics—Tetonia silt loam soil, 1% slopes, north aspect, 5400 feet elevation, 18 inch precipitation zone, non-irrigated, T2N R43E NW1/4 Section 26. FY99 planted spring 1999 with good stand establishing. FY00 excellent stand and vigor. Seed production unknown at evaluation date. Good regrowth in spite of very droughty conditions. FY01 excellent stand and vigor. 150 pounds per acre cleaned seed production (some problem with silver top). 900 pounds of straw per acre.

ID99020 Winterfeld Nezpar Indian ricegrass District Seed Increase. Seed ordered August 20, 1999. Site characteristics—Hobarker gravelly loam soil, 2% slope, north aspect, 5315 feet elevation, 18 inch precipitation, non-irrigated, 25 acres, T1N R44E SE1/4 Section 17. FY99 planted late October 1999. FY00 fair stand with fair vigor. No seed was produced this year due to extended drought and slow plant establishment. FY01 failed due to drought – **cancel**.

ID01006 Winterfeld Ephraim crested wheatgrass District Seed Increase. Seed ordered March 13, 2001. Site characteristics—Tetonia silt loam soil, 2% slopes, south aspect, 5600 feet elevation, 18 inch precipitation, non-irrigated, T2N R43E SE1/4 Section 8. FY01 plan to plant spring 2002 due to drought this year.

ID01008 Winterfeld Lodorm green needlegrass. Seed purchased through North Dakota and shipped April 4, 2001 for seed increase. FY01 failed due to drought – **cancel**.

ID01012 Winterfeld Regar meadow brome—Foundation. FY01 good stand establishing with fair vigor due to drought conditions.

ID01013 Winterfeld Sodar streambank wheatgrass—Foundation. FY01 excellent stand establishing with excellent vigor under severe drought conditions.

FIELD OFFICE: REXBURG

ID89015 Wagoner Luna pubescent wheatgrass, P-27 Siberian wheatgrass, Sodar streambank wheatgrass, Greenar intermediate wheatgrass, Delar small burnet, Trevois alfalfa field planting on rangeland. Site is gravelly loam soil with a pan at 5-6 inches, non-irrigated, 12-inch ppt, 6300 feet elevation, and 3% slopes on NE exposure. FY89 ripped rangeland in spring and seeded mix in fall of 1990. FY91 excellent stand establishing with production about 1400 lbs/ac. FY92 clipping data: No Treatment—318 lbs/ac., chisel only treatment (native species)—495 lbs/ac., chisel/disc/seed treatment—1110 lbs/ac. Clipped 7/9/92. FY93 Clipped plots resulted in production of 1200-2000 lbs/ac. FY94 production of about 800 lbs/ac in extremely droughty year. Non treated rangeland producing about 100 lbs/ac this year. FY95 excellent stand Luna and Greenar, Good stand P-27, Sodar and Travois and Poor stand of Delar. Stand produced 1400+ lbs/acre this year. High antelope use of stand was noted. Stand was grazed 3 weeks in spring and 4 weeks in fall with good management. FY96 excellent stand of Trevois, and good stand of Luna, P27, Sodar, and Greenar. Very poor stand of Delar. Considered 90% stand overall. Produced 1000 lbs/ac in very poor moisture year. Stand is doing great under good management. **Next evaluation will be FY02**.

ID90025 Wagoner Rush intermediate wheatgrass field planting on rangeland. Site is gravelly loam soil with a pan at 5-6 inches, non-irrigated, 12-inch ppt, 6300 feet elevation, and 3% slopes on NE exposure. FY89 ripped rangeland. FY90 planted April 1990. FY91 excellent stand establishing with no weeds. Production is 1400 lbs/ac. FY92 stand excellent with 1200 lbs/ac production. FY93 excellent stand producing 2000+ lbs/ac. Grazing value—appears to be a highly preferred/selected species according to cooperator. FY94 excellent stand producing 800 lbs/ac in very droughty year. FY95 excellent stand producing 1800+ lbs/acre. Rush is the most productive species in all range trials. FY96 excellent stand with 5-10 plants/ft^2 producing 1000-lbs/ac and good vigor in very low rainfall year. **Next evaluation will be FY02.**

ID90035 Wagoner Bozoisky Russian wildrye field planting on rangeland. Site is gravelly loam soil, non-irrigated, 12-inch ppt, 6200 feet elevation, and 2% slopes on NE exposure. FY90 planted April. FY91 good stand establishing. FY92 excellent stand producing 1100 lbs/ac. FY93 90% + stand and up to 4' tall, estimated production 1200-1400 lbs/ac. FY94 good stand producing about 600 lbs/ac in very droughty year and only 50% of plants produced seedheads this year. FY95 good stand producing 1200+ lbs/acre. This species is doing very well and is well adapted to site. FY96 good stand with 4-5 plants/ft^2 and 1200-lbs/ac production in very low summer rainfall year. **Next evaluation will be FY02.**

ID91033 Madison SCD Multiple species demo plots. Located behind Rexburg FO. FY91 planted in spring. FY92 planting establishing well. Shrubs under fiber mulch are out performing those that are not. FY93 plants were doing well but had to be moved because of enlargement of parking lot. Will know survival in 94. FY94 Grass plots were removed because of parking lot enlargement. Austrees are 4 years old and about 20 feet tall and 2 year old poplars are 10-12 feet tall. FY95 Arctic willows failed transplant, all others are doing very well. Austrees are 25 to 30 feet tall (five years Old). Grass will be planted in spring of 1996. FY96 Austrees 30+ feet tall, Poplars 20+ feet tall and

Larch is eight feet tall (4 years old). FY97 lost one poplar to disease all others doing well. **Next evaluation will be FY02**.

ID92013 Webster Regar meadow brome, Bozoisky Russian wildrye, Luna pubescent wheatgrass, Critana thickspike wheatgrass field planting on rangeland. Site is gravelly silt loam soil, non-irrigated, 14-inch ppt, 6000 feet elevation, and 4% slopes on SE exposure. FY92 site sprayed for weed control, but too dry to seed. FY93 seeding not completed. FY94 very poor moisture conditions, planting not installed. FY95 good stand of all species establishing with good spring moisture. FY96 good stand of all species with 2-4 plants/ft^2 and good vigor on all except Regar has fair vigor. Stand had low production and is still establishing. FY97 good stands for all species with 60% stands and good vigor—they have been slow to establish on this tough site. FY99 Bozoisky and Luna good stands, Regar and Critana fair stands. **Next evaluation will be FY02**.

ID93001 Clark SCD Multiple species demo plots. Site is located near Clark County Senior Center. FY93 trees were planted and ground prepared by chiseling to plant grass in the spring of 94. FY94 trees and shrubs planted with fabric material have a 98-100% survival. Grass plots were not installed due to drought conditions. FY95 all trees have survived and doing great. Poplars are 6-8 feet tall second year. Grass plots were planted in spring of 1995 and are establishing well. FY96 poplars 10-15 feet tall, juniper 4-5 feet tall, grass plots are establishing well. FY97 excellent growth for both trees and shrubs. FY99 grass plots are well established. A 1600 feet windbreak with drip system has been added to area (species include row 1: poplars, row 2 mixed shrubs of Siberian peashrub, chokecherry, and Nanking cherry, and row 3 Rocky Mountain juniper. Survival the first year was 98%. **Next evaluation will be FY02**.

ID94017 Lerwill Multiple willows adaptation demo. Colorado accessions. Cuttings ordered 3/94. Cuttings shipped 4/94. FY94 no evaluation. Some cuttings of each species have survived. The PMC accessions have much better growth than native species. Some loss due to spraying herbicide to control thistles. FY96 willows that survived are doing well. FY97 40% survival with surviving willows growing well. They survived spring flooding. FY98 vigor is good with plants now 8 to 10 feet tall and 10 feet crown width. **Next evaluation will be FY02**.

ID98009 Lerwill Aberdeen PMC - Laurel willow field planting. Materials ordered 2/9/98. FY98, FY99, FY00 and FY01 no evaluations.

ID00011 Richard Beesley Poplar field planting of accessions (15-29; 50-197; OP-367; 184-411; 52-225). Materials shipped from Oregon to Aberdeen PMC April 1998 and transferred to Rexburg same date. FY98 Poplar accessions planted in April were subjected to several hard frosts, and very hot dry summer. Survival was poor at 30%.

100 cuttings each of OP367 Hybrid poplar and 52-225 Hybrid poplar were ordered March 1, 2000 from Aberdeen for shipment on about March 7, 2000. FY00 and FY01 no evaluation.

FIELD OFFICE: RIGBY/TERRETON

ID96019a Mud Lake Willows and cottonwood demo planting Laurel, Coyote, White, Robusta poplar, Siouxland poplar, and Carolina poplar. Cuttings ordered 2/20/96. Planted May 8, 1996 using fabric mulch material and drip irrigation. FY96 Water application, started July 5th with willows receiving 7 gallons/week and poplars receiving 12 gallons/week. Flood irrigation by Park officials resulted in over-irrigation and drip system was cut back. 100% survival of all species except coyote, which had 70% survival. Good vigor for all species except Carolina poplar, which had fair vigor. Growth: Carolina 3.2 feet; Siouxland 5.7 feet; Robust 5.5 feet; Laurel 2.7 feet; White 3.7 feet; Coyote 4.0 feet. FY97 Irrigation: 3 gallons/tree from May through September. Survival/Vigor/Height: Carolina poplar 75%/good/10.5 feet; Siouxland poplar 100%/excellent/14 feet; Robust poplar 100%/fair/7 feet; Laurel willow 100%/excellent/7.5 feet; White willow 100%/excellent/9 feet; Coyote willow 67%/fair/ 4.5 feet. FY98 Survival/ Vigor/Height: Carolina poplar 75%/good/15 feet; Siouxland poplar 100%/excellent/ 20 feet; Robust poplar 100%/fair/12 feet; Laurel willow 100%/excellent/10.5 feet; White willow 100%/good/14 feet; Coyote willow 70%/good/6.5 feet. FY99 Carolina poplar 75% survival with good vigor and 21.2 feet height. Siouxland poplar 100% survival with excellent vigor and 26.4 feet height. Robust poplar 100% survival with poor vigor (yellow leaves) and 16.6 feet height—seedlings are vigorous with good color and suspect Aberdeen stock may have disease. Laurel willow 100% survival with good vigor and 12.4 feet height. White willow 100% survival with good vigor and 18.5 feet height. Coyote willow 70% survival with fair vigor and 6.9 feet height. FY00 Flood irrigated every two weeks with drip irrigation 6-10 gal/week. Carolina poplar 75% survival with excellent vigor and 320 inch height. Siouxland poplar 100% survival with excellent vigor and 354 inch height. Robust poplar 100% survival with poor vigor (disease) and 216 inch height. Laurel willow 100% survival with excellent vigor and 180 inch height. White willow 100% survival with fair vigor and 240 inch height. Coyote willow 66% survival with fair vigor and 90 inch height. FY01 6-year-old planting was flood irrigated every two week this year. Carolina poplar (10-15 feet spacing recommended)—75% survival, excellent vigor, 36 feet height, 16 feet crown width, and 5.5 inch DBH. Siouxland poplar (10-15 feet spacing recommended)—100% survival, excellent vigor, 38 feet height, 15 feet crown width, and 5 inch DBH. Robust poplar (10-15 feet spacing recommended) – 100% survival, poor vigor, 25 feet height, 9 feet crown width, and 3.5 inch DBH. Laurel willow (8-10 feet spacing recommended)—100% survival, good vigor, 17 feet height, 12.5 feet crown width, and 2 inch DBH. White willow (10-12 feet spacing recommended) – 100% survival, fair vigor, 20 feet height, 12 feet crown width, and 2 inch DBH. Coyote willow (3-5 feet spacing recommended)—70% survival, fair vigor, 8 feet height, and 3 feet crown width.

ID96019b Rigby Cottonwood demo planting—Carolina, Siouxland, Robusta. Planted April 29th using fabric mulch and drip irrigation. FY96 Water application 10-14 gallons per week. Growth Carolina 2.0 feet; Siouxland 3.2 feet; Robust 4.0 feet. FY97 100% survival for all poplars. Good vigor for Carolina and Siouxland / poor vigor for Robust. Height 8-9 feet Carolina and Siouxland / 3 feet Robust. FY98 Survival/Vigor/Height: Carolina poplar 100%/good/15 feet; Siouxland poplar 100%/ excellent/18 feet; and

Robust poplar 100%/poor/5.5 feet. FY99 Carolina poplar 100% survival with fair vigor and 21 feet height. Siouxland poplar 100% survival with fair vigor and 21 feet height. Robust poplar 100% survival with very poor vigor and 7 feet height. Note: Robust poplars from Lawyers Nursery are thriving, so suspect Aberdeen cuttings may be carrying a disease. FY00 Drip irrigated (14 gal/week)—Carolina poplar 100% survival with fair vigor and 240 inch height; Siouxland poplar 100% survival with fair vigor and 252 inch height; Robust poplar 100% survival with poor vigor and 84 inch height. FY01 6-year-old planting is irrigated with drip irrigation system at 7 gallons per week. Carolina poplar—100% survival, poor vigor 22 feet height, 7 feet crown width, and 2.5 inch DBH. Siouxland poplar—100% survival, poor vigor, 24 feet height, 6 feet crown width, and 3 inch DBH. Robust poplar—100% survival, very poor vigor, 7 feet height, 4 feet crown width, and 1 inch DBH. Drought stress is evident and drip irrigation system is probably not fully functioning with plugged emitters, need for additional emitters, and need for longer watering sets.

ID97019a Hager Willow field planting. 5 cuttings of Aberdeen willows—Laurel, Streamco, and White; 5 cuttings of Meeker willow—Scouler. Cuttings ordered 2-11-97. FY97 windbreak planted mid April 1997 with fabric mulch and drip irrigation (averaged 8-10 gallons/plant/week. Survival/Vigor/Height: Laurel 100%/excellent/2.5 feet; Streamco 100%/excellent/4 feet; White 100%/excellent/ 6 feet; Scouler 75%/good/4.5 feet—Scouler affected by fungus on leaves. FY98 Survival/Vigor/Height: Laurel 100%/good/5.5 feet; Streamco 100%/fair/5 feet; White 100%/good/8 feet; and Scouler 75%/fair/5 feet. FY99 Laurel willow 100% survival with fair vigor and 6.3 feet height. Streamco willow 100% survival with good vigor and 6.7 feet height—note looks like spider plant and would not recommend for windbreaks, but would probably make an excellent streambank erosion control species. White willow 100% survival with good vigor and 5 feet height. Scouler willow 75% survival with good vigor and 13.5 feet height. FY00 Laurel willow 100% survival with good vigor and 96 inch height; Streamco willow 100% survival with good vigor and 60 inch height; White willow 100% survival with fair vigor and 192 inch height; Scouler willow 75% survival with fair vigor and 84 inch height. FY01 five-year-old planting is drip irrigated. Laurel willow—100% survival good vigor, 9.5 feet height, 8 feet crown width, and out performing others in this test with healthy vigorous growth and increased density. Streamco willow—100% survival, good vigor, 5.5 feet height, and 10 feet crown width. White willow—100% survival, fair vigor, 16 feet height, and 9 feet crown width. Scouler willow—75% survival, poor vigor, 7 feet height, 6 feet crown width, and damage by borers.

ID97019b Camas Creek site 1 Willow field planting. Cuttings of Aberdeen PMC willows—White, Laurel, Streamco, Geyer, Coyote and Meeker PMC willows Scouler, Pacific, Booth (827), Drummond (828), Greyleaf, Wolf and Geyer (832). Planted April 10, 1997 for streambank protection (no irrigation). On May 21, 1997 Laurel and White were submerged and all others were partially submerged. FY97 Survival/Vigor/Height: White 100%/excellent/3 feet; Laurel 100%/excellent/ 1.5 feet; Streamco 100%/excellent/2.5 feet; Geyer 100%/ excellent/2 feet; Coyote 60%/excellent/2 feet; Scouler 100% excellent/2 feet; Pacific 100%/excellent/3 feet; Booth (827) 100%/good/1.5 feet; Drummond (828) 100%/good/1.5 feet; Greyleaf 80%/fair/2 feet;

Wolf 80%/fair/0.5 feet; Geyer (832) 100%/exc./2 feet. FY98 Survival/Vigor/Height: White 100%/good/4 feet; Laurel 100%/fair/2 feet; Streamco 100%/good/3 feet; Geyer 100%/fair/2.5 feet; Coyote 67%/excellent/5-5 feet; Scouler 80%/fair/2 feet; Pacific 100%/good/3 feet; Booth (827) 100%/poor/ 2 feet; Drummond (828) 80%/fair/2.5 feet; Greyleaf 80%/poor/2 feet; Wolf 80%/ poor/l foot; and Geyer (832) 80%/fair/2.5 feet. FY99 White willow 100% survival with good vigor and 6 feet height. Laurel willow 100% survival with fair vigor and 3 feet height. Streamco willow 100% survival with good vigor and 4 feet height. Geyer willow 100% survival with good vigor and 5 feet height. Coyote willow 100% survival with good vigor and 5 feet height. Scouler willow 60% survival with fair vigor and 4 feet height. Pacific willow 100% survival with good vigor and 7 feet height. Booth (827) willow 100% survival with fair vigor and 3 feet height. Drummond (828) willow 20% survival with poor vigor and 2 feet height. Greyleaf willow 80% survival with poor vigor and 1 foot height. Wolf willow 20% survival with poor vigor and 1.5 feet height. Geyer (832) willow 80% survival with fair vigor and 3.5 feet height. FY00 Elk heavily utilize site in winter. Overall the Streamco, White, Pacific, Coyote willows are performing the best under browsed conditions. Streamco is probably the best streambank stabilization willow being tested and is spreading with noticeable root growth. Aberdeen willows—White willow 100% survival with excellent vigor and 80-inch height; Laurel willow 75% survival with good vigor and 48 inch height; Streamco willow 100% survival with good vigor and 48 inch height; Geyer willow 80% survival with poor vigor and 60-inch height; Coyote willow 100% survival with good vigor and 48 inch height. Meeker willows—Scouler willow 60% survival with fair vigor and 40 inch height; Pacific willow 100% survival with good vigor and 90 inch height; Booth (827) willow 100% survival with fair vigor and 48 inch height; Drummond (828) willow 80% survival with fair vigor and 48 inch height; Greyleaf willow 40% survival with poor vigor and 28 inch height; Wolf willow 40% survival with poor vigor and 28 inch height; Geyer (832) willow 60% survival with good vigor and 60 inch height. FY01 riparian planting with moisture provided by stream/subirrigation through 1st week of July (2 years of drought have affected this planting—however, tree type willows Pacific, White, and Streamco are best performers perhaps because they were able to root more deeply than shrub type willows). Scouler willow—40% survival, very poor vigor, 4 feet height, and 3 feet crown width. Pacific willow—100% survival, good vigor, 7 feet height and 7 feet crown width. Booth willow (827)—100% survival, poor vigor, 2.5 feet height, and 3 feet crown width. Drummond willow (828)—100% survival, poor vigor, 2.5 feet height, and 2 feet crown width. Greyleaf and Wolf willow failed. Geyer willow (832)—40% survival, fair vigor, 4 feet height, and 4 feet crown width. White willow—100% survival, fair vigor, 7 feet height, and 6 feet crown width. Laurel willow—75% survival, poor vigor, 3 feet height, and 3 feet crown width. Streamco willow—100% survival, good vigor, 6 feet height, and 8 feet crown width. Geyer (Aberdeen) willow—100% survival, poor vigor, 3 feet height, and 3 feet crown width. Coyote willow—40% survival, poor vigor, 4 feet height, and 2 feet crown width.

ID97019c Camas Creek site 2 Willow field planting. Cuttings of Meeker PMC Drummond (827), Drummond (829), Booth (827), Booth (825), Sandbar (831), Geyer (822), Yellow (819), Yellow (834), and Yellow (835). Planted April 17, 1997 for streambank protection (no irrigation). All cuttings submerged at mid May for about one

month. FY97 Survival/Vigor/Height: Drummond (827) 80%/good/2 feet; Drummond (829) 60%/fair/l foot; Booth (827) 40%/good/1.5 feet; Booth (825) 60%/ fair/l foot; Sandbar (831) 80%/fair/l foot; Geyer (822) 60%/ poor/l foot; Yellow (819) 40%/fair/1.5 feet; Yellow (834) 100%/excellent/1.5 feet; Yellow (835) 60%/fair/1.5 feet. FY98 Survival/Vigor/Height: Drummond (827) 60%/fair/3.5 feet; Drummond (829) 0%; Booth (827) 20%/fair/3 feet; Booth (825) 60%/fair/2.5 feet; Sandbar (831) 100%/excellent/5 feet; Geyer (822) 20%/poor/3 feet; Yellow (819) 40%/good/5 feet; Yellow (834) 100%/excellent/7 feet; and Yellow (835) 40%/good/ 3.5 feet. FY99 Drummond (847) willow 60% survival with good vigor and 5 feet height. Drummond (829) willow failed. Booth (827) willow 60% survival with good vigor and 5 feet height. Booth (825) willow failed. Sandbar (831) willow 100% survival with excellent vigor and 8.3 feet height. Geyer (822) willow failed. Yellow (819) willow 60% survival with good vigor and 7 feet height. Yellow (834) willow 60% survival with good vigor and 8 feet height. Yellow (835) willow 20% survival with fair vigor and 4 feet height. FY00 Coyote willow (native) is thriving and dominating the site with average of 1 plant/foot. Weeds are being crowded out. The planted willows performing the best are Booth (825) and Yellow (819) willows. Drummond (827) willow 60% survival with good vigor and 76 inch height. Drummond (829) willow failed. Booth (827) willow 20% survival with good vigor and 84 inch height. Booth (825) willow 80% survival with excellent vigor and 100 inch height. Sandbar (831) willow 100% survival with excellent survival and 96 inch height. Geyer (822) willow 20% survival with good vigor and 90 inch height. Yellow (819) willow 60% survival with excellent vigor and 100 inch height. Yellow (834) willow failed. Yellow (835) willow 20% survival with fair vigor and 84 inch height. FY01 5 five-year-old planting is naturally irrigated from streambank moist and is suffering from severe drought. The jungle of native coyote willow provided severe competition. Half of native coyote willows died due to drought and other are now defoliated. All Yellow willows died due to severe competition. The Drummond willow closest to the weir survived because no coyote willows established in that location. Coyote willow is only willow that will survive on this site (even though many have died this year, it has such a superior spreading ability, that new generations will occupy site as moist conditions improve. **Cancel** future evaluations at this location.

ID97022 Hager Field Planting. Non-Irrigated or Partially Irrigated-Bannock thickspike wheatgrass, Newhy hybrid wheatgrass, P27 Siberian wheatgrass and Irrigated-Rush intermediate wheatgrass, Paiute orchardgrass, and Regar meadow brome. Site is on a Bannock silt loam soil with gravel modifier, 0-2% slope, west aspect, 4795 feet elevation, 10-12 inch ppt., irrigated to partially irrigated, T4N R38E SW1/4 Section 28. Seed ordered 3/3/97. Planting planned for spring 1997. FY97 planted mid May by broadcast and harrowing. All species irrigated with sprinkler the first season June through September at 1 inch per week. Stand/Plants per Ft^2/Vigor/Tons per Acre: Regar good/6/good/0.9; Rush excellent/20/excellent/1.9; Paiute excellent/6/good /1.05; Bannock poor/2/ poor/0.65; Newhy good/7/good/0.8; P27 good/5/fair/0.65. Excellent stand of Rush with earlier start and double the production of other fully irrigated species. FY98 Stand/Plants per Ft^2/Vigor/Tons per Acre: Regar fair/3/good/3.5; Rush excellent/5/excellent/3.5 to 4.5; Paiute fair/5/poor/1.5; Bannock poor/2/ fair/1.4; Newhy excellent/3/excellent/2.0; and P27 good/9/good/1.7. FY99 Irrigated—Regar fair stand

with fair vigor and 3 plants per square foot. Rush excellent stand with excellent vigor and 4 plants per square foot. Paiute fair stand with very poor vigor and 4 plants per square foot. Non-irrigated—Bannock poor stand with fair vigor and 1 plant per square foot. Newhy good stand with good vigor and 5 plants per square foot. P27 good stand with good vigor and 4 plants per square foot. Rush (irrigated) and Newhy (non-irrigated) have best stands in these gravelly soils. FY00 Due to drought production and vigor considerably less than prior years. Wildfire in late June burned all if Bannock, Paiute, and most Newhy and Rush. Regar and Rush are semi-irrigated with total rainfall and irrigation totaling 10-12 inches this year. All other species received 5-6 inches this year. Irrigated—Regar poor stand with poor vigor and 1500 pounds of production; Rush excellent stand with poor vigor and 3400 pounds of production. Non-Irrigated—Paiute and Bannock no regrowth following fire; Newhy good stand with very poor vigor and 1200 pounds of production; P-27 good stand with very poor vigor and 1000 pounds of production. FY01 5th year of planting with past two being severe drought. Rush and Regar were partially irrigated through June. All plants are very drought stresses. Production has decrease significantly the last two years. Regar and Paiute are about gone – mostly replaced by quackgrass. Rush and P-27 are still full stands, although vigor is poor due to drought. Bannock and Newhy are maintaining stands although Newhy vigor is very poor.

ID98010 Hager Willow and shrub field planting (Aberdeen—Laurel willow and Pullman shrub—Blanchard Blue Elderberry). Materials ordered 2/9/98. Site is loam soil, 0-2 % slope, west aspect, 4795 feet elevation, 10-12 inch ppt, irrigated, T4N R38E SW1/4 Section 28. FY98 Survival/Vigor/Height: Laurel willow (deep soil with fabric) 100%/excellent/3.5 feet; Laurel willow (gravelly soil with fabric) 100%/good/2.5 feet; Elderberry (with fabric) 80%/excellent/1.33 feet; and Elderberry (without fabric) 50%/very poor/0.5 feet. FY99 Laurel willow loam soil—100% stand with good vigor and 6 feet height. Laurel willow gravelly soil—100% stand with fair vigor and 4.8 feet height. Blanchard weed barrier material—80% stand with excellent vigor, berry production, and 5.2 feet height. Blanchard no weed barrier material—failed. FY00 Laurel willows are vigorous, healthy and thriving under drip irrigation. Blanchard elderberry are vigorous and produced abundant elderberries beginning around first of August. Laurel willow on loamy soil had 100% survival with good vigor and 84 inch height. Laurel willow on gravelly soil had 100% survival with fair vigor and 80 inch height. Blanchard elderberry under weed barrier material has 80% survival with good vigor and 80 inch height. FY01 plants are 3 years old and are drip irrigated. Laurel willow (loamy site)—100% survival good vigor, 8 feet height, and 9 feet crown width. Laurel willow (gravelly site)—100% survival, good vigor, 8.5 feet height, and 7 feet crown width. Blanchard blue elderberry—80% survival, good vigor, 8 feet height, 8.5 feet crown width and abundant elderberries use heavily by Brewer sparrows.

ID98013 Jefferson County Landfill Field planting 1) Ephraim crested wheatgrass, Sodar streambank wheatgrass, and Bannock thickspike wheatgrass; 2) Covar sheep fescue, Schwendimar thickspike wheatgrass, and Secar Snake River wheatgrass. Seed ordered Feb 9, 1998. Site is silty clay loam soil, 0-1 % slope, east aspect, 4785 feet elevation, 10-12 inch ppt, non-irrigated, T6N R33E SEl/4 Section 14. FY98 initial

evaluation showed very poor to no establishment of Covar, Schwendimar, Secar, Sodar, and poor to very poor establishment of Ephraim and Bannock. The clay soil portions of the seeding crusted and the sandy soil portion of the seeding may have been too dry. Site should be evaluated one more season before a decision to reseed is made. FY99 Covar—fair stand with poor vigor and .2 plants per square foot. Schwendimar—very poor stand with poor vigor and .1 plants per square foot. Secar – very poor stand with poor vigor and .1 plant per square foot. Bannock fair stand with poor vigor and 1 plant per square foot. Sodar—poor stand with poor vigor and .1 plants per square foot. Ephraim—fair stand with fair vigor and 1 plant per square foot. FY00 Planting Mix 1—fair stand of Ephraim/Sodar/Bannock is establishing with fair vigor and stand is limiting weed growth. Planting Mix 2—poor stand of Covar/Schwendimar/Secar is establishing with fair vigor. Secar and Schwendimar failed in planting for the most part, but Covar is establishing slowly. Stand is dominated by kochia weed. Planting 3—Bannock has good stand with fair vigor. Windbreak planting (drip irrigated) is irrigated once per week for 12-16 hours, is doing very well, and trees are uniform—Russian Olive 5-8 feet height with 5 feet crown width; Rocky Mountain Juniper 3-5 feet height with 3 feet crown width; Siberian Peashrub 4-7 feet height with 4 feet crown width. FY01 the Ephraim-Bannock-Sodar mix and Bannock only plantings are increasing and spreading. Covar in the Covar-Schwendimar-Secar mix is also increasing. Grass densities of 2+ plants per foot squared occur on more favorable sandy soils. The hard packed clayey areas have few grass seedlings established. The windbreak planting is doing very well with 100% survival and very good maintenance for water (drip irrigation system) and weed control. Russian olive is averaging 9 feet tall and 7 feet crowns on sandier soils and 5-6 feet tall with 5 feet crowns on clayey hard packed soils. Junipers and Siberian peashrub are not affected as much by varied soil conditions with Junipers averaging 5 feet tall with 4 feet crowns on sandy soils and 4.5 feet tall with 4 feet crowns on clayey soils. The Siberian peashrub is averaging 6 feet tall with 5 feet crowns on sandy soils and 5.5 feet tall with 5 feet crowns on clayey soils.

ID98014 Calvin Moser Rush intermediate wheatgrass pasture trial. Seed ordered 2/9/98. Site is sandy loam soil, 0-2 % slope, west aspect, 4795 feet elevation, 10-12 inch ppt, irrigated, T4N R38E SEl/4 Section 29. FY98 two acres of Rush were seeded at the end of March with oats as a cover crop (15 lbs/acre oats). The oats were harvested in mid-September and the Rush is responding with average of one foot tall and 2 plants/ft^2 at the end of October. FY99 Rush—excellent stand with excellent vigor, 9000 pounds per acre production, 4 to 6 feet height, and 3+ plants per square foot. Regar—not planted. FY00 good stand with fair vigor and 5400 pounds production. Production lower due to heat and severe drought conditions. FY01 good stand with 3 plants per square foot and good vigor. Stand produced about 4000 pounds per acre this year with two flood irrigation applications. Stand probably would have produced more if cooperator had fertilized planting.

ID98015 Holly Canal Company Canal bank erosion control trial plots with Alma blue grama, Hachita blue grama, Willis blue grama, Covar sheep fescue, Tegmar intermediate wheatgrass, Sodar streambank wheatgrass, Ephraim crested wheatgrass, Bannock thickspike wheatgrass. Seed ordered 2/9/98. Site is silty clay loam, 0-33 %

slope, all aspects, 4790 feet elevation, 10-12 inch ppt, dry to partially irrigated T6N R35E SW1/4 Section 2. FY98 plots planted the first week of April along recently constructed canal bank via broadcast and hallow. Stand/Plants per foot2/Vigor: Tegmar excellent/3/excellent; Sodar poor/0.7/ fair; Ephraim fair/l/fair; Bannock excellent/1.3/good; Covar poor/0.4/very poor; Alma good/0.8/excellent; Hachita very poor/0.1/very poor; and Willis fair/0.5/fair. FY99 Tegmar—good stand with fair vigor. Sodar—good stand with fair vigor. Ephraim good stand with good vigor. Bannock—good stand with good vigor. Covar—good stand with good vigor. Alma very poor stand with good vigor. Hachita—failed. Willis—poor stand with good vigor. Ephraim has the best stand and Covar has increased considerably and is spreading. FY00 Much of grass planting was killed on NW bank due to chemical treatment for potatoes last year. Ephraim, Bannock, and Sodar are increasing and will eventually dominate drier sites, Covar is doing poorly, Hachita failed, Alma has a few scattered plants, and Willis occupies a considerable area of East Top Bank. Very little grass establishment on inside bank where quackgrass and smooth brome dominate. FY01 kochia dominates all areas that were sprayed through pivot. Smooth brome and quackgrass have taken over canal bank and areas irrigated by pivot. Bannock, Tegmar and Ephraim have survived the best primarily on tops of canal dike. **Cancel**

ID00013 Hager Field Planting—9033732 mockorange, 9033800 mockorange, 9033580 serviceberry, and 9033672 serviceberry. Materials ordered March 13, 2000 for shipping about April 10, 2000. FY00 Plantings are drip irrigated. Mockorange (732) 45% survival fair vigor and 7 inch height. Mockorange (800) 67% survival with good vigor and 10 inch height. Serviceberry (580) 95% survival with poor vigor and 4 inch height. Serviceberry (672) 100% survival with poor vigor and 6 inch height. FY01 plants drip irrigated. 9033732 Mockorange 20% survival very poor vigor, and 1-31 inch height. 9033800 Mockorange 67% survival, fair vigor and 13-25 inch height. 9033580 Serviceberry 80% survival, poor vigor and 8-15 inch height. 9033672 Serviceberry 85% survival, fair vigor and 16-22 inch height. Overall growth is slow for both species, but much improved over last year. Growth rates are doubled when using fabric mulch materials verses not using materials.

ID01004 Cooperator unknown cottonwood field planting. Ten cuttings each of 9067408 Narrowleaf cottonwood, 9067443 Narrowleaf cottonwood, 9067484 Narrowleaf cottonwood, 9067502 Narrowleaf cottonwood, Robust poplar, Carolina poplar, and Siouxland poplar. FY01 no evaluation.

ID02005 SCD Leafy Spurge Demonstration Plots. Covar sheep fescue, Durar hard fescue, and Manchar smooth brome. Seed ordered September 2001.

FIELD OFFICE: SALMON

ID81016 Smith Rincon fourwing saltbush field planting for rangeland. Evaluate every 3 years. Site is Dacore-Resoot-Nielson complex soil, non-irrigated, 12-inch ppt, 5920 feet elevation, and 2-4% slopes on a NW exposure. Planted 65 seedlings. FY92 75% survival and no seed production last 2 years. FY94 90% survival with good vigor, 3 feet

height, 3.5 feet crown width and 60% branching density. Several plants have died back and resprouted over the years. Some seed germination has occurred in the plots down wind of mother plants. FY99 85% survival with good to excellent vigor, 36-inch height, 3.5 feet canopies width, and fair fruit production. **Planting Canceled – retain write-up and file.**

ID00012 SCD Field Planting – Blanchard blue elderberry, 9023733 dogwood, 9023739 dogwood, and 9023740 dogwood. Materials ordered March 13, 2000 for shipping on April 10, 2000. FY00 and FY01 no evaluations.

FIELD OFFICE: ST. ANTHONY

ID93005 Fremont County willow field planting for Stream Stabilization at Frome Park, Henries Lake. FY93 70-90% survival of Curlew, Rivar and Palouse willows. FY94 27% survival Curlew, 43% survival Rivar, 37% survival Palouse, 0% survival of native willow. Planting was made into riprap with two equal rows, the first row high on the bank and the second row in a lower position. The upper row had 70-90% survival and the lower row had 0% survival and was assumed drowned. FY95 40% Curlew, 50% Rivar and 50% Palouse survival. Rivar moderate branching and Curlew/Palouse dense branching. Only one willow, Palouse failed during past year and all look very good. FY96, FY97, FY98, FY99, FY00 and FY01 no evaluations. **Cancel**

ID99009 Henrys Lake area field planting. Species include Coyote willow, Geyer 435 willow, Geyer 448 willow, Geyer 483 willow, Geyer 491 willow, Geyer Meeker willow, Snowberry, Elderberry, Dogwood 733, Dogwood 740, Booth willow, Drummond willow, Serviceberry 548, Serviceberry 580, Serviceberry 672, and Mockorange. FY99, FY00 and FY01 no evaluations.

IDAHO

KANSAS

Manhattan Plant Materials Center

2002 WCC-21 PROGRESS REPORT

Prepared by

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INTRODUCTION

This report summarizes NRCS plant materials projects relative to the revegetation of altered or drastically disturbed lands.

COMPLETED PROJECTS

None

ONGOING PROJECTS

1. Evaluation of Salix Species for Stream Corridors and Shoreline Erosion (NRCS, Manhattan Plant Materials Center, Manhattan, Kansas),

   Shrub-type willows of known origin and adaptability are not currently available for revegetation work along stream and river corridors in the Central Great Plains. Willows currently available to solve conservation problems must come from wild harvest or from commercial sources. Some commercially available sources are introduced species that have not been fully evaluated in the Central Plains. Increased interest in soil bioengineering systems have placed additional demand on native willow populations for source materials. Thirty-nine vegetative willow collections were assembled at the PMC. These collections will be evaluated for performance and adaptation for use in bank stabilization along rivers and streams, shoreline and beach stabilization on large reservoirs, and for improved wildlife habitat.

2. Revegetation of an Exposed Raw Shale Site in Jewell County, Kansas (Terry Conway, Plant Materials Specialist, NRCS, Salina, Kansas; Jewell County Soil and Water Conservation District, Mankato, Kansas; Kansas Department of Environment and Health, Topeka, Kansas).

   Past management and naturally occurring slumping have exposed large areas of raw shale. These areas are prone to erosion, resulting in offsite degradation to the downslope plant community. The quality of water flowing from these sites is very acidic which also has a negative effect on downstream resources. The objective of the study is to evaluate the adaptability, survival, and spread of common reed (*Phragmites australis*) on these sites and determine the effectiveness of the established plant cover in reducing offsite degradation.

3. Controlling Shoreline Erosion With Bioengineering Techniques at Cheney Reservoir State Park, Cheney, Kansas (Terry Conway, Plant Materials Specialist, NRCS, Salina, Kansas, USDI Bureau of Reclamation, Austin, Texas; Kansas Department of Wildlife and Parks, Cheney, Kansas)

   Shoreline erosion is a significant tissue at Cheney Reservoir particularly where existing facilities are being threatened. Structural measures have been used in the past, but installation cost, aesthetics, and safety concerns with these measures have agency supervisors looking for other options. The objective of this study is to evaluate various bio engineering techniques and plant materials for the purpose of the potential development of cost effective and aesthetic alternatives for addressing the shoreline erosion.

4. Sand Dune Stabilization (Terry Conway, Plant Materials Specialist, NRCS, Salina, Kansas; Morris Houck, Plant Center Manager, NRCS, Knox City, Texas; Wade Anderson, Range Conservationist, NRCS, Cheyenne, Oklahoma)

   Where vegetation has been damaged or destroyed on sandy rangeland sites, the area becomes prone to severe wind erosion resulting in blowouts. The blowout areas are troublesome because of their potential for migration onto adjacent rangeland, the potential for road and fence inundation, and the difficulty with revegetation. While the principles of dune revegetation are well know, cost effective methods that would have local application are needed. The objective of this study is to evaluate various plant materials and stabilization techniques that are cost effective and would have application at the local level for dune stabilization.

MONTANA

Montana State University

WCC-21 Progress Report

Prepared by

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INTRODUCTION

This report summarizes revegetation and restoration research conducted in 2001 by the Reclamation Research Unit and the Department of Land Resources and Environmental Sciences at Montana State University.

COMPLETED PROJECTS

1. Effect of Alkaline Industrial Byproducts on Plant Growth in Acidic Contaminated Soils (Doug Dollhopf, Reclamation Research Unit, Montana State University).

   The objective of this research was to determine whether a low pH metalliferous soil (pH 5.0) and a low pH metalliferous smelter tailing material (pH 1.8) amended to a target pH range of 7.0 to 8.4 with alkaline industrial by-products enabled plant growth equivalent to that attained when these materials were treated with commercial grade mixture of $CaCO_3$ and CaO. Three types of cement kiln dust (CKD), three types of lime kiln dust (LKD), and two other alkaline by-products(dicalcium silicate, carbide lime) were evaluated in this investigation. Following a 111 day plant growth period with Basin Wildrye (*Leymus cinereus*) and Redtop (*Agrostis alba*) all alkaline industrial by-products tested had plant growth equal to-or greater than- the $CaCO_3$/CaO mixture. This was the case in tailings and the contaminated soil for above ground plant biomass, plant height, root biomass, root depth, and number of roots at the 5 cm and 10 cm soil depths. For each alkaline

product, including the $CaCO_3$/CaO mixture, the greater the application rate, the less was plant growth. Over the alkaline product dosage range of 0% to 12% (soil dry weight basis), the loss in aboveground plant biomass was 65% for Basin Wildrye and 88% for Redtop. For this reason, it was recommended that when designing the alkaline amendment application rate for a project landscape, procedures should be used to apply the correct amount of alkaline material as opposed to an known excess.

2. The Role of Arbuscular Mycorrhizal Fungi and Soil Microbes For Increasing Plant Growth in Metal-Contaminated Substrates (October Seastone Moynahan (Division of Biological Sciences, The University of Montana) and Cathy Zabinski (Land Resources and Environmental Sciences, Montana State University).

   Arbuscular mycorrhizae (AM) are an important component of plant-soil systems that may be crucial for successful revegetation of metal-contaminated soils associated with hard-rock mining. By altering plant nutrient uptake abilities, protecting plants from pathogens, and possibly contributing to plant metal-resistance, AM can enhance plant growth and affect plant community composition. This research examined the role of AM in mine revegetation in western Montana. Working with acidic (pH 3.5), metal contaminated hard-rock mine wastes from an abandoned mine in western Montana, we grew *Deschampsia cespitosa* (tufted hairgrass) in non-amended tailings, with three arbuscular mycorrhizal treatments (no AM, AM from a metals-contaminated site, and AM from a non-contaminated site), and three microbial community (MC) treatments (no MC added, MC from a metals-contaminated site, and MC from a non-contaminated site) in a complete factorial design.

   Plants grown with AM from metals-contaminated soil had 67% greater biomass, while biomass of plants growing with uncontaminated soil AM was not statistically different than non-mycorrhizal control plants. The only significant difference caused by MC inoculation was a negative effect, in which the MC from metals-contaminated soil reduced AM fungal colonization and eliminated the positive effect of the AM from metals-contaminated soil. Biomass patterns corresponded with phosphorus uptake by plants, but not with tissue metal (Cd, Cu, Fe, Pb and Zn) levels, indicating that benefits of AM from metals-contaminated soils to the plant were probably general mycorrhizal benefits, rather than direct metal-resistance conferred by AM.

3. Mycorrhizal Source Effects on Six Native Plants with Potential for Mine Tailings Revegetation (October Seastone Moynahan (Division of Biological Sciences, The University of Montana) and Cathy Zabinski (Land Resources and Environmental Sciences, Montana State University)

   The effects of three arbuscular mycorrhizal (AM) sources were evaluated with six native plant species growing in limed mine tailings. Sources of AM include 1) sterilized inoculum, 2) inoculum from a metals-contaminated site, and 3) inoculum from an uncontaminated site. Plant species were selected for their sensitivity to metal-contamination and potential use for mine revegetation. Tufted hairgrass

(*Deschampsia cespitosa*) and yarrow (*Achillea millefolium*) are often used in mine waste revegetation because of their tolerance of soil acidity and elevated metals. Bluebunch wheatgrass (*Pseudoroegnaria spicata*), rough fescue (*Festuca scabrella*), blue flax (*Linum lewisii*), and purple coneflower (*Echinacea augustifolium*) are generally more sensitive to harsh soil conditions and are not widely used for mine revegetation. Biomass of yarrow, tufted hairgrass, and bluebunch wheatgrass was not affected by AM source. Metals-contaminated soil AM increased biomass of rough fescue (53%), blue flax (283%), and purple coneflower (798%) relative to nonmycorrhizal plants. Uncontaminated soil AM increased biomass of blue flax (262%) and purple coneflower (646%), but not rough fescue. Root mass ratios of blue flax and purple coneflower, the most mycorrhizal-dependent species, were greater in mycorrhizal than nonmycorrhizal plants. This study shows that AM effects vary with plant species and AM inoculum source, and exposes the bias of selection of revegetation species toward plants that are not mycorrhizal-dependent. Re-evaluating plant species with their natural AM symbioses will expand the pool of desirable revegetation species and lead to more productive and diverse plant communities.

ONGOING PROJECTS

1. M Reclamation Project (Stuart Jennings, Reclamation Research Unit, Montana State University).

   This community service project has been initiated to repair ecological damage caused to the University and Bozeman community icon-- a large rock "M" monument on the southern end of the Bridger Mountains. The "M" is a very popular destination for local hikers which has resulted in severe erosion and loss of native species. This project combines technical expertise found at MSU with the regulatory requirements of the U.S. Forest Service and U.S. Fish and Wildlife Service, as complemented by community conservation groups. This community based partnership has come together to mitigate the effects of past use and design facilities capable of handling present recreational usage.

2. East Helena Smelter Superfund Site (Dennis Neuman, Reclamation Research Unit, Montana State University).

   Reclamation Research Unit scientists continue to advise the U.S. Environmental Protection Agency on issues dealing with land reclamation, agricultural land use, ecological risks, and urbanization at this Montana Superfund Site. The RRU scientists have conducted research and acted as reclamation policy advisors to the EPA for nearly twenty years.

3. Ash Disposal Pond Revegetation (Frank Munshower and John Goering, Reclamation Research Unit, Montana State University).

   This is a long-term investigation of the potential to revegetate the surface of the coal

ash disposal ponds near Colstrip, MT. Permanent reclamation of the ponds is the ultimate goal of this study. Initial objectives were to determine 1) how much soil is necessary over the ash to permit establishment of a permanent vegetation cover; 2) if a diffusion barrier is necessary to seal the ash from the soil and prevent movement of salts into the soil; 3) if topsoil is necessary over the soil layer to provide an adequate plant growth medium; and 4) to determine what plant species should be seeded on the site to insure survival of a permanent plant cover that can be grazed by wildlife and/or livestock. Replicated field plots were constructed of varying materials and depths, with and without barriers, with and without topsoil, and species selection trials were integrated into the experimental design. The hydrologic and vegetation response to the different treatments have been monitored throughout a ten-year period.

4. Plant Growth and Soil Metal Concentrations: (Dennis Neuman, Reclamation Research Unit, Montana State University).

   Phytostabilization techniques are proposed for remediation of selected areas affected by metal mine wastes in Montana's Clark Fork River Basin. In 1990, an in situ reclamation project was implemented on fluvially-deposited tailing areas adjacent to the Clark Fork River. As part of this project, a 2.3 ha field containing tailing deposits was tilled to 1.2 m, lime was incorporated into the soil, and rangeland grasses were initially planted. In June of 2000, the field was plowed and seeded with six-row barley (Hordeum vulgare). Variable growth of this species was observed. It was hypothesized that plant growth was negatively correlated with metal and arsenic concentrations in the soil. Variability in barley growth attributable to other measurable soil characteristics was statistically quantified and modeled to account for the effects of landscape spatial heterogeneity. Elemental data were first reduced using Principal Components Analysis (PCA) to provide a primary "metals" predictor variable for subsequent regressions. All subset regression analyses were used on the principal components to determine which component was the best predictor of plant biomass. Metal concentrations in the soil were the only statistically significant predictors of plant biomass among all factors tested.

5. Phytoextraction of Selenium and Metals from Contaminated Soils (Doug Dollhopf, Reclamation Research Unit, Montana State University).

   Slurry emanating from an oil refinery wastewater treatment system was incorporated into a Montana soil over a multi-year period. As a result, the soil contained elevated concentrations of various elements including arsenic (34.4 mg/kg), chromium (159.6 mg/kg), lead (26.2 mg/kg), selenium (18.6 mg/kg), and zinc (185.8 mg/kg). The soil selenium concentration approached a threshold established by the state regulatory authority. This project evaluated the use of selenium accumulating plant species to decrease the soil selenium concentration. Selenium accumulating plant species (Canola, Desert prince's-plume, and Indian mustard) and selenium non-accumulating species (Pubescent wheatgrass and Tall fescue) were seeded into the soils at the land application site and harvested upon maturity. No significant change in soil metal concentration was measured. Plant tissue selenium concentrations in

Canola (6.8 mg/kg), Canola grown on phosphorous amended soil (7.6 mg/kg), Indian mustard (10.4 mg/kg), and Desert prince's-plume (111.6 mg/kg) were considerably lower than expected. Selenium concentrations in all species were great enough to present a chronic toxicity hazard in grazing animals. A subsequent greenhouse study was conducted to determine whether lower than expected selenium accumulation was due to plant species selection, soil characteristics, or a characteristic of the waste slurry. Selenium accumulating plant species were grown on four different substrates; the test soil, selenate enriched test soil, waste slurry enriched sand, and selenate enriched sand. Mean plant tissue selenium concentrations in each substrate were 10.2 ± 6.5 mg/kg, 49.0 ± 27.8 mg/kg, 43.0 ± 37.5 mg/kg, and 683.9 ± 423.1 mg/kg, respectively. Plant selenium concentrations in selenate enriched sand were significantly greater than in either of the other three substrates that received waste slurry as their principle supply of selenium. It was concluded that waste slurry, when applied to soil, contained either a form of selenium that was in a reduced oxidation state and thus unavailable for plant uptake or another chemical constituent was present that competed with selenium for plant uptake.

6. Development of a Riparian Evaluation System for the Clark Fork River, Montana (Dennis Neuman and Stuart Jennings, Reclamation Research Unit, Montana State University, and Paul Hansen, Bitterroot Restoration Incorporated)

   Floodplain deposits of metal-mine, mill, and smelter wastes have contaminated soils, streambed sediments, surface water and groundwater, and some historically irrigated fields located above the floodplain of Montana's Clark Fork River. Major contaminants of concern are arsenic, copper, cadmium, lead and zinc. The Environmental Protection Agency will select remedial actions for this Superfund site in 2002. To assist remedial design, a riparian evaluation system has been developed to provide an objective, data predicated decision tool to assess the ecological dysfunction of lands along the Clark Fork River, and to determine whether the identified areas require remedial action, and by extension the intensity of that clean up. The system contains the following elements: Superfund mandated requirements addressing risk reduction, remedial objectives and goals, and legal requirements for clean up of the river corridor; a numerical component that will be used to score the current status of the plant community integrity, contamination severity, and landscape stability; decision diagrams to help guide the selection of remedial actions during design; and the identification of modifying factors that affect the selection of remedial actions for specific lands. The numerical component of the system will be calibrated and validated in the summer of 2002 and then applied across the landscape concentrating on lentic and lotic positions, as well as wet meadows and upland areas.

7. Ecological Restoration Website (Stuart Jennings, Reclamation Research Unit, Montana State University)

   A Web Site devoted to the restoration of disturbed lands has been developed. The Ecosystem Restoration Website (http://ecorestoration.montana.edu) has been

developed to provide web-based access to technical resources for project managers and designers and to serve as a central repository for restoration/reclamation information. Links to existing web sites have and will continue to be established. Case histories and a 'Technology Guide' form the core side content. These sections deliver current examples of the "state-of-the-art" supplemented by the underlying design basis and scientific literature. The information is being collected from state and federal agencies, university researchers, mining companies, and private sector. Mineland restoration content is emphasized.

8. Clark Fork River, Montana Superfund Site (Dennis Neuman, Stuart Jennings, and Doug Dollhopf, Reclamation Research Unit, Montana State University)

   Members of the Reclamation Research Unit have participated in the preparation of the Remedial Investigation for one of the nation's longest Superfund Sites. In addition, RRU scientists have assisted the U.S. Environmental Protection Agency in discussions with the Agency's National Remedy Review Board, acted as major reviewers on the Feasibility Study, and participated in U.S. EPA sponsored Phytostabilization Forums.

9. Land Reclamation Evaluation System for Anaconda Smelter Superfund Site (Stuart Jennings and Dennis Neuman, Reclamation Research Unit, Montana State University)

   At least 6,000 ha of land surrounding the Anaconda Smelter in Montana are contaminated from nearly a century of stack emissions from copper smelting. In the mid-1990s, the Reclamation Research Unit conducted a multi-year laboratory-greenhouse-field research investigation of the potential to reclaim and restore these impacted lands. Based on the results, land reclamation was chosen by the Environmental Protection Agency as the remedial approach (estimated at $186M) for this Superfund Site. A decision making tool was then developed to help EPA determine which lands are to be remediated. The decision tool incorporates legal mandates, estimates of current ecological function, human health risk action levels, and land use interests into a decision matrix. Site specific data, when coupled with the Land Reclamation Evaluation System (LRES) logic, provide the most appropriate land reclamation strategy for a specific land area. The LRES process has been used to map thousands of hectares of the site. These land units now serve as the remedial design area where an action will be taken.

10. Effect of Mechanical and Biological Control Measures on Sediment Movement for High Elevation Regraded Slopes at the Treasure Mine (Doug Dollhopf, Reclamation Research Unit, Montana State University)

    The purpose of this study is to test two mechanical and one biological method to decrease erosion of newly reclaimed steep slopes. Soil erosion off each test plot is quantified by collecting sediment accumulated in a collection trough at the bottom of each treatment plot. The measured sediment yield (field data) will be compared to the amount predicted by the Revised Universal Soil Loss (RUSLE) v. 1.06 erosion modeling software.

11. Butte Reclamation Evaluation System (Dennis Neuman, Stuart Jennings and Pam Blicker, Reclamation Research Unit, Montana State University)

    Mine land sites have been reclaimed in the Butte, Montana area since the mid-1980s. Recognizing the need to evaluate the success of reclaimed lands, the EPA began formally evaluating these lands in 1992. Since then, EPA has conducted reclamation assessments in Butte, Anaconda, and at a variety of sites throughout the Clark Fork River Basin of Montana. During this period, a variety of soil and vegetation parameters were used to provide data and information regarding the success of reclaimed mined lands.

    From this work, EPA recognized the need for an evaluation tool that would allow agency personnel to determine whether sites under their jurisdiction were meeting the remedial goals and if that trend was likely to continue. Based on other decision tools being developed for other Superfund Sites within the Clark Fork River Basin, EPA requested that the Reclamation Research Unit design a similar tool that would incorporate the following aspects: utilize soil and vegetation parameters that are key to assessing reclamation success; emphasize the parameters critical to maintaining site stability; be easily and quickly applied in the field due to the large number of sites that need to be evaluated; utilize a minimum amount of equipment; be simple to learn by new evaluators; and, provide precise (i.e., reproducible) results when applied by different evaluators. Initial development and field assessment of this tool was conducted in 2001 and additional activities will conducted during the 2002 field season.

12. Long-term Water Quality Monitoring, Colstrip, Montana (Stuart Jennings and John Goering, Reclamation Research Unit, Montana State University)

    Mining of near surface coal deposits in Montana and Wyoming is a significant commercial industry. The Rosebud Coal member of the Paleocene age Fort Union formation is mined at Colstrip Montana. A large portion of the coal mined is burned on-site for power generation. The large ecological disturbance caused by mining and power generation is a concern to nearby residents, particularly the ranching community downgradient from the mine disturbance. This research project provides twice yearly sample collection of ground, surface and spring water quality to ensure the non-degradation of water quality in ranch lands adjacent to the mine. Research is performed in conjunction with Battelle Pacific Northwest Labs from Richland, Washington.

13. Bond Release Vegetation Criteria (Frank Munshower, Dennis Neuman and Pam Blicker, Reclamation Research Unit, Montana State University and Tad Weaver, Department of Ecology, Montana State University).

    Since the passage of the Surface Mining Control and Reclamation Act (SMCRA) in 1977, vegetation data have been collected by mine operators to describe pre-mining vegetation and establish baseline data from which vegetation reference areas can be derived. These vegetation reference areas are intended to serve as a standard for comparisons to revegetated areas on reclaimed coal mines to evaluate the

success of reclamation for bond release. To date, the reference area data and pre-mine data have not been synthesized in a manner to facilitate statistical equivalency, derivation of revegetation standards, or facilitate appropriate categorization of reference areas and data in relation to some revegetation and postmine land use requirements. The principal goal is to design a database that will determine the extent to which the existing vegetative data can be synthesized and compared between years, between sampling sites at a mine, and between mines so that the success of postmine vegetation can be adequately analyzed for Phase III/IV bond release. This database will also store metadata related to all sampling events that have been completed over the years at each mine site.

The first phase of the project is underway. This phase is comprised of database design and the development of data quality objectives and a quality assurance/quality control plan. Future phases include Phase II - Data Queries and statistical analysis of results; Phase III - Plant Community Characterization; and Phase IV - Plant Community Categorization.

14. Effects of Compost and Arbuscular Mycorrhizal Inocula on Simple Native Plant Communities Transplanted for Mine Waste Revegetation October Seastone Moynahan (Division of Biological Sciences, The University of Montana) and Cathy Zabinski (Land Resources and Environmental Sciences, Montana State University)

    This study examines the effects of compost addition and arbuscular mycorrhizal (AM) source on three plant species in three coversoil substrates. At one field site located in a fresh tailings deposition area, inoculated transplants of tufted hairgrass (*Deschampsia cespitosa*), bluebunch wheatgrass (*Pseudoroegneria spicata*), and yarrow (*Achillea millefolium*) were planted into coversoil substrates (overburden, low-sulfide ore tailings, and reprocessed tailings) with and without compost. The AM treatments included 1) sterilized inoculum, 2) inoculum from a metals-contaminated site, and 3) inoculum from an uncontaminated site. At a second site that had been composted six years earlier, the same plant species and AM treatments were included. At the first site, after two years of growth, plants growing in compost-amended substrates had 84% greater biomass, with a 111% increase in number of flowering stalks. Overall, AM from metals-contaminated soil increased plant biomass by 19% and number of flowering stalks by 20% over nonmycorrhizal plants, while plant growth with AM from uncontaminated soils was not different from nonmycorrhizal plants. Similar trends occurred within each plant species, although differences were less conspicuous and not statistically significant. Data from the second site are still being analyzed.

15. Revegetation Strategies to Minimize Weed Re-Colonization Following Herbicide Application Lew Stringer, Cathy Zabinski (Land Resources and Environmental Sciences) and Joyce Lapp (Glacier National Park)

    Eradication of invasive species through herbicide application represents a major ecological disturbance to a plant community, providing space and resources for subsequent plant colonization. This project focuses on revegetation after herbicide

application on spotted knapweed-infested sites in northwestern Montana grasslands. We are measuring the density and species composition of seeds stored in the soil of weed-infested sites, to test the hypothesis that seed bank composition and density can be a good predictor of revegetation patterns after herbicide application. Additionally, we have set up a field experiment that will enable us to compare site preparation approaches, to determine whether the seed bank can be effectively manipulated to further management goals. This research is being done at 2 subalpine grassland sites: one within Glacier National Park and the other on the Blackfeet tribal land, near the eastern border of the Park.

16. The Ecology of Plant-Fungal Symbioses in Extreme Environments. Rebecca Bunn and Catherine Zabinski (Land Resources and Environmental Sciences).

    The study of plant growth and the mycorrhizal symbiosis in extreme environments is relevant to understanding the potential for vegetation establishment on industrially-impacted sites. Our research focuses on arbuscular mycorrhizae (AM) and plant growth on thermal soils Yellowstone National Park. These soils are characterized by acidic to basic chemistry, elevated rooting zone temperatures (up to 57^{o}C), low phosphorous levels, and potentially toxic concentrations of multiple elements. These sites are very old, and therefore the potential exists for plant and fungal adaptations to extreme environmental conditions. The overall goals for this research are: 1) to measure the effects of mycorrhizae on plant growth in thermal soils with a pH range of 3.5 to 9.5; 2) to assess the mechanisms by which mycorrhizae affect plant growth; and 3) to determine whether mycorrhizal fungi occurring in thermal sites are specifically adapted to those sites. In the greenhouse, we are conducting an experiment to measure plant growth when grown in low and high pH soils, either without mycorrhizae, or with mycorrhizal fungi isolated from thermal or from non-thermal sites. This will provide us with important information relative to fungal adaptation to site conditions. We will assess mechanisms of mycorrhizal effects through measurements of element concentration in plant tissues.

PLANNED OR POTENTIAL PROJECTS

1. Development of Erosion and Sediment Control Best Management Practices Manual.
2. Development of reclamation/restoration success criteria.
3. Phytotoxicity responses of metal and acid tolerant plant species used in reclamation of acid metalliferous mine and smelter tailings.
4. Investigations of cover soil material's suitability for plant establishment and growth.

CURRENT PUBLICATION AND PAPERS

Dollhopf, D.J. 2001. Contaminant Migration from Acidic-Metalliferous Tailings into an Earthen Cover During a 26 Year Time Period, pp. 407-413 *In:* Proc. 2001 Amer. Soc. Surface Mining and Reclamation - Land Reclamation - A Different Approach. Albuquerque, NM, June 3-7.

Dollhopf, D.J. and J.T. Mehlenbacher. 2001. Alkaline Industrial By-Product Effects on Plant Growth in Acidic-Contaminated Soil Systems. Montana State Univ., Reclamation Research Unit Publ. No. 0101, 104 p.

Kapolka, N.M. and D.J. Dollhopf. 2001. Effect of Slope Gradient and Plant Growth on Soil Loss on Reconstructed Steep Slopes. Internat'l J. of Surface Mining, Reclamation and Enforcement, Vol. 15, No. 2, pp. 86-99.

Munshower, F.F. 2001. Report of 2001 Activities on Stage I Ash Disposal Pond. An Update of Reclamation Research Unit Activities on and Near the Stage I Ash Disposal Ponds, Colstrip, MT. 2001. Montana State Univ., Reclamation Research Unit Publ. No. 0102, 62 p.

Neuman, D.R. 2001. Assessment of Data Quality, Grant-Kohrs Ranch National Historical Site Project. Prepared for U.S. Dept. of Interior, Grant-Kohrs National Historic Site, Deer Lodge, MT. 162 p., March 5, 2001.

Neuman, D.R. 2001. Assessment of Data Quality, Grant-Kohrs Ranch National Historical Site Project - 2001 Data. Prepared for U.S. Dept. of Interior, Grant-Kohrs National Historic Site, Deer Lodge, MT. 91 p., December 3, 2001.

Neuman, D.R. 2001. Land Reclamation Evaluation System for the Anaconda Smelter Superfund Site, Poster. *At* Annual WCC-21 meeting held concurrently with Society for Range Management 54th Annual Meeting, Kailua-Kona, HI, Feb. 17-23, 2001.

Winking, S.R. and D.J. Dollhopf. 2001. Estimated Erosion Rates on Mine Wastes Located at the Tenmile Creek Superfund Site. Prepared for CDM Federal Programs Corp., Helena, MT. Reclamation Research Unit, Montana State University, Bozeman, MT. 18 p.

Winking, S.R. and D.J. Dollhopf. 2001. Effect of Reclamation Procedures on Erosion Rates on Mine Wastes Located at the Tenmile Creek Superfund Site. Prepared for CDM Federal Programs Corp., Helena, MT. Reclamation Research Unit, Montana State University, Bozeman, MT. 34 p.

MONTANA

BRIDGER PLANT MATERIALS CENTER
WCC21 2001 PROGRESS REPORT

Submitted by

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WHAT IS THE BRIDGER PMC?

The Bridger Plant Materials Center (BPMC) is one of 26 Centers nationwide that use plants to solve natural resource problems. These problems include soil erosion, water quality deterioration, native habitat disturbance, mining and logging impacts, wildlife habitat loss, wetlands damage, and other conservation issues. Our work reflects the current needs of CRP, EQIP, WHIP, and other farm programs. Plant testing/selection and the development of new conservation technologies are the primary products of the program. The BPMC serves all of Montana and Wyoming.

PROGRAM EMPHASIS

Although the BPMC addresses many resource issues, our current program emphasis is in the following areas:

- Seed Production
- Windbreak and Shelterbelt Improvement
- Habitat Restoration and Enhancement
- Native Plant Propagation and Production

This document presents an overview of Year 2001 activities at the BPMC. For detailed information, contact the staff at the Bridger Plant Materials Center or the Montana Plant Materials Specialist.

SEED PRODUCTION

Seed production at the Bridger PMC begins in mid-June with alpine bluegrass and continues until late October with winterfat and prairie sandreed. Foundation seed is distributed through the Montana and Wyoming Seed Certification programs, with the proceeds supporting graduate research at Montana State University and the University of Wyoming. A large portion of the cooperative work with the National Park Service (Glacier and Yellowstone Parks) and Deer Lodge Valley Conservation

District (acid/heavy metal tolerant project) involves seed production and associated research.

Category	No. Accessions	Pounds
Foundation	16	5,496
Initial Increase	15	1,226
YNP Reimbursable	13	467
GNP Reimbursable	12	69
Acid/Heavy-Metal Grant	21	302
Total:	77	7,560

WINDBREAK AND SHELTERBELT IMPROVEMENT

The BPMC's goal is to improve the performance of windbreak plants in order to maximize benefits to the environment and consumers. In 2001 the BPMC circulated for release a Selected Class germplasm of ponderosa pine with impressive rates of growth and improved seedling survival. Hunter Germplasm ponderosa pine should be available from the Montana Conservation Seedling Nursery in 2003 and seeds are currently available to the nursery industry for production.

Bur oak is a hardy, native tree providing a long-lived, strongly wooded alternative for windbreaks and shelterbelts in the Northern Plains. Data was collected on our 400-tree bur oak seed orchard again in year 2001 and included timing of bud break, survival, height, width, form, and seed production. An MSU graduate project funded through our Foundation Seed Research Program was initiated in 2001 that will study the vegetative propagation of this species.

HABITAT RESTORATION AND ENHANCEMENT

Habitat restoration work continued at the BPMC in 2001 and included the following projects:

1. Restoration of Roadside Disturbances in Yellowstone and Glacier National Parks.

   Since 1985 the BPMC has assisted Yellowstone and Glacier National Parks with the collection, propagation, and reestablishment of native indigenous plant material along reconstructed roadsides. The Parks have utilized native plants to reduce soil erosion, compete with invasive plants, and improve the aesthetics on these disturbed sites. In 2001, the BPMC cleaned 233 wildland seed collections from the Parks and produced about 540 pounds of seed of 25 collections. Technical Note No. MT-39 was developed to predict the cost of seed and plant production based on potential production levels and degree of difficulty. The matrix was circulated nationwide to PMCs and Parks with cooperative agreements. A paper titled "Native Plant and Seed Production for High Elevation Restoration" was presented at Eugene, Oregon.

2. Development of Acid/Heavy Metal-Tolerant Plants Project (Deer Lodge Valley CD).

   Results from a greenhouse Comparative Evaluation Planting, reported in the DATC Project Biennial Report (April-September 2001), provided data supporting the release of three accessions collected on low pH and heavy-metal laden sites near Anaconda, Montana. These upcoming pre-varietal releases are Washoe Germplasm basin wildrye, Old Works Germplasm fuzzytongue penstemon, and Prospectors Germplasm common snowberry. These releases and other promising accessions are being further tested at two field plots near Anaconda installed late October 2001. The relative competitiveness and compatibility of eight seed mixes of varying blends and compositions are being tested in the plots. First-year evaluation results from a third Anaconda field plot comparing the performance of 19 woody accessions have been published in an NRCS Plant Materials Technical Note and submitted for journal publication.

3. Rangeland and Mineland Restoration.

   Since the BPMC was established in 1959, there has been an emphasis on the development of native plants for use on all disturbances on semi-arid grasslands and foothills of Montana and Wyoming. The BPMC continues to select native grasses, forbs, and shrubs to add species diversity to reclamation mixes.

   Evaluations of Idaho fescue are being conducted on the top 9 accessions, with a potential release to be made in 2005. Evaluation continues on Montana's state grass (bluebunch wheatgrass). Recurrent selection on 20 east-slope accessions will potentially provide a cultivar that is adapted for range and wildlife habitat restoration in the eastern plains of Montana and Wyoming. Other future releases include Gardner saltbush, winterfat, western yarrow, bottlebrush squirreltail, blanketflower, prairie coneflower, dotted gayfeather, and silverleaf phacelia.

4. Wildlife Habitat Restoration and Enhancement.

   Plant materials are being evaluated for upland game bird habitat, winter grazing for large ungulates, and native landscaping designed to attract wildlife. In cooperation with Ducks Unlimited, Pheasants Forever, and MT and WY Game & Fish Departments, the BPMC has established test plantings to evaluate native plant mixtures and patterns of planting. In May 2000, the BPMC, in cooperation with the NRCS Montana State Biologist, established an Annual Food Plot study evaluating a variety of grains and row crops as annual food crops. Thirteen species were seeded in strips and then cross-seeded so that each plot contained two species. Species tested include oats, wheat, barley, canary seed, pinto beans, Austrian winter pea, corn lentil, millet, sorghum, safflower, canola, and sunflower. A combination of grain sorghum with millet was most effective at providing wildlife food and cover. Wheat, barley, and oats also worked well with sorghum. Portions of the plots were left to determine if seed shatter would perpetuate the stands, but poor growing conditions prevented any useful data from this part of the study.

5. Low-maintenance Landscaping

   Introduced dryland forage and native reclamation grasses are finding new uses--*xeriscaping*. These hardy, drought tolerant species have lower maintenance requirements than typical turf grasses. Plots of 11 potential xeriscape grasses established at the BPMC were evaluated in 2001 for growth and performance with and without mowing, as well as assessed for resilience to foot traffic. A 15-page booklet titled *Creating Native Landscapes in the Northern Great Plains and Rocky Mountains* was completed and published in 2001. The booklet walks homeowners through planning, design, site preparation, plant selection and care, water conservation, maintenance, and protection. Nearly all of the 10,000 copies produced in the first printing have been distributed. An *American Nurseryman* FieldNotes was published on the use of sheep fescue *Festuca ovina* as a low maintenance landscape plant.

NATIVE PLANT PROPAGATION AND PRODUCTION

Numerous projects in 2001 involved propagation and production research with native plants. Work continued on separate projects with Rocky Mountain juniper, ponderosa pine, and bur oak to evaluate the seed production of individual seed sources from across the Northern Great Plains. Work continued in 2001 on a Rocky Mountain juniper seed-dormancy study to determine the most effective combination of treatments to break dormancy. Results indicate that the traditional combination of warm stratification and cold chilling works best to break dormancy. Germination and establishment research was initiated on beargrass *Xerophyllum tenax*. Propagation protocols of ~50 species were developed and submitted to the Native Plants website. Sweetgrass is a culturally significant plant historically used by Native American tribes in their religious and cultural activities. Field- grown plants were transplanted to containers in anticipation of increasing the production of this species prior to release.

TECHNOLOGY TRANSFER

Technology transfer is all information that the Center provides through talks, tours, written materials, and other forms of communication. In 2001 four quarterly BPMC newsletters were published covering such topics as CRP establishment, enhancing with shrubs, invasive species, meadow bromegrass, tree and shrub stress, wildlife food plots, enhancement and interseeding, sweetgrass, sheep fescue, as well as numerous projects and activities. A presentation and paper titled “Native Plants of Lewis and Clark – Establishing Indoor and Outdoor Classrooms” was given at the Montana Education Association annual meeting in Belgrade, Montana. A paper titled “Rocky Mountain Juniper Seed Collecting, Processing and Germinating” was published in the *Native Plants Journal*. PMC tours included visiting Chinese and Mongolian scientists, CSU wildlife biology class, Kentucky stockmen, MSU graduate students, and Rocky Boy Advanced Science high school students. Presentations were given at the Montana Seed Trade Association meeting and Governor’s Range Tour.

Outreach assistance was provided to tribal college professors, high school teachers, students, state park administrators, and conservationists in Montana, Oklahoma, and

South Dakota. The Center hosted honor students from Rocky Boy Schools on a day-long tour that emphasized alternative careers in agriculture. Nearly 600 vegetative tillers of sweetgrass were distributed to cultural leaders for demonstration and educational purposes.

NEW MEXICO

2002 WCC-21 PROGRESS REPORT

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INTRODUCTION

This report summarizes the revegetation and native plant propagation research associated with the joint revegetation research program between researchers at the New Mexico State University – Mora Research Center and the Natural Resources Conservation Service – Los Lunas Plant Materials Center. The majority of the revegetation research projects described in this report are associated with research on the direct establishment of container stock onto overburden piles at the Molycorp Inc., molybdenum mine located in Questa, New Mexico. The riparian restoration research discussed in this report reflects several years of on-going research in developing revegetation stock for deciduous riparian species for various riparian sites in the mountainous southwestern United States. The native plant propagation research is primarily focused on those plants with potential applications in other revegetation, reclamation and restoration research.

COMPLETED AND ONGOING PROJECTS

1. Three to 20 Year Transplant Height Growth of *Pinus Ponderosa* (Laws.) Planted on Non-Amended Mine Overburden (John T. Harrington and Mark Loveall).

The purpose of this study is to examine the growth rate of *Pinus Ponderosa* (Laws.) planted directly into mine overburden. Height growth data is being collected on a series of transplant sites associated with a molybdenum mine in north central New Mexico and several reforestation sites in the region. Future analysis will involve

comparing the growth rates among the traditional reforestation sites and between the traditional reforestation and the mine site.

2. Dormancy and Germination in *Cercocarpus montanus* (Raf) seed from New Mexico. (Lee Rosner, John T. Harrington, David R. Dreesen and Leigh Murray).

Mountain mahogany (*Cercocarpus montanus* Raf) is a useful reclamation species because it can occupy and improve poor soils. Literature regarding seed propagation of this species is varied and often contradictory, recommending stratification durations of 14 to 90 days, and sulfuric acid scarification durations of none to 60 minutes. To assess variability in propagation requirements among seed sources, 8 New Mexico seed sources were tested with factorial combinations of scarification and stratification treatments. Sources were selected to encompass both a range of latitudes throughout New Mexico and a range of elevations at Questa, N. M. Seeds were scarified 5 or 10 minutes in concentrated sulfuric acid, tumbled 5 or 10 days in course grit, or unscarified (control). Seeds underwent subsequent stratification for 0 (control), 30, or 60 days. Averaged across scarification treatments, the 2 southernmost sources lacked a stratification requirement, while northern seed sources achieved their highest germination following the longest stratification duration (60 days). Improvement in germination due to stratification was greatest for the 2 highest elevation Questa sources. Scarification treatments were less effective in improving germination than stratification treatments, and produced more variable results. A 5-minute soak in sulfuric acid was the most effective scarification treatment, but for 2 sources, this treatment reduced germination. Variability in the stratification requirement appears to be an adaptation to macroclimatic differences among seed sources, whereas differential response to scarification may be a response to microclimatic differences.

3. Germination Response of New Mexico Sources of *Ribes cereum* (Dougl.) to Sulfuric Acid Scarification. (Lee Rosner, John T. Harrington, David R. Dreesen and Leigh Murray).

Seeds from six New Mexico sources were scarified in concentrated sulfuric acid for 0, 2, 4, or 8 min and then cold-stratified for 0, 60, 90, or 120 d. Response to combinations of cold stratification and scarification treatments varied widely among seedlots. For most seedlots, cold stratification was more effective than scarification in improving germination, and scarification improved germination only at low, ineffective levels of cold stratification. For three of six seedlots, maximal germination was achieved without scarification. For the remaining three seedlots, optimal scarification duration varied. Variability in sensitivity to acid scarification is discussed in terms of environmentally-induced effects on seed coat structure and physiology.

4. Percussion as an Alternative Seed Treatment for *Robinia neomexicana* (A. Gray) (Nabil Khadduri, John T. Harrington, and Leigh Murray).

Robinia neomexicana is a valuable reclamation species, yet seedling production has been hampered by inconsistent germination due to seed coat-imposed dormancy. Percussion scarification, in which seeds are repeatedly propelled against a hard surface, represents a potential improvement over standard seed treatments for this species. Nine seed sources were collected throughout New Mexico, USA and subjected to treatments including a control, hot water (immersion at 100^0C, boiling for 30 sec or 60 sec) and percussion scarification (1, 2, 4 or 8-min durations). Averaged over all seed sources, and for each seed source, percussion scarification durations of 4 or 8 min yielded highest germination. In addition, 4 and 8-min percussion-treated seeds germinated as fast or faster than all other treatments. Unlike hot water treatments, percussion scarification specifically weakens the strophiole without excessively damaging the seed coat. SEM images revealed the separation of strophiolar cells in seeds percussed for 4 min and X-ray radiographs confirmed a lack of structural damage for seeds percussed for up to 4 min. This percussion scarification technique has the potential to facilitate the use of other valuable reclamation species that share similar seed anatomy.

5. Hydrogen Peroxide Seed Scarification of New Mexico Collections of *Ribes Cereum* (Dougl.). (John T. Harrington, Lee Rosner, Leigh Murray and David R. Dreesen).

Ribes cereum (Dougl.) is and early-colonizing shrub species being evaluated for disturbed-land revegetation in New Mexico. Along with embryo dormancy, seed coat dormancy is thought to occur in this species, but scarification with acid has failed to improve germination consistently. To examine the efficacy of scarification using hydrogen peroxide, seeds from six *R. cereum* collections from throughout New Mexico were soaked in a 3% hydrogen peroxide solution for either 0,4,8 or 16 hours and then stratified for either 0, 60, 90 or 20 days at 38 C. The combination of a four hour hydrogen peroxide soak followed by 120 days of stratification yielded the greatest germination for most collections. With the exception of the southernmost collection, stratification was more effective in promoting germination than scarification with hydrogen peroxide.

6. The Influence of Fertilizer at time of Planting on Survival, Root Growth and Shoot Growth of Two Shrubs on Mine Overburden. (Mary Williams, Mohammed Tabbouh, John T. Harrington, David R. Dreesen, Leigh Murray, and April Ulery).

This study evaluated root growth of Apache plume (*Fallugia paradoxa*) and serviceberry (*Amelanchier alnifolia*) on overburden at the Molycorp mine near Questa, New Mexico. In August 1995, container grown, one-year-old seedlings were transplanted onto two sites (main plots) in a split-plot generalized complete block design with 3 blocks per site. Each species was replicated by 2 rows of 7 seedlings in each block. One row received slow-release fertilizer at the time of planting and the other row received no fertilizer at time of planting. In November 2000, root density was determined for each species by counting the number of roots in 3 diameter classes

(<0.5, 0.5-2.00 and >2.00 mm) at 3 horizontal planes (10, 20 and 30 cm) within 6 depths (0-5, 5-10, 10-15, 15-20, 20-25 and 25-30 cm). Two plants per species per fertilization treatment at each site were excavated for root analysis. Fertilization influenced root distribution in both species. Apache plume total root density (number of roots greater than 0.05 mm/150 cm^2) and distribution were influenced by fertilization with greater root densities at the deeper (> 20 cm) depths of the horizontal plane 20 cm from the plant base. Fertilization effects on serviceberry root densities were depth dependent. Fine root densities of unfertilized plants were greater than fertilized plants at 5-15 cm deep and coarse root densities were greater at 15-20 cm deep. In contrast, coarse root density of unfertilized plants was greater than fertilized plants at 5-10 cm deep. Serviceberry fine and total root densities differed among horizontal planes between fertilization treatments. Fertilized plants had fewer fine and total roots in the plane 10 cm from the plant base relative to the 20 and 30 cm planes. While fertilizer treatments in mine revegetation may increase root growth for shrubs such as Apache plume, it may hinder root growth in other shrubs such as serviceberry.

PLANNED PROJECTS

1. Post-establishment Fertility Responses of Woody Plants Growing on Hard Rock Overburden (John T. Harrington, David R. Dreesen, and Mark Loveall).
2. Influence of Cover Soil Thickness on Woody Plant Establishment on Hard Rock Overburden (John T. Harrington and David R. Dreesen).
3. Influence of Sequential Versus Simultaneous Establishment of Woody Plants and Grass Cover on Hard Rock Overburden (John T. Harrington and David R. Dreesen).

RECENT PUBLICATIONS

Khadduri, N.Y., J.T. Harrington, and L. Murray 200x. Percussion as an alternative seed treatment for *Robinia neomexicana*. Seed Science and Technology (*In Press*).

Rosner, L., J.T. Harrington, D.R. Dreesen, and L. Murray 200x. Sulfuric acid seed scarification for wax currant from New Mexico. Native Plants Journal (*In Press*).

Rosner, L., J.T. Harrington, D.R. Dreesen, and L. Murray 200x. Effect of gibberellic acid and standard seed treatments on mountain snowberry germination. Native Plants Journal (*In Press*).

Rosner, L., J.T. Harrington, D.R. Dreesen, and L. Murray 200x. Dormancy and germination in New Mexico mountain mahogany seed collections. Journal Range Management (*In Press*).

Rosner, L**.,** J.T. Harrington, D.R. Dreesen, and L. Murray 200x. Hydrogen peroxide scarification of *Ribes cereum*. Seed Science & Technology (*In Press*).

Jones, C.L., J.T. Harrington, and D.R. Dreesen. 200X. Refinement and stratification of thinleaf alder and water birch seeds from New Mexico. Native Plants Journal (*In Press*).

Dreesen, D.R., J.T. Harrington, T. Subirge, P. Stewart, and G. Fenchel. 200X. Riparian restoration in the southwest – species selection, propagation, planting methods, and case studies. *In:* Proc of the 2001 Forest and Conservation Nursery Proceedings, Durango, CO July 30 – August 2, 2001. (*In Press*).

Loveall, M., R. P. Maiers, and J.T. Harrington. 200X. Windbreak establishment in the Middle Rio Grande Valley, New Mexico. *In:* Proc of the 2001 Forest and Conservation Nursery Proceedings, Durango, CO July 30 – August 2, 2001. (*In Press*).

Khadduri, N., J.T. Harrington, L. Rosner, and D.R. Dreesen. 200x. Percussion as an alternative scarification for New Mexico locust and black locust seeds. In. Proc of the 2001 Forest and Conservation Nursery Proceedings, Durango, CO July 30 – August 2, 2001. (*In Press*).

Khadduri, N.Y., 2002. Percussion as an Alternative Seed Treatment for *Robinia **n**eomexicana* (New Mexico Locust)**.** Master of Science Thesis. New Mexico State University, Las Cruces, NM 63pp.

Tabbouh, M.B., 2001. The Effects of Fertilization on Shrub Establishment and Growth on High Elevation Overburden. Master of Science Thesis. New Mexico State University, Las Cruces, NM 107 pp.

Khadduri, N., and J.T. Harrington 2002. Shaken not stirred – a percussion scarification technique. Native Plants Journal 3: 65-66.

Rosner, L., J.T. Harrington, D.R. Dreesen, and L. Murray. 2001. Influence of provenance on *Ribes cereum* and *Symphoricarpos oreophilus* seed germination in New Mexico seed sources. *In:* R. Barnhisel (ed) Proc. American Society of Surface Mining and Reclamation, 2001 National Meeting. June 2-7, 2001. Albuquerque, NM pp. 31-38.

Harrington, J.T., D.R. Dreesen, A.M. Wagner, L. Murray, and P. Sun. 2001. Results of species trials on low pH overburden materials for mine land reclamation. *In:* R. Barnhisel (ed) Proc. American Society of Surface Mining and Reclamation, 2001 National Meeting. June 2-7, 2001. Albuquerque, NM pp. 112-120.

Harrington, J.T., A.M. Wagner, and D.R. Dreesen. 2001. Influence of *Pisolithus tinctorius* inoculation on greenhouse growth and first-year transplant survival of conifer seedlings. *In:* R. Barnhisel (ed) Proc. American Society of Surface Mining

and Reclamation, 2001 National Meeting. June 2-7, 2001. Albuquerque, NM pp. 265-270.

Harrington, J.T., D.R. Dreesen, A.M. Wagner, L. Murray, and P. Sun. 2001. The influence of seed source and stock size on first-year performance of direct transplanted conifer seedlings. . *In:* R. Barnhisel (ed) Proc. American Society of Surface Mining and Reclamation, 2001 National Meeting. June 2-7, 2001. Albuquerque, NM pp. 255-264.

Dreesen, D.R**.,** J.T. Harrington, A.M. Wagner, L. Murray, and P. Sun. 2001. Testing native grasses for survival and growth in low pH mine overburden. *In:.* R. Barnhisel (ed) Proc. American Society of Surface Mining and Reclamation, 2001 National Meeting. June 2-7, 2001. Albuquerque, NM pp. 2-17.

NORTH DAKOTA

Bismarck Plant Materials Center Progress Report for 2002

2002 WCC-21 Progress Report

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INTRODUCTION

This report summarizes 2002 project activities at the USDA, Natural Resources Conservation Service, Plant Materials Center located at Bismarck, North Dakota. Current projects have focused on native prairie and riparian restoration. Development of native forbs, legumes and wetland species for conservation use. Work also continues on woody species and foundation grass seed production.

COMPLETED PROJECTS

Our most recent release Itasca Germplasm little bluestem (*Schizachyrium scoparium*) was released in 2001. A four acre foundation seed production field of Itasca is currently being established. We continue to grow and offer commercial growers foundation seed of 13 native grasses and forbs. These native releases will continue to add diversity to conservation plantings such as range and pasture seedings, wildlife habitat development, prairie restoration and prairie landscaping.

Evaluation of warm and cool season grasses for conservation use. Evaluation of various grass species at two sites has recently been completed. (Hettinger ND and Morris MN).

ONGOING PROJECTS

Plant Materials for Saline Areas. Various grass species are being evaluated for potential use in salt affected areas.

Evaluation of slough sedge (*Carex atherodes*). Technology development and selection for future release of this common wetland species, which has potential use in wetland restoration, creation or enhancement.

Prairie Restoration Partnership. This study is a cooperative effort between the Bismarck Plant Materials Center and the North Dakota State Game and Fish Department. Field trials are currently being evaluated and data collected on diverse native seedings. Project plans include the renovation of introduced species with a diverse mixture of native grass forbs and shrubs. Standards and specifications for prairie restoration in the Northern Great Plains will be developed at the end of the study period.

Direct Seeding Woody Species into Riparian Zones. Direct seeding methods are being evaluated as a potential option for renovation of riparian areas. This study is being conducted on lands enrolled into the Emergency Watershed Program.

Evaluation of the Effectiveness of Various Grasses and Herbicides in Reducing Leafy Spurge. Cooperative study with North Dakota State University evaluating various grass mixes and their competitive association with leafy spurge.

Native Shrubs for Conservation. Ongoing data collection and evaluation of native hawthorn (*Crataegus chrysocarpa*) silver buffaloberry (*Shepherdia argentea*), sandbar willow (*Salix interior),* false indigo (*Amorpha fruiticosa*), select plum (*Prunus* sp.) and chokeberry (*Photinia melanocarpa*).

Native Forbs and Legumes for Conservation. Evaluation and increase of leadplant (*Amorpha canescens*) and silky prairie clover (*Dalea villosa*).

Effect of Selected Herbicides on Seven Native Forbs/Legumes. Evaluation of selected herbicides on stand establishment.

Woody Field Evaluation Plantings. Ongoing evaluation of tree and shrub material at seven sites in Minnesota, North Dakota and South Dakota. This long-term study evaluates numerous tree and shrub stock over a number of years for potential selection of suitable material for conservation use in the Northern Great Plains and Minnesota.

PLANNED OR POTENTIAL PROJECTS

Seed collection of prairie dropseed (*Sporobolus heterolepis)*.

Seed collection of shell leaf penstemon (*Penstemon grandiflorus*).

CURRENT PUBLICATIONS AND PAPERS

Bismarck Plant Materials Center. 2002. Native Prairie Restoration Annual Report-2001. USDA-NRCS-Bismarck Plant Materials Center, Bismarck, ND. 19 pages.

Bismarck Plant Materials Center. 2002. Notice of Release : Itasca Germplasm Little Bluestem, USDA-NRCS Bismarck Plant Materials Center, Bismarck, ND.

September 2001. 9 pages.

Bismarck Plant Materials Center. 2002. Big Bluestem High Quality Summer Forage for the Northern Plains, USDA-NRCS Bismarck Plant Materials Center, Bismarck, ND.

May 2002. Brochure.

Jensen, N., R Bergsagel, P. Halko. 2002. Prairie Cordgrass *Spartina pectinata* Propagation. Native Plant Summit VI, Kirksville, Missouri. June 2002. poster.

OREGON/WASHINGTON

USGS
FOREST AND RANGELAND ECOSYSTEM SCIENCE CENTER
2002 WCC-21 PROGRESS REPORT

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INTRODUCTION

This report summarizes the revegetation and restoration research being conducted or contracted by the USGS, Forest & Rangeland Ecosystem Science Center (FRESC) for the period of January 16, 2001 to June 30, 2002. The research reported in this document was funded by USGS, the Bureau of Land Management, or by funds obtained through external granting agencies.

COMPLETED PROJECTS

1. Quantification of vegetation diversity on intact and deteriorated rangelands: Experiment 1 - Plant diversity on sagebrush steppe rangelands varying in ecological condition. (Lee E. Eddleman & Pat Dysart, Department of Rangeland Resources, Oregon State University)

   The following is an excerpt from the abstract of Patricia Dysert's dissertation (Dysart 2001) which is the final report for this project (see products section).High seasonal and yearly variation exhibited by all classification schemes studied (species richness counts, diversity indices, functional groups, and soil surface microtopography) confounded their ability to consistently distinguish among condition classes. Highest diversity was obtained in the spring and least in the fall. A significant correlation was obtained between diversity and modified condition class index calculated using actual field data by season, and showed that based on diversity, sites might be classified as poor in one year and good in the next. Five distinct soil surface types showed apparent trends across the gradient, but no statistically significant results were obtained between the amount of cover of any of the soil surface types and range site condition. Significant natural changes in cover by soil surface microtopography category did occur in the year following grazing exclusion

regardless of range condition. This may indicate system resilience is initially high and that recovery thresholds may be approached quickly regardless of initial range condition. Our results indicate that in ecosystems where distinct seasonal changes affect plant community composition, species richness numbers and diversity indices should be used with caution as a criterion for ecological assessment. An a priori delineation of the temporal scale for measurement is an essential condition of using any vegetation or soil indicator as an evaluation tool.

2. Fire History in the Intermountain Sagebrush Steppe (Richard F. Miller, Department of Rangeland Resources, Oregon State University, Burns, OR**)**

Fire is thought to have played an important role in shaping plant communities in the Intermountain sagebrush steppe. The post-settlement increase in woody plants at the expense of many important forage species has been attributed to the declining role of fire during the past 100 years. Many private landowners and public land management agencies have been attempting to reintroduce fire to restore range health, improve livestock grazing conditions, and enhance wildlife habitat. However, our ability to use fire as a tool for vegetation management is becoming more limiting particularly as urbanization continues to increase throughout the West. Increasing concern and lack of understanding over the reintroduction of fire by many urbanites and some resource managers has lead to both criticism and lawsuits related to the use of prescribed fire. This is due in part to a lack of information that directly supports the reoccurrence of fires on shrub steppe landscapes before settlement. In addition, we have little direct information on the length and variation of fire-return intervals, season of fire occurrence, and growing conditions in years before and after pre-settlement fires. The objectives of this study include: (1) document fire-return intervals in mountain big sagebrush and juniper woodlands; (2) attempt to describe fire history for several aspen communities; (3) document the climatic conditions during years before pre-settlement fire events and during the year of the fire; (4) determine the seasonal variation among pre-settlement fires; and (5) integrate these results (fire frequency, season of burn, and climatic conditions) into an Intermountain West prescribed and wildfire restoration program.

This project was initiated in Spring 1998. The investigators worked with the Department of Interior agencies to locate potential sites for use in this study, evaluating each site for presence of the appropriate plant communities. Data collection began in July 1998. The first year of sample collection and measurements was completed. Currently eight locations across southeast and central Oregon, and northeast California have been sampled. A number of other sites have been searched for potential fire history sampling, of which two more sites, Dry Mt and Silver Lake area, will be sampled during the year 2000. A total of 37 samples have been collected and prepared for cross dating. Sixteen of these samples representing nine sites have been cross-dated. Incomplete results of fire return intervals and length of the fire period are reported in Table 2 of the 1999 Annual Report. Mean fire return intervals across nine sites (7 locations) vary between 12 to 20 years for mountain big sagebrush communities. Earliest cross-dated fire scares date back to

1656. Age structure and presettlement dynamics in aspen stands have been summarized and currently in the peer review process. Over 85 % of nearly 100 aspen stands measured throughout southeast Oregon, northeast California, and northwest Nevada were over 90 years old. Pre-1900 mean disturbance intervals occurring within two large aspen stands located on Steens Mountain and Fish Creek Rim, was 10 to 12 years, with replacement of the entire stand occurring approximately every 60 years. Progress through January 2001: The fieldwork was completed in the mountain big sagebrush communities. A total of 37 fire scar samples and 130 tree cores have been sampled across 13 sites in eastern Oregon and northeastern California. All samples have been prepared for analysis. Sixteen fire scar samples have been analyzed at the Dendrochronology Laboratory at the University of Arizona. The remaining 21 samples are presently being analyzed and should be completed this winter. Ages of juniper cores have been recorded and data are being summarized. Fire histories for each of the 9 sites analyzed indicate a mean fire return interval between 12 and 16.4 years. The initial encroachment of juniper appears to be synchronized with the reduction in fire events. The aspen portion of this study has been completed. Aspen stands below 2100 m and interspersed in the sagebrush steppe biome in the northwest averaged 98 years old, with 85% of the stands varying between 70 and 130 years. Juniper invasion began in the 1890s, peaked between 1900 and 1939. Western juniper replaced or dominated 35% of the 91 aspen stands measured and was common in 60%. Aspen age structure across two large stands indicated a mean disturbance frequency within a portion of the stand of 16 years, and total stand replacement to occur about every 60 years prior to 1900. The absence of presettlement juniper within all sampled aspen stands suggests fire was the primary stand-replacing disturbance in these northwest Great Basin aspen communities.Progress through April 2002: The final report has been submitted and peer-reviewed. Nearly 200 fire scars were collected and analyzed. Mean fire return intervals (MFRI) for the years 1600 to 1830 (before European settlement) varied between 10 and 20 years. MFRI could not be calculated post settlement since fire events were too infrequent. Fire has not occurred on 6 of 10 sites and only one or two events have occurred at the remaining 4 sites during the post-settlement period. The final report is available on the FRESC website: http://fresc.usgs.gov/online/online_docs/NIFC/NIFC_Final_Report.pdf

ONGOING PROJECTS

1. VegSpec. (Phil Smith, Natural Resources Conservation Service, Information Technology Center, Fort Collins, CO; John Patterson, NRCS, Lincoln, NE; James Henson, NRCS, Baton Rouge, LA; Steven Warren, Cntr. for Ecol. Mgmt. of Military Lands, Colo. State Univ., Ft. Collins, CO; David Pyke, USGS, Forest and Rangeland Ecosystem Science Center, Corvallis, OR)

   The temperature probabilities for climate stations have been corrected. This resulted in two choices for climate data, either averages based on 2-in-10 year averages or based on 30 year averages. The default will be 2-in-10 year averages since this

captures the great variation. Implementation of the PRISM dataset into VegSpec has been delayed once again since the database language being used by the NRCS was changed and this required considerable time for the programmer to modify the code. We anticipate that PRISM will be implemented in the coming year. Work continues on the thorough validation of the data within VegSpec. As inconsistencies are discovered, they have been implemented. A 3-hour training session on VegSpec has now been incorporated into the BLM's National Training Course #1730-60 Restoration of Disturbed Wildlands. Students select species for their case study using VegSpec as a tool.

2. Interactions of Cattle Grazing and Climate Change on Semi-arid Ecosystem Function (David Clausnitzer, David A. Pyke, Jayne Belnap, Tim Graham, USGS, Forest & Rangeland Ecosystem Science Center, and Robert Sanford, Denver University).

   The second year's field sampling took place from April through July 2001. Eight sites were sampled, 4 on the Colorado Plateau and 4 in the northern Great Basin. In each region, sampling was repeated at 2 sites that were sampled in 2000, and 2 new sites were sampled. Two sites in each region have been chosen for more intensive sampling, to provide additional data (above- and below-ground plant biomass, soil temperature, and plant lignin) required for CENTURY modeling. At all sites, we eliminated measurements of infiltration, soil shear strength, and bulk density due to inadequate sensitivity. Measurements of soil enzyme activities and field-extractable mineral N were added. A sixth plot, at 300 m from each water source, was added. Measured variables correlate more clearly with estimates of animal use/plot based on feces counts than with distance from water. We are evaluating results of an animal use index based on feces counts, hoof print cover, and cow trail lengths. Gradients in measured variables correlate with overall animal use intensity. At lowest-use sites, gradients are undetectable for most variables at our level of sampling. Variables that so far show the highest sensitivity to animal use gradients include: percent cover of intact soil surface, microbiotic crust, and plant functional groups; surface soil stability (slake); and soil N, P, K, organic matter, and enzymes. Of arthropods collected in pitfall traps, *Coleoptera*, *Lepidoptera, Microcoryphia*, and *Pseudoscorpions* had positive correlations with animal use. Most predatory taxa were negatively correlated with use indicators. We have begun analysis of the data using a hierarchical, or mixed, statistical model that essentially estimates average effects for a given variable over all sites. We have also initiated the modifications to the Century model to run it for ecosystems in the Great Basin and Colorado Plateau shrub grasslands.

3. Coordinated Intermountain Restoration Project (David A. Pyke, USGS, Forest & Rangeland Ecosystem Science Center, and Mike Pellant, Bureau of Land Management, Idaho State Office, Boise ID).

   The strategic plan was accepted and approved during the summer of 2001. Four studies have begun to address some of the high priority issues in the plan. (1) Although decomposition is an important aspect of nutrient cycling, little is known

about decomposition in sagebrush ecosystems in the northern Great Basin. We have designed a project to address five objectives: (1). Quantify the difference in decomposition rates in native and cheatgrass-dominated sites; (2). Characterize the difference in decomposition rates between native and introduced grasses in these two systems; (3). Characterize the number and functional diversity of microorganisms in the grass litter in the native and cheatgrass-dominated sites; (4). Quantify the difference in UV penetration to the litter layer in the communities and describe the significance of its effect on decomposition rates; (5). Quantify the difference in nitrogen availability (magnitude and distribution) between the two communities using ion-exchange resins. Site selection for this project was completed in December 2000. All sites were located on the Snake River plain near Boise, Idaho. Four grasses, three native (*Pseudoroegneria spicata* bluebunch wheatgrass, *Poa secunda* Sandberg bluegrass, and *Elymus elymoides* bottlebrush squirreltail) and one exotic (*Bromus tectorum* cheatgrass), are used in the decomposition study. All grasses were collected in May 2001 from the Snake River Birds of Prey National Conservation Area (NCA). Litter bags of all species were placed at five sites in the NCA by July 6, 2001. Each site consists of five, 50-m transects established at random directions away from a center point. The six of the seven sets of collections have been completed during 2001 and 2002. Data analysis began after the fourth collection in January 2002. Percent mass loss of approximately 30 % occurred between November and January in all litter species. Principle Components Analysis was used to examine the Biolog (numbers and functional groups) bacterial and fungal groups found on the litter. No separation was detected between litter samples located on native vs. cheatgrass-dominated sites nor was separation detected among the species of litter. The ordinations suggest that the most important explanatory variable for describing differences in bacterial carbon source utilization patterns in this study was sampling date. New study plans have been accepted for three new projects. Two projects will focus on controlling cheatgrass competition. One will be a defoliation study to examine determine the phenologic period when grazing might be effective as a tool to control cheatgrass. The second will be an herbicide study to investigate the effect of Plateau, an herbicide that may be effective in controlling cheatgrass, on seedling establishment of native species. The last project is investigating BLM's success rate in establishing Wyoming big sagebrush and mountain big sagebrush on wildfire rehabilitation projects.

4. <u>BLM's Emergency Fire Rehabilitation (EFR) Monitoring in the Intermountain West</u> (David A. Pyke, USGS, Forest & Rangeland Ecosystem Science Center, and Ted O. McArthur, Oregon State University).

   In Phase I of this study, our objectives were to determine native plant use, monitoring implementation and how often the EFR objectives were met from 1988 to 1999. Eight BLM field offices were randomly selected from the Intermountain West. Average fire size increased 4-fold, numbers of projects increased nearly 4-fold, percentage of burned lands being rehabilitated increased 3.5-fold. On average, 4-5 species were sown, but only 1 to 2 species were natives. The proportion of native

seeds (bulk numbers of seeds) in mixtures increased from 23-43%. On average, BLM implemented monitoring on 42% of the projects. Monitoring data were rarely analyzed and filed regarding the success of projects in meeting objectives. Recommendations included: increasing species, especially natives, in EFR projects; adding PLS and seeding rate to project files; eliminating nitrogen-fixing plants from mixtures in shrub steppe ecosystems; monitoring should address effectiveness of projects to meet objectives and the BLM should use consistent and practical techniques. For ease of analysis, and distribution of results, an internet-based analysis and data warehouse system should be established. This system should include a completion report that provides an evaluation of how well the project met objectives. Phase II of the project investigates reasons why native species were or were not used and why monitoring was not proposed or was not implemented in EFR projects and examines the establishment success and sustainability of native species sown on a sample of BLM EFR projects. We have developed a survey that is being administered to ascertain BLM managers perceptions regarding the use of native plants and monitoring in EFR projects. Using a combination of current field examinations and previous monitoring results, we are comparing the status of each species, found on an EFR projects, to the original monitoring status and to the original species list for the EFR project. On selected sites, we have repeated the monitoring techniques implemented by the BLM and when possible, have used a technique that was common among all sites. Site selection for this phase was limited to projects established before 1996 because we believe that three years may not provide sufficient time to evaluate establishment and survival success for many native species. Preference was given to projects that included native species in the rehabilitation seed mixture in combination with an implemented monitoring plan. We will also use VegSpec (an internet-based revegetation expert system) to aid us in determining if a species would be expected to establish and survive given the soil and climate conditions of the site. When a species is not recommended by VegSpec, we will determine the soil or climate parameters that resulted in the species not be recommended for the site. We will also examine the frequency of establishment of these species. Data are currently being analyzed.

5. Integrated Restoration Strategies towards Weed Control on Western Rangelands (Robert Nowak, Department of Environmental and Resource Science, University of Nevada – Reno and 11 other investigators including David A. Pyke, USGS, Forest & Rangeland Ecosystem Science Center).

   Although cheatgrass (*Bromus tectorum*) has been widely distributed across western rangelands for >70 years, the full ecologic and economic impacts of this non-native invasive plant have not yet occurred. Unfortunately, several independent lines of evidence indicate that the rate at which acreage becomes infested with cheatgrass is increasing rapidly. Furthermore, the invasion and spread of a number of emerging secondary weeds is coincident with cheatgrass infestation. Thus to control the spread of these secondary weeds, we must first control cheatgrass. Competitiveness and prolific seed production allow cheatgrass to invade both disturbed and intact native communities and to dominate after wildfire. Thus, efforts

to control cheatgrass need to focus on these biological characteristics while simultaneously restoring native plants on Great Basin rangelands. Our overall goal is to identify concepts and management strategies to control the spreading dominance of cheatgrass and other weeds on Great Basin rangelands and to restore native species and increase biodiversity. Our primary focus will be cheatgrass because it is the most widespread and damaging invasive weed, but we will also examine the extent that secondary weeds complicate cheatgrass control and native species restoration efforts. Supporting objectives are: (1). Conduct a series of common experiments across the Great Basin that test management techniques for controlling cheatgrass and other weeds, establishing native plant communities, and restoring ecosystem structure and function while reducing the cost of restoration. (2). Provide an ecological understanding of why restoration techniques succeed or fail. (3). Develop conceptual and economic bases for choosing appropriate management techniques. (4). Use partnerships among governmental agencies, universities, cooperative extension, and land managers to convey knowledge to ranchers and other professionals. (5). Use partnerships with educators to increase student and public awareness of invasive species issues and to develop educational tools that convey solutions to invasive species and native plant restoration problems. By combining expertise and sharing resources, our multi-state, interdisciplinary consortium of research, education, extension, and agency personnel is poised to identify ecological principles and fundamental knowledge needed to manage invasive weeds and facilitate native plant restoration on Great Basin rangelands. We also plan an active program to disseminate that knowledge to managers and users of Great Basin rangelands. Field site selection and hiring of personnel is occurring this field season.

PLANNED OR POTENTIAL PROJECTS

None

CURRENT PUBLICATIONS AND PAPERS

Brooks, M.L. and D.A. Pyke. 2001. Invasive plants and fire in the deserts of North America. Pages 1-14 *IN*: K.E.M. Galley and T.P. Wilson (eds.). Proceedings of the invasive species workshop: the role of fire in the control and spread of invasive species. Fire Conference 2000: the first national congress of fire ecology, prevention, and management. Miscellaneous Publication No. 11, Tall Timbers Research Station, Tallahassee, FL.

Dysart, P.L. 2001. Quantification of vegetation diversity and variation on intact and degraded rangelands. Ph.D. dissertation, Oregon State University, Corvallis, Oregon. 210 pages

Humphrey, L.D. and D.A. Pyke. 2001. Ramet spacing of *Elymus lanceolatus* (thickspike wheatgrass) in response to neighbor density. Canadian Journal of Botany 79:1122-1126.

Miller, R., C. Baisan, J. Rose, & D. Pacioretty. 2001. Pre and post settlement fire regimes in mountain big sagebrush steppe and aspen: the northwest Great Basin. Final report to the National Interagency Fire Center, Boise ID. http://fresc.usgs.gov/online/online_docs/NIFC/NIFC_Final_Report.pdf

Pellant, Mike, Patrick Shaver, David Pyke, Jeffrey Herrick. 2000. Interpreting indicators of rangland health, version 3. BLM National Science and Technology Center, Technical Reference 1734-6, Denver, CO. 118pgs.

ftp://ftp.ftw.nrcs.usda.gov/pub/glti/IntIndRangeHealth.pdf

UTAH

BRIGHAM YOUNG UNIVERSITY

and

U. S. FOREST SERVICE SHRUB SCIENCES LABORATORY

2001-2001 WCC-21 PROGRESS REPORT

Prepared by

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INTRODUCTION

This report summarizes revegetation and restoration-related research conducted by faculty and scientists of Brigham Young University, the U.S. Forest Service Shrub Sciences Laboratory, and their cooperators for the year of 2001-2002. Projects range from basic studies of physiology, ecology, and genetics to applied revegetation trials and weed control procedures.

ONGOING PROJECTS

1. **Role of Seedbanks in the Management of Semiarid Rangelands Under Grazing** (Jaime Kigel, Hebrew University of Jerusalem, P.O. Box 12, Rehovot,Israel, Avi Perevolotsky, Volcani Center, Bet-Dagan, Israel, Bruce A. Roundy, Phil Allen (Brigham Young University, Provo, UT 84602, and Susan Meyer, U.S. Forest Service Shrub Lab, Provo, UT 84401).

   The objective of this study is to determine the effects of grazing, topography, and soil moisture and temperature on annual plant germination and emergence in the northern Negev Desert. Greenhouse experiments instrumented for moisture and temperature measurement have compared germination predicted by a hydrothermal time model and actual emergence of seeds. Under 3 relatively wet conditions, all seeds germinated when soil water sensors indicated high water potentials and the hydrothermal model accurately predicted germination. Colman cells and gypsum blocks were more sensitive to decreasing near-surface water potential than watermark sensors or TDR probes. Under a rapid drying treatment, the hydrothermal model predicted germination when none occurred. This suggests

that sensors buried at 1-3 cm may not be measuring water potential conditions representative of the seed zone under such conditions.

2. **Restoration of a Mojave Desert Site** (E.Durant McArthur, Stewart Sanderson, U.S. Forest Service Shrub Lab, Provo, UT 84401, and Bob Douglas, Dixie Field Office, Bureau of Land Management, St. George, UT).

   This study is to restore native vegetation to a Mojave Desert site physically disturbed by recreational activities. Favorable precipitation has enhanced establishment of native grasses and forbs drill seeded in the fall of 1992, as well as natural recruitment of non-seeded species. Monitoring is continuing to determine if and when annual plant dominance will shift perennial dominance. Fourwing saltbush and Indian ricegrass have especially established well. Annual species occurrence varies from year to year.

3. **Ecology and Restoration of Cheatgrass Dominated Sites** (Stephen B. Monsen, U.S. Forest Service Shrub Lab, Provo, UT 84401, Mike Pellant, Bureau of Land Management, Boise, Idaho 83706, and Nancy Shaw, U.S. Forest Service, Boise, Idaho 83702).

   This project involves a number of studies designed to protect or restore sagebrush rangelands in southern Idaho and central Utah threatened by cheatgrass invasion or dominance. To encourage use of native grasses in revegetation, studies are progressing on promising native grass source identified selections, effects of row spacing, configuration and rate of seeding on cheatgrass suppression, and rearing techniques to increase efficiency of native seed production. Studies testing the fuel and fire characteristics of different species and green-strip configurations are being conducted in Utah and Idaho.

   Effects of the nonselective herbicide Oust on reduction of cheatgrass in native grass stands is being tested. Large- scale seed production is being developed for about a dozen forbs which hold promise for revegetation in the Great Basin.

4. **Secondary Succession of Montane and Subalpine Vegetation on the Wasatch Plateau** (Stephen B. Monsen, U.S. Forest Service Shrub Lab, Provo, UT 84401).

   Vegetation inside and outside exclosures established by Sampson and Ellison on the Wasatch Mountains east of Ephraim, Utah is being remeasured to determine effects of site degradation and time on seral stage composition. Also, establishment requirements and constraints of native forbs is being studied. Many of these species germinate under snow and are subject to fungal attack associated with saturated soil conditions.

5. **Regeneration Biology of Shadscale** (Susan Meyer and David Nelson, U.S. Forest Service Shrub Lab, Provo, UT 84401).

   This project is to determine the seedbank dynamics and establishment phenology of shadscale, to develop techniques for direct seeding establishment. Field experiments are underway to determine the effects of damping-off organisms and

their control by fungicides on seedling mortality. A thermal time model has been successful in predicting changes in the chill response of afterripened seed.

6. **Regeneration Biology of Blackbrush** (Susan Meyer and Burton Pendleton,U.S. Forest Service Shrub Lab, Provo, UT 84401).

   This project is determining the reproductive outpUT seedbank dynamics, and field seedling recruitment of this mast fruiting shrub. Heteromyid rodent population dynamics are currently being studied in relation to masting and seed dispersal of blackbrush. Data on home ranges and caching behavior are being collected.

7. **Modeling Dormancy Loss and Germination in the Field of Annual and Perennial Grasses** (Susan Meyer, U.S. Forest Service Shrub Lab, Provo, UT 84401, and Phil Allen, Brigham Young University, Provo, UT 84602).

   Laboratory germination data are being used to predict dormancy loss and germination in the field for cheatgrass and squirreltail grass using a hydrothermal time model. The model has been extended to include effects of dynamic temperatures in order to predict germination under field conditions. Both cheatgrass and squirreltail seeds increase their rates of afterripening with increasing temperature when soil water potential is > -150 MPa, but decrease their rate of afterripening below that water potential until afterripening stops at about - 400 MPa.

8. **Ecological genetics of the cheatgrass head smut pathosystem. (**Susan Meyer and David Nelson, U.S. Forest Service Shrub Lab, Provo, UT 84401).

   This project is determining the potential of using head smut for biocontrol of cheatgrass. The smut infects seedlings, which subsequently do not produce seeds. Basic smut genetics are being investigated in order to eventually determine the limitations of environmental conditions or frequency-dependent selection on infection rates. Inbred cheatgrass lines tested to this point are resistant to smut from other populations but are susceptible to smut strains found within their own populations. Molecular markers for cheatgrass genotypes are consistent with phenotypic characteristics. Smut has been found to much more effectively infect fall than winter-germinated cheatgrass.

9. **Germination characteristics of native forbs.** (Susan Meyer, U.S. Forest Service Shrub Lab, Provo, UT 84401).

Requirements for germination are currently being tested for ecotypes of high elevation forbs including species of *Solidago, Eriogonum, Potentilla, Castilleja,* and *Geranium.* The goal of the research is to provide guidelines for increasing native seed production.

10. **Increasing Diversity of Mountain Big Sagebrush Stands** (E.Durant McArthur, Stewart Sanderson, U.S. Forest Service Shrub Lab, Provo, UT 84401, Bruce Webb, Brigham Young University, Provo, UT 84602**,** Barbara Wachocki, and Mohammed Sandossi, Weber State University, Ogden, UT).

Effects of tebuthiuron rates and season of application are being determined on herbicide persistence, soil microbes, and shrub and herbaceous plant composition of mountain big sagebrush stands. Rates up to 0.7 kg/ha have not negatively impacted soil microbes and in some cases enhanced their growth, possibly through increased availability of resources. Rates of 0.2-0.3 kg/ha have effectively thinned sagebrush. Herbaceous perennials initially increased, but have varied on both control and treated plots.

11. **Herbicide and Grazing Effects on Increasing Diversity of Aspen Parkland** (Val Jo Anderson, Brigham Young University, Provo, UT 84602, and Scott Walker, Utah Division of Wildlife Resources, Ephraim, UT 84627).

    The effects of cattle and elk grazing, as well as herbicide applications are being measured on tarweed, mule's ear, and thistle dominance and on plant community composition of aspen parklands.

12. **Natural Resource Monitoring, Analysis, and Reclamation Activities at Dugway Proving Ground** (Val Jo Anderson, Brigham Young University, Provo, UT 84602).

    Effects of disturbance and revegetation for cold-desert communities at Dugway are being studied under the objectives of a cooperative agreement between BYU and the Department of the Army. The following studies are in progress: 1) effects of a sweep broom attachment to clear cheatgrass litter on establishment of drill-seeded perennials (wheatgrasses, flax, and four-wing saltbush); 2) effectiveness of 6 species for greenstrip-fire control (kochia, yarrow, burnet, and wheatgrasses); 3) effects of >Plateau= and >Oust= herbicides and mechanical treatments on cheatgrass control and revegetation success; 4) establishment of kochia after fire and soil disturbances; 5) small mammal presence and diversity in relation to vegetation treatments and dominance; 6) cheatgrass invasion into salt desert shrublands; 7) use of wheatgrasses to capture sites from cheatgrass as a precursor to revegetation with native species; and 8) factors that constrain Utah juniper recruitment. Although various theses and manuscripts are in various stages of preparation or completion, long-term data are still being collected on most of these experiments.

13. **Restoring Native Diversity of Mountain Meadows** (Val Jo Anderson, Brigham Young University, Provo, UT 84602).

    Herbicide (Roundup) and mechanical treatments (tillage) are being applied alone and in combination prior to seeding native grasses to convert meadows dominated by smooth brome and intermediate wheatgrass back to native species in Ephraim Canyon, Utah.

14. **Control of Squarrose Knapweed** (Scott Jensen, U.S. Forest Service Shrub Lab, Provo, UT 84401; and Scott Walker, Utah Division of Wildlife Resources, Ephraim, UT 84627).

Phenology and reproductive biology and ecology of knapweed are being studied to better understand its ability to invade or be replaced by desirable species. The environmental controls of this species= ability to remain in the rosette until released by disturbance is a key to its control. Revegetation as a follow up to fire and herbicidal control is being studied, as well.

15. **Operational Scale Fire Rehabilitation with Native and Exotic Seed Mixes.** (Tyler Thompson and Bruce Roundy, Brigham Young University, Provo, UT 84602**,** E.Durant McArthur, U.S. Forest Service Shrub Lab, Provo, UT 84601, Pat Fosse, Bureau of Land Management, Philmore, UT Jim Davis, Utah Division of Wildlife Resources, Provo, UT 84601, and Jerry Chatterton, USDA, Agricultural Research Service, Logan, UT 84322-6300).

    A multiagency cooperative study was installed fall 1999 in Tintic Valley, Utah on land burned by the Railroad Fire during midsummer 1999. Four seed mixes were drilled on five blocks in a burned Wyoming big sagebrush area and were aerial broadcast and covered by 1-way chaining on five blocks in a burned Utah juniper area. Seed mixes included two native mixes, one with a higher number of species and total seeding rate than the other. Also seeded was a mix of selected exotic and native plant materials supplied by the Agricultural Research Service, and the standard Bureau of Land Management fire rehabilitation mix, composed mainly of exotic and some native species. After 2 years, perennial grass establishment from all mixes was high and similar on 3 of the 5 drill blocks, except for the native low rate mix which had limited establishment. Seeding failure on 2 drill blocks was probably due to excessive seed burial on sandy soils. On the broadcast and chain sites all mixes established but produced less cover than on the drill sites. Monitoring will continue for 1 more year before this study is published, and will continue after that over the next 10 years.

16. **Changing fire regimes, increased fuel loads, and invasive species: effects on sagebrush steppe and pinyon-juniper ecosystems.** (Jeanne Chambers, Durant McArthur, Susan Meyer, USFS Rocky Mountain Research Station, Bruce Roundy, Brigham Young University, and 10 other cooperators and investigators).

    This project is comparing historical and current fuel load characteristics and determining the effects of residue perennial vegetation on resource availability and invasibility of weedy species.

NEW PROJECTS

1. **Native Plant Community Resistance to Weed Invasion.** (Phil S. Allen and Bruce A. Roundy, Brigham Young University, Provo, UT 84602; and Susan Meyer, U.S. Forest Service Shrub Sciences Lab, Provo, UT 84601).

    Low and high densities of 2 native grasses, 2 native shrubs, and 4 native forbs have been established in various combinations. These plots will be seeded either to no

weeds, or cereal rye, jointed goatgrass, or cheatgrass to determine resistance to weed invasion. Selected treatments will be monitored to determine the effects of native vegetation on soil water resources in relation to invasion potential.

2. **Effects of Prechilling and Light on Carex Seeds.** (Bruce A. Roundy, Brigham Young University and Nancy Shaw, USFS Rocky Mountain Research Station).

   Seed dealers sell *Carex* seeds of varying ages because seed harvests may be much greater some years than others. Experiments have been completed comparing the effects of prechilling and different light cycles on germination of *Carex rostrata* and *C. nebrascensis* from the same populations but of 0.5, 1.5, 2, and 5.5 years of age. *C. nebrascensis* seed maintained germination at 5.5 years (54 %) while that of *C. rostrata* decreased to 2 %. Increased time of prechilling up to 4 weeks increased germination slightly for younger seeds. Four 12 hour light:12 hour dark cycles increased germination of both species and all seed ages.

3. **Establishment of Reserve Pastures for Camelids on the Bolivian Altiplano.** (Val Jo Anderson and Bruce A. Roundy, Benson Institute and Brigham Young University).

   A variety of introduced grasses and shrubs have been seeded or transplanted at 3 sites in the Altiplano. Cool-season grasses have established well and show promise. Additional studies will compare native grasses and also investigate forage plants for saline soils.

4. **Renovation of Big Sagebrush Steppe.** (Bruce A. Roundy and Danny Summers, Brigham Young University, Provo, UT 84602; Scott Walker and Jim Davis, Utah Division of Wildlife Resources, Provo, UT 84601).

   A variety of mechanical methods including chaining, aeration, and harrowing prior to seeding grasses and forbs are being compared as a way to diversify decadent stands of big sagebrush in northeastern Utah. Establishment the first year suggests that aeration may be an excellent way to prepare the seedbed for seedling establishment while maintaining some sagebrush cover.

CURRENT PUBLICATIONS AND PAPERS

Abbott, L.B. and B.A. Roundy. In press. Available water affects field germination and recruitment of seeded grasses. Journal of Range Management.

de Soyza, Amrita G.; Van Zee, Justin W.; Whitford, Walter G.; Neale, Anne; Tallent-Hallsel, Nita: Herrick, Jeffrey E.; Havstad, Kris M. 2000. Indicators of Great Basin rangeland health. Journal of Arid Environments. 45: 289-304.

Gardner, Paul A.; Stevens, Richard; Howe, Frank P. 1999. A handbook of riparian restoration and revegetation for the conservation of land birds in Utah with emphasis on habitat types in middle and lower elevations. In: Utah Division of Wildlife

Resources Publication Number 99-38. Salt Lake City, UT: Utah Division of Wildlife Resources: 48 p.

Harper, Kimball T.; Belnap, Jayne. 2001. The influence of biological soil crusts on mineral uptake by associated vascular plants. Journal of Arid Environments. 47: 347-357.

Kitchen, Stanley G. 2001. Addressing native plant seed testing problems. Certified Seed Gleanings. 20: 5-6.

Kitchen, Stanley G. 2001. Intra-specific variability in germination behavior and seed testing protocols: The challenge of intermountain species. Seed Technology. 23: 68-77.

Kitchen, Stanley G.; Monsen, Stephen B. 2001. Forage kochia seed germination response to storage time and temperature. Journal of Range Management. 54: 299-306.

Kitchen, Stanley G.; Jorgensen, Gary L 2001. Winterfat decline and halogeton spread in the Great Basin. In: McArthur, E. Durant; Fairbanks, Daniel J., comps. Shrubland Ecosystem Genetics and Biodiversity: Proceedings; Proc. RMRS-P-21; 2000 June 13-15; Provo, UT. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 200-203.

Kitchen, Stanley G.; McArthur, E Durant. 2001. Native or not: Subjective labels and their application in wildland plantings. Native Plants Journal. 2: 21-24.

Korfmacher, John L., Jeanne C. Chambers, Robin J. Tausch, Bruce A. Roundy, Susan E. Meyer, and Stanley Kitchen. In press. Technical Note: A technique for conducting small-plot burn treatments. Journal of Range Management.

Liao, Julia. D.; Monsen, Stephen B.; Anderson, Val Jo; Shaw, Nancy L 2000. Seed biology of rush skeletonweed in sagebrush steppe. Journal of Range Management. 53: 544-549.

McArthur, E. Durant. 2001. The Shrub Sciences Laboratory at 25 years: Retrospective and prospective. In: McArthur, E. Durant; Fairbanks, Daniel J., comps. Shrub land Ecosystem Genetics and Biodiversity: Proceedings; Proc. RMRS-P21; 2000 June 13-15; Provo, UT. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 3-41.

McArthur, E Durant; Fairbanks, Daniel J., comps. 2001. Shrubland ecosystem genetics and biodiversity: Proceedings. In: Proc. RMRS-P-21; 2000 June 13-15; Provo, UT. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 365 p.

Megahan, Walter F.; Wilson, Monte; Monsen, Stephen B. 2001. Sediment production from granitic cutslopes on forest roads in Idaho, USA. Earth Surface Processes and Landforms. 26: 153-163.

Monsen, Stephen B.; Shaw, Nancy L. 2001. Development and use of plant resources for western wildlands. In: McArthur, E. Durant; Fairbanks, Daniel J., comps. Shrub land Ecosystem Genetics and Biodiversity: Proceedings; Proc. RMRS-P-21; 2000 June 13-15; Provo, UT. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 47-61.

Ott, Jeffrey E. 2001. Vegetation of chained and non-chained rangelands following wildfire and rehabilitation in west-central Utah. Brigham Young University: M.S. Thesis. 79 p.

Ott, Jeffrey E; McArthur, E. Durant; Sanderson, Stewart C. 2001. Plant community dynamics of burned and unburned sagebrush and pinyon-juniper vegetation in west central Utah. In: McArthur, E. Durant; Fairbanks, Daniel J., comps. Shrub land Ecosystem Genetics and Biodiversity: Proceedings; Proc. RMRS-P-21; 2000 June 1315; Provo, UT. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 177-191.

Ott, J.E., E.D. McArthur, and B.A. Roundy. In press. Vegetation of chained and nonchained rangelands following wildfire and rehabilitation in west-central Utah. Journal of Range Management.

Ramakrishnan, Alisa P.; Coleman, Craig E.; Meyer, Susan E.; Fairbanks, Daniel J. 2001. Microsatellite markers and polymorphism in cheatgrass (Bromus tectorum L). In: McArthur, E. Durant; Fairbanks, Daniel J., comps. Shrubland Ecosystem Genetics and Biodiversity: Proceedings; Proc. RMRS-P-21; 2000 June 13-15; Provo, UT. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 95-97.

Roundy, B.A., H. Heydari, C. Watson, S.E. Smith, B. Munda, and M. Pater. 2001. Summer establishment of Sonoran Desert species for revegetation of abandoned farmland using line source sprinkler irrigation. Arid Land Research and Management 15: 23-39.

Sanderson, Stewart C.; Stutz, Howard C. 2001. Chromosome races of fourwing saltbush (Atriplex canescens), Chenopodiaceae. In: McArthur, E. Durant; Fairbanks, Daniel J., comps. Shrubland Ecosystem Genetics and Biodiversity: Proceedings; Proc. RMRS-P-21; 2000 June 13-15; Provo, UT. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 75-88.

Simmons, Matthew E. 2001. An evaluation of reclaimed copper/cobalt mine spoils of Blackbird Mine, Salmon, Idaho. Brigham Young University: M.S. Thesis. 77 p.

Stewart, A., V.J. Anderson, and S.G. Kitchen. 2001. “Immigrant” forage kochia seed viability as impacted by storage methods. Journal of Range Management 54:396-399.

Stradling, Dorothy A.; Thygerson, Tonya; Smith, Bruce N.; Hansen, Lee D.; Criddle, Richard S.; Pendleton, Rosemary L 2001. Calorimetric studies of cryptogamic crust metabolism in response to temperature, water vapor, and liquid water. In: McArthur,

E. Durant; Fairbanks, Daniel J., comps. Shrub land Ecosystem Genetics and Biodiversity: Proceedings; Proc. RMRS-P-21; 2000 June 13-15; Provo, UT. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 280-282.

Stutz, Howard C. 2001. Colorado Plateau Chenopod field trip. In: McArthur, E. Durant: Fairbanks, Daniel J., comps. Shrubland Ecosystem Genetics and Biodiversity: Proceedings; Proc. RMRS-P-21; 2000 June 13-15; Provo, UT. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 363-365.

Valles, Joan; McArthur, E. Durant. 2001. Artemisia systematics and phylogeny: Cytogenetic and molecular insights. In: McArthur, E. Durant; Fairbanks, Daniel J., comps. Shrub land Ecosystem Genetics and Biodiversity: Proceedings; Proc. RMRS-P21; 2000 June 13-15; Provo, UT. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 67-74.

Vernon, Jason L; Anderson, Val Jo; Davis, James N. 2001. Response of residual native species after two-way chaining and seeding in Utah. In: McArthur, E. Durant; Fairbanks, Daniel J., comps. Shrubland Ecosystem Genetics and Biodiversity: Proceedings; Proc. RMRS-P-21; 2000 June 13-15; Provo, UT. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 192-199.

Wachocki, Barbara A; Sondossi, Mohammad; Sanderson, Stewart c.; Webb, Bruce L; McArthur, E. Durant. 2001. Impact of tebuthiuron on biodiversity of high elevation mountain big sagebrush communities. In: McArthur, E Durant; Fairbanks, Daniel J., comps. Shrub land Ecosystem Genetics and Biodiversity: Proceedings; Proc. RMRS-P21; 2000 June 13-15; Provo, UT. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 216-223.

UTAH

2001 PLANT MATERIALS PLANTINGS

UTAH FIELD, DSI and DEMONSTRATION PLANTINGS

WCC-21 PROGRESS REPORT

Prepared by

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UTAH AREA 1

UT89011 Johnson - Tooele FO Secar Snake River wheatgrass and Hycrest crested wheatgrass field planting for jointed goatgrass control. FY90 seeded in March and stand is establishing. FY91 - FY93 no evaluations. FY94 fair stand of both species. Secar has better vigor and forage production. Secar does not establish as easily as Hycrest. Cattle prefer Secar. FY95 cooperator was disappointed in slow establishment and vigor of Secar in prior years. Secar plants are now well established and very vigorous. Secar is spreading outside of planted rows. During this favorable moisture year Secar remained green and continued to grow throughout the summer. Native bluebunch wheatgrass also remained green the entire growing season. FY96 good stand and vigor for both species. Secar is spreading outside of planted rows, but does not compete well with weeds (goatgrass and morning glory). Cooperator prefers Hycrest for early spring use. Secar is better species for use in later periods. FY97- FY99 no evaluations. FY00 Secar fair stand with good vigor. Hycrest good stand with good vigor. Grazing use is higher on Hycrest (45%) than Secar (10%) in spring grazing period. FY01 no evaluation.

UT90005 Hansen - Logan FO Newhy hybrid wheatgrass field planting in 18-inch precipitation zone. FY94 excellent stand with planting showing excellent palatability for sheep and mule deer. The stand is doing very well despite heavy grazing pressure. FY95 good to excellent stand of Newhy staying more weed free than nearby stand of smooth brome. Deer heavily grazes site in spring through summer. FY96 good stand with 2 plants per square feet, good vigor and about 0.9 AUM/Acre. FY97 Stand/Plants per foot/Survival/Vigor/Height: good-excellent/2/ 95%/good/22 inches—planting receives heavy deer use in spring. FY98 no evaluation. FY99 good stand of Newhy with 85% survival, good vigor, excellent production, plant height 22 inches, and .75 AUMs

per acre. FY00 good stand with 85% survival. Deer use continues to be high. FY01 no evaluation - **cancel**

UT90012 Don Peterson – Logan FO Medusahead rye control trial with Hycrest crested wheatgrass, Sherman big bluegrass, Oahe intermediate wheatgrass, and Luna pubescent wheatgrass. 1992, the year this trial was planted, was one of the driest on record. The planting was assumed to be a total failure. Site treatment in 1991 included burning of old plant residues, spraying all new growth with Roundup-Escort mix in March 1992, and planting March 1992. FY99 evaluation by Don Peterson, Steve Dewey, and Jeff Barnes – Oahe not planted. Sherman big bluegrass failed. Hycrest 50-75% survival with 4 plants per square foot, good vigor, and 14 inch plant height. Luna 50-75% survival, 5 plants per square foot, good vigor, and 24 inch plant height. Luna pubescent wheatgrass appears to be competing the best with medusahead rye. The trial area (300 acres) was burned off in the fall 1999. Site will be sprayed in spring 2000 for additional medusahead rye control and seeded to Luna pubescent wheatgrass. Rush intermediate wheatgrass will be planted in trial areas to allow comparison with Luna. FY00 and FY01 no evaluations - **cancel**

UT94004 Cowley - Logan FO Newhy hybrid wheatgrass and tall wheatgrass field planting on saline soils. Site is silty clay to silt loam soil, irrigated, 4430 feet elevation, and 0-3% slope. Seed ordered 4/93. FY94 planting postponed until spring 1995 due to drought. FY95 planting delayed until fall 1995 due to very wet conditions. FY96 planted December 1995. In June, 95% survival noted with good initial vigor and a few plants heading. Weeds are very thick but do not appear to be hindering seedling establishment. Expect weeds to be a minor problem next year. FY97 fair to good stand (80%), with good vigor, and 12 inches in height. FY98-FY00 no evaluations. FY01 planting failed – **cancel**.

UT97001 Frank Bohman – Ogden FO Rush intermediate wheatgrass field planting. Site is loamy soil, non-irrigated, 19-inch ppt, 6000 feet elevation, and 30-40% slope on north exposure. Seed ordered July 15, 1996 for dormant fall planting. Seed shipped 9/9/96. FY97 no evaluation. FY98 excellent stand and vigor with .8 AUM/acre. Planting was over-seeded by air the same year as planting resulting in small burnet, orchardgrass, and flax also present in stand. FY99 no evaluation. FY00 excellent stand and vigor with 2 AUM/acre production. This was the first year the planting was grazed in early to mid May. Cooperator is very pleased with planting and production. FY01 no evaluation.

UT98001 Cooperator Unknown – Bonneville FO Pullman PMC shrub field planting—dogwood (3 accessions), chokecherry, mockorange, and Hawthorn. Materials ordered 2/9/98. FY98-FY99 no evaluations. FY00 40% survival with fair vigor and 30 inch height. There is a lot of competition from other riparian species, but these plants are surviving and growing slowly. FY01 no evaluation.

UT99002 Scott Hansen - Tremonton FO P27 Siberian wheatgrass, Vavilov Siberian wheatgrass, Rush intermediate wheatgrass, and Goldar bluebunch wheatgrass field planting. Rimrock Indian ricegrass and Maybell antelope bitterbrush demo packets were

also ordered. Site is a silt loam soil, 3% slope, east aspect, 5075 feet elevation, 20 inch rainfall, and non-irrigated. T12N R2W Section 22 SE Quarter. Seed ordered December 8, 1998 for delivery mid September 1999. FY99 area is heavily infested with weeds. Cooperator plans to control weeds during spring-summer 2000-2001 and plant spring 2002.

UT99003 Hathaway Family - Tremonton FO P27 Siberian wheatgrass, Vavilov Siberian wheatgrass, Rush intermediate wheatgrass, Goldar bluebunch wheatgrass, Ephraim crested wheatgrass, Nordan crested wheatgrass, and Lincoln smooth brome field planting. Site is a former beet dump with high organic soil, 1% slope, east aspect, 4800 feet elevation, 18 inch rainfall, and non-irrigated. T2N R Section ? Seed ordered December 8, 1998 for delivery as soon as possible. FY99 cooperator plans an additional season of weed control in spring—summer 2000 with planting planned for fall 2000. FY00 weeds continue to be a problem following 3 applications of Roundup this season. FY01 no evaluation.

UT99004 Roger Fridal - Tremonton FO Robusta poplar, Carolina poplar, Siouxland poplar, and Golden willow field planting. Site is below a livestock feedlot with a high organic silt loam soil, 0-20% slope, 4300 feet elevation, 18-inch rainfall, irrigated for establishment, and non-irrigated long term. T11N R3W Section 2 SE Quarter. Cuttings ordered December 8, 1998 for delivery about April 1, 1999. FY99 50% survival of all species. All have good vigor, 2-3 feet height, and good uniformity. The cuttings planted along edge of river are dead possibly due to saline conditions. The cuttings planted along fresh water seep are all doing well. FY00 site was severely damaged by livestock this season—a few willows and cottonwoods remain and will be evaluated next year. FY01 planting failed - **cancel.**

UT99005 Gordon Zito - Tremonton FO Robusta poplar, Carolina poplar, Laurel willow, Golden willow, and White willow field planting. Site is a silt loam soil, 0-25% slope, west aspect, 4300 feet elevation, 18 inch rainfall, and non-irrigated. T11N R3W Section 2 NE Quarter. Cuttings ordered December 8, 1998 for delivery about April 1, 1999. FY99 Carolina poplar and white willow failed. Robust poplar .6% survival (1 of 15), Laurel willow 13% survival (2 of 15), and Golden willow 13% survival (2of 15). Best survival in areas near fresh water seep—failure in more saline areas. FY00 site was severely damaged by livestock this season—a few willows remain and will be evaluated next year. FY01 All of the plants are still alive, but showing salt-burn on leaves.

UT99006 Ross McKinnon - Randolph FO Luna pubescent wheatgrass, Rush intermediate wheatgrass, Largo tall wheatgrass, Jose tall wheatgrass, Alkar tall wheatgrass, Bozoisky Russian wildrye, Shoshone beardless wildrye (both seed and plugs), and Prairieland Altai wildrye field planting for saline soil demonstration. Site is silty clay loam soil (saline), 0-1% slope, west aspect, 6230 feet elevation, 11 inch rainfall, and non-irrigated. T11N R7E Section 23 NW of NW Quarter. Seed ordered December 8, 1998 for delivery October 1, 1999. FY99 seeding completed in late November 1999. FY00 and FY01 no evaluations.

UT99008 Bryner - Logan FO Laurel willow field planting – nursery. Site is Airport loam soil, 7.7 pH, heavy clay sub-soils, 0 slope, 16-inch rainfall zone, high watertable, and 4430 feet elevation. FY99 cuttings planted April 17, 1999 into 12 inch scalped circles, T12N R1E SW1/4 Section 31. Trees are drip-irrigated. June 4, 1999 cuttings have sprouted and appear to be establishing well. FY00 and FY01 no evaluations.

UT00001 Don Peterson - Logan FO spring field planting of Rush intermediate wheatgrass (medusahead wildrye control). Leatham silt loam soil, 30% slopes, southwest aspect, 5400 feet elevation, 14-17 inch precipitation, non-irrigated, T9N R1E North1/2 Section 5. FY00 site burned in fall 1999 and sprayed with Roundup-Escort mix in spring 2000 for medusahead control. Chemical kill of medusahead was excellent. 14 pounds per acre were drilled in 8 inch spacing on May 20, 2000 with good initial germination and establishment. FY00 and FY01 no evaluations.

UT00005A Gordon Zito – Tremonton FO willow field planting. 40 cuttings of 9067556 Coyote willow, 15 cuttings of 9067436 Yellow willow, and 40 cuttings of 9067560 Peachleaf willow were ordered on March 1, 2000 for shipment on April 10, 2000. Planted along Malad River April 20, 2000 on Kr soil, salt limitations, 0-20% slopes, west aspect, 4300 feet elevation, 18 inch rainfall, non-irrigated, T11N, R3W, NE1/4 Section 2. FY01 All plants are still alive, but showing salt-burn on leaves.

UT00005B Roger Fridel – Tremonton FO willow field planting. 5 cuttings each of 9067556 Coyote willow, 9067436 Yellow willow, and 9067560 Peachleaf willow were ordered on March 1, 2000 for shipment on April 10, 2000. Planted along Malad River April 20, 2000 on Kr soil, salt limitations, 0-10% slopes, west aspect, 4300 feet elevation, 18 inch rainfall, non-irrigated, T11N, R3W SE1/4 Section 2. FY01 planting failed - **cancel.**

UT00005C Bret Selman – Tremonton FO willow field planting. 5 cuttings each of 9067556 Coyote willow, 9067436 Yellow willow, and 9067560 Peachleaf willow were ordered on March 1, 2000 for shipment on April 10, 2000. Planted along Spring Branch of the Little Bear River April 20, 2000 on Kr soil, salt limitations, 0-10% slopes, west aspect, 5300 feet elevation, 18 inch rainfall, non-irrigated, T9N, R1E NW1/4 Section 21. FY01 this planting is doing well - more extensive evaluation will occur in FY02.

UT01003 – Randolph FO willow field planting. 9067548 Drummond willow 15 cuttings, 9067435 Geyer willow 15 cuttings, 9067491 Geyer willow 15 cuttings, 9067437 Booth willow 15 cuttings, 9067469 Booth willow 15 cuttings, 9067478 Booth willow 15 cuttings, 9067553 Lemmon willow 15 cuttings, and 9067567 Lemmon willow 15 cuttings. FY01 no evaluation.

UT01005 Scott Hansen – Tremonton FO field planting. Tarweed control. P27 Siberian wheatgrass, Vavilov Siberian wheatgrass, Goldar bluebunch wheatgrass, Nezpar Indian ricegrass, Rimrock Indian ricegrass, Arriba western wheatgrass, Bozoisky Russian wildrye, Mankota Russian wildrye, and Richfield Selection firecracker penstemon. Seed ordered April 16, 2001. FY01 not planted in 2001 due to drought and being snowed out—hope to plant in 2002.

UT01006 Scott Hansen – Tremonton FO field planting. Tarweed control. P27 Siberian wheatgrass, Vavilov Siberian wheatgrass, Goldar bluebunch wheatgrass, Nezpar Indian ricegrass, Rimrock Indian ricegrass, Arriba western wheatgrass, Bozoisky Russian wildrye, Mankota Russian wildrye, and Richfield Selection firecracker penstemon. Seed ordered April 16, 2001. FY01 not planted in 2001 due to drought and being snowed out - hope to plant in 2002.

UTAH AREA 2

UT98002A LaDon Anderson Fillmore FO Aberdeen PMC - Laurel willow and Pullman PMC. Materials ordered 2/9/98. FY98 41 of 46 Laurel willows are surviving at the end of the first growing season. FY00 38 of 46 surviving with good to poor vigor, 3-10 feet height, 2-5 feet crown widths. All plants are brown and chlorotic due to lack of irrigation, saline water source, and saline soils. Plant loss is probably due to livestock damage and weed control is not being performed. FY01 80% survival with fair vigor—plants did not grow much in height, but did get much denser. Site conditions with high pH saline soil with saline water source are limiting plant performance.

UT98002B Randy Coates Fillmore FO - Blue Elderberry. Materials ordered 2/9/98. Elderberry will be planted this fall. FY99 no evaluation. FY00 3 of 5 plants surviving during June evaluation. August evaluation plants dormant due to severe drought. FY01 planting failed - **cancel**.

UT99001 Continental Lime Inc. – Fillmore FO Vavilov Siberian wheatgrass critical area planting. 20 pounds of Vavilov seed was ordered November 19, 1998. The Vavilov will be planted in a mix, which will include Nordan crested wheatgrass, Sodar streambank wheatgrass, Critana thickspike wheatgrass, Nezpar Indian ricegrass, and forbs and shrubs. Site characteristics are a crushed gravelly—silty material lain over rock – cobble material; this material hardens to a near cemented pavement when packed and as moisture occurs; rainfall is about 8-10 inches; site is very windy. Site modifications recommended included 10 ton per acre composted straw, fertilizer based on soil tests, ripping prior to seeding resulting in a rough - rocky soil surface with about 50% of surface being exposed rock to provide micro-sites where seedlings would be protected from constant winds were recommended. FY99 no evaluation. FY00 Three site preparation treatments were installed in the fall/spring of 1998/1999 including (1). Planting directly into shallowly scarified site where soil surface was shattered and smooth; (2). Planting into moderately ripped site where soil surface was rough with approximately 25% of surface exposed angular rock; and (3). Planting into severely ripped site where soil surface was very rough with approximately 50% of surface exposed large angular rock. Company Manager indicated the past two years were dry winters with below normal rainfall season long. The mid growing season evaluation, on June 6, 2000, indicated Sodar streambank wheatgrass, Bannock or Critana thickspike wheatgrass, Vavilov Siberian wheatgrass, Nezpar Indian ricegrass, penstemon species, scarlet globemallow, winterfat, fourwing saltbush, and Wyoming big sagebrush were all planted and present to some degree on each treatment. Treatment 1 had a 5-10%

stand present, plants were very small (stunted), and not reproducing (no seedheads present). Treatment 2 had a 30-40% stand present, plants were average sized, and a few were reproducing. Treatment 3 had a 70-90% stand, plants were tall for site (high vigor), and a high percentage of plants were reproducing. FY01 no evaluation.

UT99010 Gavin Brown – Cedar City FO Vavilov Siberian wheatgrass field planting. Site Characteristics: Calcross silty clay loam soil, pH 8.8, slope 1%, elevation 5495, 11 inch precipitation, non-irrigated, MLRA D35A, Section 14 T36S R12W. Seed ordered July 23, 1999. FY99 seed shipped July 26, 1999. FY01 planting failed - **cancel**.

UT00003 Cooperator Unknown - Beaver FO willow field planting. 50 cuttings each of 9067435 Geyer willow, 9067437 Booth willow, 5730101 Drummond willow, 9067466 Yellow willow, 9067452 Yellow willow, 9067549 Peachleaf willow. Cuttings ordered March 1, 2000 with shipment April 10, 2000. FY00 very poor establishment year due to extreme drought. FY01 grazing has been removed, but deer use is heavy in some locations. Survival-Height-Vigor: 435 Geyer 40% survival, 15 inch height and fair vigor; 437 Booth 46% survival 12 inch height and fair vigor; 101 Drummond 40% survival, 15 inch height and fair vigor; 466 Yellow 20% survival due to poor planting location, 24 inch height and fair vigor; 452 Yellow 80% survival, 26 inch height and excellent vigor; 549 Peachleaf 62% survival, 24 inch height and good vigor.

UT00004 Peterson – Fillmore FO Laurel willow field planting. 100 cuttings ordered March 1, 2000 with shipment April 10, 2000. FY00 no evaluation. FY01 50% survival with fair vigor due to inadequate water management. Plant height is 60 inches and crown width is 1-3 feet.

UT00006 Don Taylor – Cedar City FO Pete eastern gamagrass field planting. Site characteristics: Fluvent silt loam soil, 1% slope, pH 8.0, 2800 feet elevation, 6 inch precipitation zone, irrigated, T42S R15W Section 32. Seed ordered March 15, 2000. FY00 seed was soaked in water with fungicide for 24 hours and then received a cold treatment at 30^0 F. for 8 weeks prior to planting. Planted on June 6, 2000 into disked-landplained seedbed with corn planter (1.5 acres 16-inch spacing and 1.5 acres 32-inch spacing) at 13 pounds per acre. Irrigated immediately following planting. On June 26, 2000 cooperator noted that germination has started and he has been able to keep the planting wet. FY00 no evaluation. FY01 planting failed - **cancel**.

UT01001 Mike Pace – Delta/Fillmore FO saline demo plots. Species: Irrigated: Shoshone beardless wildrye, Alkar tall wheatgrass, Jose tall wheatgrass, Largo tall wheatgrass, Newhy hybrid wheatgrass, Pryor slender wheatgrass, San Luis slender wheatgrass, _____ tall fescue (many new varieties available), Prairieland Altai wildrye, Rosana western wheatgrass, Arriba western wheatgrass, _____ strawberry clover (might be good in grass mix).

Species: Dryland: Bozoisky Russian wildrye, Alkar tall wheatgrass, Jose tall wheatgrass, Largo tall wheatgrass, Pryor slender wheatgrass, San Luis slender wheatgrass, Nordan crested wheatgrass, Hycrest crested wheatgrass, CD-II crested wheatgrass, P-27 Siberian wheatgrass, Vavilov Siberian wheatgrass, Luna pubescent

wheatgrass, Rush intermediate wheatgrass. Shrubs: Fourwing saltbush, Winterfat, Immigrant forage kochia. FY01 planting failed – **cancel.**

UT01002 Cooperator Unknown – Fillmore FO willow field planting. 9067408 Narrowleaf cottonwood, 9067443 Narrowleaf cottonwood, 9067484 Narrowleaf cottonwood, 9067502 Narrowleaf cottonwood, 9067537 Black cottonwood, 9067538 Black cottonwood, 9067562 Black cottonwood, 9067563 Black cottonwood, 9067568 Black cottonwood, 9067569 Black cottonwood, Robust poplar, Carolina poplar, and Siouxland poplar – 10 cuttings each. FY01 cuttings were not planted - **cancel**.

See table on last page for Cedar City FO - Yields of Pasture Grasses Irrigated with Effluent Water in Iron County, Utah

UTAH AREA 3

UT86018 Smith – Roosevelt FO Hycrest crested wheatgrass, Ephraim crested wheatgrass, Appar blue flax, Arriba western wheatgrass, T28606 needle and thread, Magnar basin wildrye, and Nordan crested wheatgrass field planting. FY90 Hycrest, Ephraim, Appar, Magnar, Nordan all 80-100 % survival. Arriba and T28606 are less than 40% survival. FY91 and FY92 no evaluations. FY93 Hycrest, Ephraim, Appar, Nordan, and T28606 doing best. Magnar and Arriba poorer stands. Sagebrush invading site, heavy use by elk, and Appar has many new seedlings. FY94 Hycrest, Appar, Arriba, and Nordan all have good stands. Ephraim, T28606 and Magnar have fair stands. All species are adapted to site and wildlife use is heavy. FY95 no change except vigor has improved due to excellent moisture year. FY96 Hycrest, Ephraim, Appar, T28606 and Nordan have good vigor. Fair vigor for Arriba and Magnar. FY97 Hycrest, Ephraim, Appar, Arriba and Nordan good stands. T28606 and Magnar fair stands. Many sagebrush seedlings within plots, particularly heavy in Arriba western wheatgrass and T28606 needle and thread. FY98 Hycrest, Ephraim, Appar, Arriba, Magnar, and Nordan all have excellent vigor. T28606 has good vigor. FY99 very heavy wildlife use in winter and spring. Poor regrowth due to dry spring/ summer and fair regrowth following late summer rains. Planting is being invaded by sagebrush. FY00 Heavy spring use by wildlife and a very dry spring and summer. Rains began in early September and plants began to green-up. Evaluation indicated good vigor for Ephraim, Appar, Arriba, T28606, Nordan and fair vigor for Hycrest and Magnar. FY01 fair to poor vigor for all species following two years of drought and heavy wildlife use. Sagebrush invasion is effective plant growth and vigor.

UT88009 Skyline Mine - Price FO Multiple Grass on critical area planting – slopes. FY90 and FY92 planting summaries available. FY93 portion of seeding destroyed for new beltline. Rest of seeding doing very well. FY95 Appar flax is spreading, both intermediate and pubescent wheatgrass have spread, thickspike wheatgrass is doing very well, Sherman big bluegrass is doing great, mountain rye is not producing well, Paiute is doing well in plots but has not spread, Aster is improving, Covar sheep fescue

is not performing well. FY96 seeding about the same as last year, erosion from slope covered some of the seeding and it will be interesting to see how the plants can withstand this sedimentation. Rush, Sherman and Mountain ryegrass are doing the best overall. FY97 and FY98 no evaluations. **FY99 Ten Year Evaluation. Mixture 1:** Luna pubescent wheatgrass is very good on steep slopes and fair on gentle slopes. Hycrest crested wheatgrass failed. Manchar smooth brome is not present on steep slopes, but doing very well on gentle slopes. Appar blue flax is fair on steep slopes and excellent on gentle slopes. Kalo birdsfoot trefoil failed on steep slopes and fair on gentle slopes. Delar small burnet and roses are present on both steep and gentle slopes. **Mixture 2:** Topar pubescent wheatgrass is very good on steep slopes and good on gentle slopes. Ephraim crested wheatgrass and Sodar streambank wheatgrass failed. Delar small burnet is fair on steep slopes and very good on gentle slopes. Roses are present on both slopes. **Mixture 3:** Rush intermediate wheatgrass is good on both steep and gentle slopes. P27 Siberian wheatgrass failed. Critana thickspike wheatgrass is fair on both slopes. Cedar Palmer penstemon is poor on steep slopes and fair on gentle slopes. Summit Louisiana sagewort and roses are present on both slopes. **Mixture 4:** Arriba western wheatgrass is fair to good on both slopes. Mountain rye is very good on gentle slopes. Sherman big bluegrass is good steep slopes and excellent on gentle slopes. Summit Louisiana sagewort is fair on both slopes. Roses are present on both slopes. **Mixture 5:** Rosana western wheatgrass is fair on both slopes. Paiute orchardgrass is very good on both slopes. Covar sheep fescue is good on steep slopes and fair on gentle slopes. Bandera Rocky Mountain penstemon is fair on both slopes. Roses are present on both slopes. **Mixture 6:** Tegmar intermediate wheatgrass is fair on both slopes. Durar hard fescue is fair on steep slopes and high fair on gentle slopes. Bannock thickspike wheatgrass is high fair to good on both slopes. Lutana cicer milkvetch is good on both slopes. Roses are present on both slopes. **Mixture 7:** San Luis slender wheatgrass is good on both slopes. Newhy hybrid wheatgrass failed. Cascade birdsfoot trefoil is poor on steep slopes and good on gentle slope. Blueleaf aster is good to very good on both slopes. Western yarrow is good on both slopes. Roses are present on both slopes. FY00 and FY01 no evaluations.

UT90017 Snowball - Price FO Multiple species irrigated demo plots for saline soils. FY92 and FY94 detailed reports available. Irrigation has pushed salinity down below root zone to a large degree. FY95 and FY96 Cicer milkvetch best producer (5279 lbs/ac) followed by San Luis (2587), Revenue (2326), Alsike (1986), Newhy (1673), Hoffman (1646), Festorina/Forager/Tall wheatgrass (1460), Shoshone/Fawn/Altai (1350), Magnar (1125), Garrison (1050), and Kura/Matua/ Trefoil 850) FY97 and FY98 no evaluations. FY99 No yield data gathered. Excellent stands include Shoshone beardless wildrye, Fawn tall fescue, Newhy hybrid wheatgrass, Festorina tall fescue, Forager tall fescue, RS Hoffman, Kura clover, and SP90 Kura clover. Good stands include: Prairieland Altai wildrye, Revenue slender wheatgrass, San Luis slender wheatgrass, Jose tall wheatgrass, Garrison creeping foxtail, Johnstone tall fescue X perennial rye, Lutana/Monarch cicer milkvetch, Regar meadow brome, and orchardgrass. Poor stands include Magnar basin wildrye, some plots of cicer milkvetch, Cascade birdsfoot trefoil, and Dakota/Forestburg switchgrass. Mowing significantly reduces vigor of basin wildrye and switchgrass. Festorina and Forager are preferred

over Fawn by sheep. Alsike clover and Matua brome failed/died. The fescue x perennial ryegrass appears to show some signs of winterkill. FY00 and FY01 no evaluations.

UT91007 Ruble – Roosevelt FO Pryor slender wheatgrass, San Luis slender wheatgrass, Newhy hybrid wheatgrass field planting for erosion control. FY93 Newhy 10% survival, Pryor 70% survival, San Luis 90% survival and rated the best of evaluated species. FY94 San Luis continues as best performer, with Pryor a close second. Newhy is doing poorly. We should continue to evaluate stands to determine how long slender wheatgrass, a short-lived species will maintain on site. Note slender wheatgrass should normally be used as a cover crop species with the understanding it will not stay in the stand for too many years. FY95 good stands of both Pryor and San Luis are present and a fair to poor stand of Newhy is present. FY96 stands are the same as 95 with the slender wheatgrasses showing more drought tolerance than Newhy. FY97 good stand of San Luis, fair stands (50%) of Pryor and very poor stand to no stand of Newhy. FY98 plant vigor is excellent for all species due to very good moisture year. San Luis is beginning to decline in percent stand. FY99 plant growth below previous years due spring/ summer drought and no irrigation. FY00 very dry spring and summer. Rains began in early September resulting in green-up and fair vigor for Pryor and San Luis and very poor vigor for Newhy. FY01 Newhy is dead and Pryor and San Luis are having a hard time hanging on due to drought and old age.

UT93005 Smith – Roosevelt FO Trailhead basin wildrye, Magnar basin wildrye field planting for erosion control. FY94 planted October 1993 and initial evaluation indicated Magnar with best seedling establishment and Trailhead doing best in run in areas. FY95 both Trailhead and Magnar rated good stands. Magnar is best adapted. FY96 good stands for both, good vigor for both, good drought tolerance for both, all seedheads of both species eaten by wildlife. FY97 excellent stands and plant vigor for both cultivars. Plant height about 50 inches for Magnar and 38 inches for Trailhead. Magnar has excellent seed production and Trailhead has fair seed production. FY98 excellent vigor and long seedheads for both cultivars. Magnar is a more robust and taller plant than Trailhead. FY99 no evaluation. Excellent stands of each with good vigor and approximately 50 inch height. Basal areas are getting larger, but no seed production this year due to spring/summer drought. FY00 due to very dry spring and summer with rains coming in early September resulting in green-up, both Trailhead and Magnar had fair vigor and only 36-40 inches of growth. FY01 both Magnar and Trailhead have poor vigor after very dry spring and summer (7.7 inches of precipitation this year). Each plant only has 2-3 reproductive stems, which probably did not produce seed this year.

UT98005 Prevedel – Roosevelt FO Rush intermediate wheatgrass sprinkler irrigated field planting. Materials ordered 3/30/98. FY98 planted August 16, 1998 into excellent seedbed. FY99 excellent stand with excellent vigor and 20 plants per square foot. In early August plants went from very palatable to coarse. Fall rains softened it up making it more palatable to elk now utilizing field. FY00 stand produced approximately 3000 pound/acre under sprinkler irrigation. Elk graze stand until it gets rank, but will graze regrowth. Cooperator states Rush is an excellent grass for intensive grazing systems. FY01 excellent stand and vigor with 7 AUMs per acre. Cooperator is very satisfied with Rush intermediate wheatgrass performance.

UT99007 Curtis Rozmon - Price FO field planting on irrigated pasture. Trial includes 905438 switchgrass, 905439 switchgrass, Cave-In-Rock switchgrass, Blackwell switchgrass, Kanlow switchgrass, Latar orchardgrass, perennial ryegrass, and white clover. Site is MLRA D35, loamy fine sand soil, 0-1% slope, southwest exposure, 4000 feet elevation, 6-8 inch precipitation, irrigated, T23S R16E SE1/4 Section 25. Seed ordered March 22, 1999. FY99 not planted this year. FY00 didn't plant due to extreme drought. FY01 no evaluation.

UT00002 Mike Wilcox - Monticello FO field planting. UT98004 planted fall (seeding germinated) 1998, but failed due to drought with little to no winter-spring precipitation. This is a dormant fall replanting of Rush intermediate wheatgrass. Luna pubescent wheatgrass is the standard of comparison. Barnam loam soil, 3% slopes, south aspect, 6000 feet elevation, 14 inch precipitation, non-irrigated, T31N R26E Section 8. FY00 very little germination this spring (<10%) due to very dry spring. FY01 no evaluation.

UT00007 George Carter – Monticello FO critical area planting. Seed ordered July 5, 2000. Site characteristics: Herm-Lles clay loam to stony loam, 8% slopes, west aspect, 8500 feet elevation, 14-16 inch rainfall zone, irrigated for establishment, T26S R23E Section 24. Planting planned for October 2000. FY01 no evaluation.

UT01004 Monument Valley High School. Critical Area Planting – Volga mammoth wildrye. Seed ordered April 2001. FY01 no evaluation.

Cedar City FO - Yields of Pasture Grasses Irrigated with Effluent Water in Iron County, Utah

Variety/Species	Yield – Production						Crude Protein %					Grazing Preference*			Soil Test Nitrate N.	
	Spr. 99 lbs/ac	Fall 99 bs/ac	Spr. 00 lbs/ac	Fall 00[3] lbs/ac	Spr. 01 lbs/ac	Total lbs/ac	S99	F99	S00	F00	S01	F99[1]	S00[2]	S01[3]	F00[4]	F01[4]
Johnstone Tall Fescue	1748	9945	2325	4925	1873	20816	25.0	15.7	17.2	18.9	15.4	8	6	8	3.2	2.5
Newhy Hybrid Wheatgrass	1846	6465	5896	3404	2529	20140	18.8	14.4	16.3	15.4	18.0	4	4	7	1.3	2.3
Stargrazer Tall Fescue	2094	5353	2255	6708	2279	18689	19.7	15.1	15.5	11.8	14.1	4	6	7	1.2	4.2
Regar Meadow Brome	3361	3701	5383	3787	2011	18243	21.7	11.9	13.9	14.6	17.6	5	4	8	2.0	4.0
Paddock Meadow Brome	2054	4621	5632	2489	2820	17616	20.9	14.2	15.9	14.4	15.6	7	5	8	1.0	1.8
Oahe Intermediate Wheatgrass	3388	4592	4258	2053	2024	16315	16.2	16.1	15.1	11.3	14.3	9	9	9	1.5	2.5
Potomac-Rush-Paddock Mix	2482	3368	4128	3490	1542	15010	17.3	11.8	12.5	13.7	15.9	6	6	8	0.8	3.3
Potomac Orchard Grass	3041	4278	3212	2200	1259	13990	16.3	11.1	17.2	18.6	18.3	5	7	9	1.0	5.0
Rush Intermediate Wheatgrass	2671	2423	4657	2672	2288	14711	24.8	14.2	15.0	14.4	15.8	9	8	9	1.7	3.6
Oahe-Paddock Mix	2727	2358	3122	2053	1705	11965	15.0	11.7	17.1	25.7	14.7	8	7	9	1.9	1.8

Notes: All Yields are reported on a 100% Dry Matter basis
S99=Spring1999; F99= Fall 1999; S00= Spring 2000; F00= Fall 2000; S01= Spring 2001; F01= Fall 2001
Quality Data was determined by NIR analysis and reported on 100% Dry Matter Basis
* Grazing Preference = average of two independent observers rating on scale of 1-10 with 10 being extensively grazed and 1 being not grazed at all.
[1] Seventy, 950lbs heifers for 40 days. Rating was done on 12/13/99
[2] Eighty-one, 1050lbs heifers with calves for 30 days. Rating was done on 6/21/00
[3] Seventy cows, 60 calves and 3 bulls for 10 days. Rating completed 5/24/01
[4] Nitrate-Nitrogen-N in parts per million (ppm)

WASHINGTON

WASHINGTON STATE UNIVERSITY

WCC21 2002 Progress Report

Prepared by

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INTRODUCTION

This report summarizes land rehabilitation and related research at Washington State University from April 2001 through July 2002. Research is conducted through the Department of Natural Resource Sciences, the Washington Water Research Center, and the USDA NRCS Plant Materials Center.

NEW PROJECTS

1. Negative influence of herbivory or plant manipulations on endangered or economic and ecologically valuable plants and wildlife (L. Shipley and R. Sayler, NATRS, Washington State University.

   A new field project examining how cattle grazing influences the habitat quality and populations of endangered pygmy rabbits in the shrub-steppe of Washington. During the course of this project, pygmy rabbit populations continued to plummet. Our work, some completed in Spring 2002 (manuscript in preparation) has provided critical information for state and federal biologists to secure Federal Endangered Species listing and protection and to remove cattle grazing on the last area in Washington in which pygmy rabbits are known to reside, which is on State Fish and Wildlife property. In fact, this project launched subsequent contracts from WDFW to develop a captive breeding facility and program at WSU, and to develop techniques for reintroduction into native habitats. The pygmy rabbit project has received much public attention over the last year, and I have been asked to speak on National Public Radio and have conducted numerous interviews for newspapers and magazines. With the captive pygmy rabbits, we will also begin studying the role of sagebrush and other native forages in the nutrition of these animals.

2. A. Role of nutrition in population declines of mule deer in Washington (L. Shipley, R. Wielgus and C. Robbins, NATRS, Washington State University, and W. Myers, Washington Department of Fish and Wildlife.

   Mule deer, popular for both consumptive and nonconsumptive uses, have been declining in the western U.S. for the last few decades. A grant from Bonneville Power Administration was received to study the declines in mule deer populations in Washington. Wielgus is examining the role of cougar predation, and Shipley is looking at the role of nutrition on reproduction in mule deer. For this work, Shipley has been supported by WSU's College of Agriculture with a partial R.A. and new deer facilities at Steffan Center, WSU. Management of habitat, disease, and predators of mule deer will be influenced by the results of this study.

3. A Study of Agricultural Drainage in the Puget Sound Lowlands to Determine Practices which Minimize Detrimental Effects on Salmonids (C. Feise, Center for Sustaining Agriculture and Natural Resources, WSU; S. Chen, Biological Systems Engineering and Washington Water Research Center, WSU and UW; D. Saul, Center for Environmental Education, WSU; B. Goalach, WSU Cooperative Extension; J. Dobrowolski, NATRS and Washington Water Research Center, WSU and UW; M. Barber, Washington Water Research Center.

   The project is to provide consistent and comprehensive information base on the natural habitat quality, the extent of salmonid use of King County's floodplain habitats and how to avoid, minimize, or mitigate agriculture-related impacts on listed salmonids and their habitat. Additionally, the information garnered from this study will enable King County officials, working in conjunction with technical staff, to make decisions relating to allocation of resources as well as to establish work priorities in the county's agricultural areas. Furthermore, the study findings can be shared with other government partners in the region in order to facilitate the development and implement of programs that address salmonid use of floodplain habitats. The project will provide the county with a solid base of scientific research that enables the county to be better prepared to make decisions on a holistic scale in its rural areas. This project requires multi-disciplinary expertise, including fish biology, physical sciences, engineering, and riparian and ecological sciences in addition to a working knowledge of the County's agricultural industry and community.

4. Forested Riparian Buffers: Function, Management and Economic Implications for Agriculture (J. Johnson, Puyallup Research and Extension center, Washington State University; J. Dobrowolski, NATRS and Washington Water Research Center, WSU and UW; and Carolyn Henri, Resource Consulting, Arlington, Washington).

   Declining populations of native salmon species in the Pacific Northwest led to the listing in 1999 of several Puget Sound salmon species as threatened or endangered under the federal Endangered Species Act (ESA). Recovery of these populations is a complex and time intensive task that will require efforts in many sectors. One of the critical elements in improving water quality and restoring salmon is the restoration of riparian habitat in agricultural areas where salmon populations exist.

Toward this end, Skagit County, located in western Washington, has implemented a new critical areas ordinance requiring agricultural landowners to establish forested buffers along agricultural watercourses. The purpose of this project is to examine the environmental and economic implications of establishing forested riparian buffers, a sustainable agricultural practice, on land that is in current agricultural production in Skagit County.

5. Palouse Prairie restoration (R. Sayler and L.H. Hardesty, NATRS, Washington State University).

   In 2001, we continue to develop a restoration plot at Washington State University devoted to a variety of native plants characterizing the highly endangered Palouse Prairie ecosystem. We have propagated a variety of native plants in greenhouses and used them in restoration efforts on a small watershed on the edge of campus. Information we developed from this restoration effort has been used to support teaching, other research, and public outreach efforts. In 2001, we began work to develop a series of print and web publications on *Camassia* and *Chalocortus spp*. as part of the funding received from an endowment by the Mariposa Foundation.

6. Habitat restoration, and adaptive management of Sharp-tailed Grouse on lands of the Colville Confederated Tribes (R. Sayler and R.B. Wielgus, NATRS, Washington State University).

   This project will conduct a population viability analysis which, in turn, will aid in the development of an adaptive management plan to restore critical shrub-steppe habitat for sharp-tailed grouse in the Intermountain West.

ONGOING PROJECTS

1. Integration of upland, riparian and stream condition monitoring for intermediately sized watersheds on rangelands (G.A. Rasmussen, Department of Rangeland Resources, Utah State University and J.P. Dobrowolski, NATRS, Washington State University).

   During the final year of this three-year study we will develop and test a monitoring protocol that will assess the hydrologic stability of rangeland watersheds and link upland and riparian conditions with downslope or down stream condition within intermediate-sized watersheds (<1000 km2). This assessment, with implications for restoration, will allow the interpretation of the overall condition of watersheds and evaluate the individual contribution of each sub-component (upland, riparian or stream. The major product of the research is a watershed based monitoring protocol that will help managers monitor and understand the cause of erosion- and sediment-related environmental changes in a watershed. The protocol uses GIS technology and conceptual and mathematical models for its implementation.

2. Plant materials for western riparian areas (S.M. Lambert, USDA NRCS Washington State University).

   Increasing emphasis on improvement of degraded wetlands and riparian areas in the western United States has necessitated development of appropriate plant materials and planting technology. Treatment of damaged wetlands requires restoration of proper hydrologic functioning (e.g., Barker Ranch WRP on the Yakima River) and reestablishment of native vegetation. USDA NRCS Plant Material Centers in the western U.S. are developing source-identified material of common wetland species adapted to specific geographic areas. They are also developing new revegetation equipment and formulating planting guidelines.

3. Identification of grasses for possible use in upland restoration on eastern Washington and Oregon rangelands (S.M. Lambert, USDA NRCS Washington State University).

   The objective of this project is to provide plant identification assistance to restorationists for the purpose of restoring upland and riparian plantings.

4. Habitat restoration of grizzly bear populations (Robert B. Wielgus, NATRS, Washington State University.

   This study evaluates grizzly bear populations to test three hypotheses on the effects of adult male mortality on female reproduction. There are three hypotheses, “no effect” (reproduction should be higher in the population with superior overall diet quality), “increased reproduction” (higher in the hunted population because of lowered numbers of competitive or cannibalistic males), and “decreased reproduction” (reproduction should be lower in the hunted population because of increased immigration by potentially infanticidal, nonsire males, and/or increased sexual segregation resulting in reduced production of cubs.

5. Two stage sampling to determine vegetation status on reclamation sites B.A. Zamora, NATRS, Washington State University).

   Two-stage sampling is tested as a means of measuring the revegetation status of reclaimed pasture, forest or rangeland sites for comparison to vegetation success standards. Study sites are located on reclamation areas in eastern and western Washington. Results of this two stage sampling study are compared to single line transect sampling of the same area. Initial results show two stage sampling producing more consistent measures of variation, is more efficient in application, and is considered more reliable for accurate relocation of macroplots for repeat measurements and monitoring.

6. Effects of shade and defoliation on reed canarygrass *(Phalaris arundinacea* L.) biomass production: A greenhouse study (D.J. Forman, L.H. Hardesty and R.D. Sayler; NATRS, Washington State University).

   Many wetlands in the Pacific Northwest have become dense monotypic stands of reed canarygrass, reducing biodiversity. Control methods are not well developed.

The literature is inconclusive on the effectiveness of defoliation and shade in controlling reed canarygrass. We investigated the effect of combining defoliation and shading on reed canarygrass productivity.

CURRENT PUBLICATIONS AND PAPERS

Bartsch, K.P., H. Van Miegroet, J. Boettinger, and J.P. Dobrowolski. 2002. Using empirical erosion models and GIS to determine erosion risk at Camp Williams, Utah.

Soil and Water Conservation Society 57(1):29-36.

Collins, G.H., R.B. Wielgus, and G.M. Koehler. 2002. Effects of sex and age on

American black bear conifer damage and control. Ursus (*in press*).

Hobbs, N. T., J. E. Gross, L. A. Shipley, D. E. Spalinger, and B. A. Wunder. Submitted. Foraging by herbivores in food-dispersed patches: tests of a mechanistic model of functional response. (Ecology, accepted with revisions, May 2002).

Fletcher, J. D., L. A. Shipley, W. J. McShea, and D. L. Shumway. 2001. Wildlife herbivory and rare plants: The effects of white-tailed deer, rodents, and insects on growth and survival of Turk's cap lily. Biological Conservation 101:229-238.

Fletcher, J. D., W. J. McShea, L. A. Shipley, and D. Shumway. 2001. The utility of using common forest forbs to measure browsing pressure by white-tailed deer (*Odocoileus virginianus*). Natural Areas Journal 54:413-419.

Laca, E., L. A. Shipley, and E. Reid. 2001. Structural anti-quality characteristics of range and pasture plants. Journal of Range Management 54:413-419. Res. and Rehab. 13:145-154.

Siegel, N.J., L.A. Shipley, R.D. Sayler. 2001. Ecology of pygmy rabbits at Sagebrush Flat in eastern Washington. Proceedings WA Chapter of the Wildlife Society Annual Meeting, Moses Lake, WA, March 19-21.

Siegel, N.J., L.A. Shipley, R.D. Sayler. 2001. Ecology of pygmy rabbits at Sagebrush Flat in eastern Washington. Annual Cooperators Meeting, Washington Cooperative Fish & Wildlife Research Unit, Washington State University, October 10-11.

Spear, J. M., P. J. Smallidge, L. A. Shipley, and D. L. Shumway. In press. Effects of deer herbivory on forest regeneration in hemlock-dominated riparian forests on the Appalachian Plateau, Western Maryland. Natural Areas Journal.

Wielgus, R.B., P. Vernier, and T. Schivatcheva. 2002. Grizzly bear use of open, closed and restricted forestry roads. Canadian Journal of Forest Research *(in press*).

Wielgus, R.B. 2002. Minimum viable population and reserve sizes for naturally regulated grizzly bears in British Columbia. Biological Conservation 106(3):381-388.

WYOMING

UNIVERSITY OF WYOMING

2001-2002 WCC-21 PROGRESS REPORT

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INTRODUCTION

This report summarizes revegetation and stabilization of disturbed land research activities conducted during 2001-2002 and emphasizes activities of Department of Renewable Resource's personnel at the University of Wyoming. The projects listed below were funded by federal, state and private industry, including the Abandoned Coal Mine Land Research Program (ACMLRP) and Agricultural Experiment Station Competitive Grant Program at the University of Wyoming. The ACMLRP support is administered by the Abandoned Mine Land Division of the Wyoming Department of Environmental Quality from funds returned to Wyoming from the Office of Surface Mining of the U.S. Department of the Interior.

COMPLETED PROJECTS

1. Ecological Assessment and Evaluation of Snowfence Areas and Snowfence Mitigations (J.D. Shirley, B.L. Perryman, P.D. Stahl and M.J. Henn, Department of Renewable Resources, University of Wyoming)

   The "Wyoming" type snowfence is a common feature along Interstate 80 in Southeastern Wyoming, resulting in the formation of large snowdrifts. These snowdrifts alter the environment in areas where they were formed. In the early 1990's, a seeding trial was conducted to determine which seeded grass species would produce the most aboveground biomass and percent foliar cover in drifted areas. The previous study was the framework used for this study. Objectives of the studied report in this thesis were to 1.) Determine impacts of snow drifts created by the "Wyoming" type snowfence on soil, soil physicochemical, and biotic characteristics, and 2.) determine which seeded grass species produced the best aboveground biomass and percent foliar cover. Drifted areas were compared to adjacent areas not cover by the snow drift. Results from this study indicate

decreased plant biomass and cover in drifted treatments. Tillage is still showing a benefit to percent foliar cover. Pubescent wheatgrass produced the most cover and biomass of any species planted. Changes to soil physicochemical parameters are occurring underneath the snowdrift. Soil pH, EC, microbial biomass carbon, and potentially mineralizable carbon are all reduced in drifted plots. No changes have occurred to soil organic matter, phosphates, sulfates, and mycorrhizal root development under drifted plots.

2. Systems Approach to Smooth Brome Control in a Reclaimed Cool Season Grassland Community (M.D. Stacy, B.L. Perryman, P.D. Stahl, K.J. Reddy and M.A. Smith, Departments of Renewable Resources, University of Wyoming; D. Koch, Plant Sciences, University of Wyoming)

   Smooth brome invasion of reclaimed areas is now recognized as a problem requiring research to identify efficient and effective control methods that will not damage or destroy newly developed native cool- and warm-season plant communities. The study site is located in north central Wyoming at the Pittsburg & Midway Ash Creek Mine. The objectives of the project were: (1) determine the efficacy of burning, grazing, and herbicide (Gramoxone) measures on smooth brome, while trying to enhance native grasses, and forb production; (2) determine treatment effects on soil moisture content; (3) determine effect of treatments on mycorrhizal root infection; (4) determine effects of treatments on total microbial biomass carbon; (6) determine effects of moisture on microbial biomass; (7) determine effects of soil moisture on mycorrhizal root infection. All treatments were applied at the tiller elongation stage of smooth brome. In order to try and ameliorate effects of the long topsoil storage (20 years), native undisturbed topsoil was spread on appropriate cells at a rate of 538g m^{-2}. Data collected in 1999 indicated a difference between aboveground management practices (for smooth brome and native grasses) in relation to control cells, however no differences were found between belowground management practices. In 2000, analysis was split into two categories, cells re-treated that year (RT), and cells not re-treated (NT). No difference was found in 2000 NT, differences were determined in 2000 RT cells however only in the same manner as in the 1999-growing season. No difference was determined in percent foliar cover (1999 & 2000 TR) in relation to above or belowground management practices. Root infection results indicated significance in relation to inoculation in the 2000 NT cells. Soil moisture for 1999 varied in relation to aboveground management practices as well as the random affects factor time. No difference was determined for 2000 moisture samples for any of the management practices, however differences were determined in the random affects factor time. Researchers were also interested in investigating the relationship with soil moisture and microbial biomass, as well as soil moisture and mycorrhizal root infection. As soil moisture decreased throughout the growing season so did microbial biomass, as was expected. 2000 results indicated no interaction. In 1999 root infection also decreased throughout the growing season as moisture decreased. No interaction seemed to take place in 2000 in regards to this relationship.

ONGOING PROJECTS

1. Relationship Between Soil Organic Matter Content and Sustainable Nutrient Cycling in Reclaimed Soils. (P.D. Stahl and L. Ingram, Department of Renewable Resources, University of Wyoming; G.E. Schuman, USDA-ARS, High Plains Grasslands Research Station, Cheyenne, WY; L.K. Spackman, Wyoming Department of Environmental Quality-Land Quality Division)

   An important aim of mineland rehabilitation is to ensure wherever possible that the "reconstructed" ecosystem is self-sustaining, requiring minimal or preferably no additional inputs. Therefore, it is critical that soils used in mine reclamation are able to provide sufficient quantities of nutrients for ecosystem sustainability. Many of the nutrients required for plant growth, in particular N and P, are found in the greatest abundance in soil organic matter (SOM). Equally important is the large amount of C found in SOM, which provides "energy" to microbial populations and enables them to mineralize the nutrients in SOM and make available for plant uptake. One objective of this project is to determine the minimum amount of SOM required to potentially sustain nutrient cycling in disturbed ecosystems. The rate at which N is mineralized (converted from an organic form to a plant available, inorganic form) is usually considered to be the factor most limiting to plant growth in semi-arid ecosystems.

   Soil samples were subjected to a series of laboratory incubations to assay microbial respiration at three, 10 and 21 days, microbial biomass and N-mineralization. To maximize rates of N-mineralization and standardize soil conditions, all soil incubations were undertaken at -0.5 bar soil moisture. These various assays were then correlated against three-day microbial respiration. In a number of mine sites, N-immobilization was readily apparent, suggesting N is limiting the rate of SOM decomposition, and subsequently, the further release of nutrients from organic matter. Also in soils only recently replaced (1-3 years old), much greater microbial activity occurred in the top 2.5 cm of soil, with subsequent decline with depth of microbial activity, SOM, and N, suggesting that development of the soil profile may already be occurring. Relationships between 3 day microbial respiration with both 10 and 21 day respiration, as well as microbial biomass and soil organic C, were all highly correlated and highly significant. The relationship between three-day microbial respiration and N-mineralization, while highly significant, was less well correlated. As such, this may mean that the organic C measured is not readily decomposable, reducing the extent of SOM mineralization. Additionally, at several coal mine sites, two reclaimed sites. replicate reclaimed sites were sampled as well as nearby native sites. Sampling consisted of establishing three 12 m transects, with soils sampled at 0, 3, 6, 9 and 12 m at two depths; 0-2.5 and 2.5-15 cm. Due to the rapid decline in microbial activity at the 15-30 cm depth, it was decided not to sample the 15-30 cm depth. Finally at each of the sites, 6 replicate quadrats (0.18 m^2) of above-ground vegetation were sampled for the purpose of both biomass production as well as total aboveground N content in order to calculate an estimate for the N requirements of the vegetation at the various sites to compare with laboratory estimates of N-mineralization.

2. Controls of Carbon Sequestration on Northern Rocky Mountain Rangelands. (G.F. Vance and P.D. Stahl; Department of Renewable Resources, University of Wyoming, Laramie, WY 82071-3354; J.M. Welker and J.T. Fahnestock, Natural Resource Ecology Laboratory, Colorado State University, Ft. Collins, CO 80523; G.E. Schuman and J.A. Morgan, USDA-ARS, High Plains Grasslands Research Station, Cheyenne, WY 82009)

Understanding factors governing soil C sequestration are essential for addressing questions related to rising atmospheric CO_2 concentrations, global warming and ecosystem C exchange. Carbon sequestration is the net effect of C fixation by plants, heterotrophic respiration and production (microbial and plant), and soil C storage, all of which are potentially sensitive to land use, abiotic and biotic conditions, soil N processes and grazing. In this project we are studying the temporal coupling of soil N processes (N mineralization, immobilization) with net CO_2 exchange and long-term soil C storage, and grazing effects on microbial biomass production, N mineralization, SOM traits (labile vs. recalcitrant soil C) and annual budgets of net CO_2 exchange. We are comparing C and N processes in grazed and ungrazed, fenced exclosures (ungrazed by domestic livestock for 60 years) within a mixed-grass prairie. Our studies involve extensive comparisons of vegetation C and N characteristics (species composition, biomass production, photosynthesis, respiration), soil organic matter chemistry (constituents, pools), and biotic processes (microbial biomass, N mineralization) between the grazed and exclosure areas. In addition, we will quantify the magnitude of net CO_2 exchange in summer and winter using annual CO_2-C budgets as an estimate of current C sequestration patterns. This project will advance the fundamental understanding of soil biological processes, especially the synchrony between soil N dynamics and CO_2 flux, while providing insight as to how land management may alter soil C sequestration.

Hypotheses to be tested include: 1) C sequestration is greater in areas that have been grazed because rates of gross photosynthesis exceed annual respiration losses and there is a tighter coupling of C and N processes, such as N mineralization and ecosystem photosynthesis and 2) grazing results in more stable and recalcitrant pools of soil C, suggesting grazing can be useful as a management tool to sequester C in soil fractions that will not be oxidized in the near future. Research questions addressed in this project include: to what extent are plant and soil C and N concentrations, pools, and/or fluxes altered by grazing, 2) are the patterns and the synchrony of C and N processes altered by grazing and can this alteration curtail the rates of C sequestration, are the pools and fluxes of C and N in soil microbial biomass, root and shoot biomass and the rates of N mineralization and immobilization different between grazed and ungrazed (exclosure) areas, and to what degree are SOM constituents, their accumulation, humification and aggregation altered by grazing, and to what degree has grazing altered the amount of SOM stored in recalcitrant and long-term storage pools? The approach we are using to answer these questions are: utilizing established fenced (ungrazed) areas in comparison to grazed areas in primarily mixed-grass prairie, employing standard and modern techniques to measure C and N pools and fluxes with conceptual

models to address the synchrony of C and N processes, and conducting laboratory and field studies to evaluate SOM and biotic constituents and processes.

3. Potential Impacts and Alternatives to Land Application of Coalbed Methane Product Water. (G.F. Vance, Department of Renewable Resources, University of Wyoming, Laramie, WY 82071-3354)

   The Powder River Basin (PRB) in Wyoming and Montana has seen extensive coalbed methane (CBM) development over the past 10 years, with thousands of CBM wells in production and more than 50,000 total active wells projected within the next 10 years. During CBM production, large amounts of water are produced as coal seams are de-pressurized; most of this water is surface discharged to local streams and/or impoundments. Due to the quality of the product water, particularly its salinity and sodicity, CBM producers are required to obtain National Pollution Discharge Elimination System permits to surface discharge CBM waters into Tongue, Powder and Little Powder River Basins. Limitations on discharge permits has generated significant interest in alternative water disposal techniques. Land application of CBM product waters has been proposed as a method for water disposal; however, some of these waters have salinity and sodicity characteristics that may impact plant growth and/or soil chemical and physical properties. With the estimated production life of a CBM well at 10 to 20 years, there is great potential for CBM product water to cause salinization, sodicity, sedimentation, and erosion in affected lands and stream channels and tributaries. In addition, altered vegetative communities and wildlife habitats will result from the excess water, causing uncertainty in the sustainability of these ecosystems. The focus of this research is on potential impacts CBM discharge water has on soil properties and vegetation, with alternative application methods currently being tested in the PRB, e.g., sprinkler systems, water cannons or atomizer units.

4. The Effects of Varying Topsoil Replacement Depth on Various Plant Parameters Within Reclaimed Areas. (B.K. Schladweiler, BKS Environmental Associates, Inc., P.O. Box 3467, Gillette, WY 82717; L.C. Munn and G.F. Vance, Department of Renewable Resources (Soil Science), University of Wyoming, Laramie, WY 82071; R. Haroian and S. Belden, Powder River Coal Company, NA/RC Complex, Gillette, WY 82717)

   Tasks for this project included: 1) review existing vegetation/soil information from the WDEQ-LQD and obtain permission from the WDEQ-LQD to conduct the proposed variable topsoil study on Rochelle Mine; 2) establish and construct the study site at the Rochelle Coal Mine; 3) obtain quantitative field data of three treatments on reclaimed areas and the corresponding reference areas; 4) summarize findings from the field sampling in No. “III” and provide annual/final recommendations; and 5) disseminate that information to interested parties. Initial reference areas were established in Breaks Grassland and Upland Grassland areas within the North Antelope/Rochelle Mine Complex. Three contiguous blocks within each reference area “replicate” that ran perpendicular to the slope, i.e., “top of the slope” (15 cm reclaimed area treatment), “middle of the slope” (30 cm reclaimed area treatment),

and “bottom of the slope” (55 cm reclaimed area treatment. Five random 30 meter cover intercept transects were sampled within each treatment replicate.

Significant differences were found between native and reclaimed areas. This point exemplifies the difficulty in selecting native areas as a revegetation success standard for reclaimed areas. Inherent differences resulting from the mining process, i.e., homogenous, replaced soil material make it difficult to compare native areas that have well defined profiles with horizons. The pH of the native areas is generally lower in the upper horizons than in the lower horizons. Due to homogenous replaced soil material on reclaimed areas, higher pH material is mixed throughout the replaced topsoil depth and could be found in the upper portion. Once the deeper depths are reached in the native areas, it is possible that the pH is higher in the native than the reclaimed. The same argument would apply to EC and SAR which shows higher material throughout the replaced topsoil depth, especially in the upper sampling intervals. Total vegetation cover and total cover percentages are higher in the native areas due to the relatively young age of the reclaimed area and relatively low precipitation throughout the 2000 and 2001 growing season in 2000. Fall moisture, however, was good to adequate in 1999 which aided the growth of species during the 2000 growing season. Typically, the total cover percentages are higher in a reclaimed environment as litter accumulates with time. Average species and total species were higher in the native areas. Although, this is a new reclaimed area, the problem of comparing diversity with native areas exists for older reclaimed areas, as well.

5. Impacts of Wildlife Utilization on Big Sagebrush Survival on Reclaimed Mined Lands. (K.A. Strait and R. A. Olson, Department of Renewable Resources, University of Wyoming, Laramie, WY 82071; G.E. Schuman, High Plains Grasslands Research Station, USDA-ARS, Cheyenne, WY 82009)

Past research has enabled reclamation specialists to successfully establish big sagebrush on reclaimed lands; however, there is a lack of quantitative information on utilization levels of big sagebrush by wildlife and browsing impacts on long-term seedling survival. This project is evaluating the historical progression of big sagebrush density from initial seeding to the present, vegetation canopy cover, community composition and diversity, utilization levels of big sagebrush by wildlife, browsing impacts on big sagebrush survival, and potential management practices to reduce browsing impacts. To investigate the influence of wildlife utilization on big sagebrush growth and survival, a game-proof exclosure was constructed on a portion of the original a study site established earlier by Schuman and others to provide comparative data on browsed versus unbrowsed big sagebrush. The original study was established in August 1990 on approximately 1.2 ha of leveled coal mine spoil and included the following treatments: topsoil, mulch (stubble mulch, surface-applied straw mulch, stubble and surface-applied straw mulch, and no mulch), and grass seeding rate (no perennial grass seeded, 16 kg PLS [pure live seed] ha-1, and 32 kg PLS ha-1). Game-proof exclosure were constructed at the study site on June 4, 2001. Dimensions of the constructed exclosure are 90 by 30 m and 3.05 m tall. The exclosure encloses half of each of the 3 replicated topsoil treatments. The same

number of mulch treatment subplots and grass seeding rate sub-subplots are located inside and outside the exclosure. The fence is constructed of woven wire with chicken wire extending along the ground surface about 0.5 m high along the fence to exclude rabbits.

Differences in the mean percent of big sagebrush plants browsed inside versus outside the exclosure were contrastingly different during the summer 2001. As expected, the mean percent of browsed big sagebrush plants decreased from the early summer to fall sampling period inside the exclosure. High values for the mean percent browsed big sagebrush plants inside the exclosure for the June 2001 sampling period were attributable to browsing events prior to exclosure construction. Reduction of browsing because of exclosure construction and summer re-growth inside the exclosure was expected in the September 2001 sampling period. Likewise, there was significantly higher numbers of browsed big sagebrush plants across all grass seeding rates from the June to September sampling period outside the exclosure. Seasonal differences in big sagebrush browsing intensity will be studied with future data collections. Mean number of big game pellet groups and presence/absence of rabbit pellets were recorded and cleared from the permanent belt transects during the September 2001 sampling period. Analysis of pellet groups (by grass seeding rate) outside the exclosure will provide additional verification on preferential browsing by big game and rabbits as affected by grass seeding rate. Future sampling will provide better clarification of the impact of wildlife utilization on plant communities of the reclaimed site as differences inside and outside the exclosure are evaluated over time.

6. Indicators of Mine Soil Recovery. (J. Anderson and P.D. Stahl, Department of Renewable Resources, University of Wyoming, Laramie, WY 82071-3354)

As the nation's leading producer of coal, Wyoming has thousands of acres of soil that are affected by surface mining each year. In the year 2000 alone, over 330 million tons of coal was surface mined in Wyoming. Although topsoils are removed from mine sites and stockpiled for protection to be later redeposited, soil organisms including plants, animals and microorganisms are negatively impacted by surface mining activities. Microorganisms in soils play important roles in organic matter decomposition, nutrient cycling, and vegetation reestablishment, as well as soil development and stabilization. The response of soil microorganisms to disturbance and their recovery during reclamation of surface mine sites is not well understood, yet extremely important to sustainable mine land reclamation. The objective of this study was to examine the recovery of soil microorganisms and ecosystem processes they control by analyzing a chronosequence of nine different aged reclamation sites (ranging in age from 2 to 32 years since reclamation was initiated) and adjacent undisturbed sites on the Dave Johnson Coal Mine located in Central Wyoming. Results indicate that the soil microbial community may take much longer than 30 years to recover to native undisturbed levels. Even though the plant community may recover in terms of biomass production and surface cover within 20 years or less, amounts of soil microbial biomass C were only approximately half of that found in

adjacent undisturbed soils. Concentrations of organic matter in reclaimed soils, however, appear to increase to levels above that found in adjacent undisturbed soils.

7. Microbial Community Structure in Surface Mine Reclamation Soils. (Peter D. Stahl and Daniel L. Mummey, Department of Renewable Resources, University of Wyoming)

   Little data is available about how bacterial communities respond to drastic soil disturbance. In this study we evaluate the effects of drastic disturbance associated with surface mining on soil bacterial community structure. Differences in the bacterial diversity in soils reclaimed between two and twenty years after disturbance and adjacent undisturbed soils were examined using 16S ribosomal DNA sequence and terminal restriction fragment length polymorphism (TRFLP) analyses. On the basis of the presence or absence of specific ribotypes, cluster and similarity analyses of TRFLP data indicated three distinct bacterial populations associated with undisturbed sites, sites reclaimed for over two years, and sites reclaimed less than two years. However, analysis of the relative abundance each ribotype over all sites indicated that undisturbed and older reclaimed sites share many of the same predominant ribotypes, despite large differences in microbial biomass, SOM, and nutrient status. These results suggest that, even though relatively large differences exist between ribotypes of undisturbed and all reclaimed soils, many of the most abundant members of undisturbed soil communities have reestablished on older reclaimed soils. Phylogenetic analysis indicated that the majority of 16S rDNA sequences obtained from all sites are from bacterial lineages for which no cultivated isolates are available, including a new potentially division-level group previously known from only three clones obtained in two different studies of Arizona soils. Phylogenetic analysis of 16S rDNA sequences from newly reclaimed sites indicate that members of a little know and highly divergent Actinobacteria subdivision (Rubrobacter Group 3) are in high abundance.

8. Accumulation of Organic Carbon in Reclaimed Surface Coal Mine Soils in Wyoming. (P.D. Stahl, J.D. Anderson, D.L. Mummey and L.J. Ingram, Department of Renewable Resources, University of Wyoming, Laramie, WY 82071-3354)

   The potential to sequester C and increase organic nutrient storage in disturbed soils, such as those presently being reclaimed after surface coal mining or those abandoned after surface coal mining (prior to passage of SMCRA in 1977), appears to be particularly great. Our data on organic matter accumulation in reclaimed soils at surface coal mines in Wyoming indicate that these soils are sequestering carbon at a rapid rate. Studies at a surface mine reclamation site near Hanna, WY indicates that over the past 15 years, surface (0-20 cm) soil organic matter content has increased from a low of 1.9% in 1983 to 3.2% in 1998. Undisturbed soil directly adjacent to the reclaimed site has a mean organic matter content of 2.6%. At a mine near Glenrock, WY, soil organic matter content at a site reclaimed in 1979 increased from an estimated low of 1.0% to a current level of 3.2%. Organic matter content of undisturbed soils adjacent to the reclaimed area range from 1.7 to 2.7%. In contrast to the elevated organic matter content, amounts of microbial biomass in reclaimed

soils at both mines are lower than in nearby undisturbed soils (ca. 60% or less). Possible mechanisms explaining the accumulation of organic carbon in these soils will be discussed.

9. Grass competition and sagebrush seeding rates: Influence on sagebrush seedling establishment. (G.E. Schuman, High Plains Grasslands Research Station, USDA - ARS, Cheyenne, WY 82009; M.I. Fortier and A.L. Hild, Department of Renewable Resources, University of Wyoming, Laramie, WY 82071; L.E. Vicklund, RAG, Coal West, Inc., Belle Ayr Coal Mine, Gillette, WY 82717)

   Competition from herbaceous plants has a negative effect on big sagebrush seedling establishment. However, details of the interaction between this shrub species and grasses seeded together on mined land in Wyoming are not well documented. This lack of specific information has prompted reclamationists to continue to seed shrub and grass species concurrently despite the lack of Wyoming big sagebrush establishment success. Research is needed to further assess the levels of herbaceous competition that will favor sagebrush seedling establishment as well as produce adequate ground cover to ensure stability of the soil resource, yet achieve the shrub density standard set by the Wyoming Department of Environmental Quality, Land Quality Division. A study was located at the Belle Ayr Coal Mine, RAG Coal West, Inc. mine near Gillette, WY. Topsoil was spread on the study site in January 1998 to an average depth of 56 cm. In the spring of 1998 the site was seeded to barley (Hordeum vulgare var. 'Steptoe') and in late summer it was mowed to achieve a standing stubble mulch. In December 1998, seven grass seeding rates (0, 2, 4, 6, 8, 10, and 14 kg PLS/ha), comprised of a mixture of western, slender, and thickspike wheatgrass were randomly assigned and drill seeded into 6.5 x 27 m plots within each of four, 27 x 45.5 m blocks. Each grass main plot was divided into three 6.5 x 9 m subplots, which were randomly assigned to one of three sagebrush seeding rates (1, 2, and 4 kg PLS/ha) and broadcast seeded in March 1999. Prior to any seedling emergence, six 1-m2 permanent quadrats were established in each sagebrush by grass seeding rate subplot to assess sagebrush seedling density in 1999-2001. Sagebrush seedling size (canopy volume) was also assessed in these permanent quadrats in 2001.

   Sagebrush seedling density data continue to show no statistically significant differences on either of the sampling dates (June and October 2001) for grass seeding rates. Sagebrush seeding rate continues to exhibit a significant effect on sagebrush seedling density. Grass seeding rates (competition) continue to show limited effect on the sagebrush seedling density; however, grass seeding rates has definitely affected the canopy volume of the sagebrush seedlings. This study continues to supply important information on the effects of grass and sagebrush seeding rate on plant community development which will enable us to develop improved reclamation technology.

10. Strontium isotopic characterization of coal and sandstone aquifers, Powder River Basin, Wyoming. (C.D. Frost, R.M. Lyman and E.L. Heffern; Department of Geology and Geophysics, University of Wyoming, Laramie, WY; K.M. Ogle, U.S. Geological

Survey, Cheyenne, WY)

The purpose of this study is to evaluate the utility of the Sr isotope composition of groundwaters to characterize coal and sandstone aquifers. Ground water samples obtained from USGS-WRD, BLM and the Wyoming State Engineer's Office were geochemically and isotopically analyzed, with an additional 50 samples from coal aquifers provided by the USGS Geological Division in Denver for future analysis. In addition a collaborative project was developed with the Jacob's Ranch surface coal mine that will include aquifer water samples, and rock samples from underburden, coal, overburden, spoil and clinker for rock leachate experiments. A regional study of coal and sandstone aquifers in the Powder River Basin has also been developed in conjunction with Barrett Resources, Pennaco Energy, and J.M. Huber Corporation, as well as with BLM and their monitoring wells. Finding to-date suggest that the Wyodak-Anderson coal zone groundwaters have a Sr isotopic composition that is distinct from adjacent sandstone aquifer groundwaters, and is also different from lower coal zone aquifer groundwaters. The Sr isotopic ratio can distinguish aquifers that are indistinguishable in terms of major ion chemistry and stable isotopic compositions. It appears that most of the water samples are derived from isolated aquifers, suggesting that coal bed methane production has not impacted adjacent sandstone aquifers. However, in several instances, intermediate Sr isotope ratios of groundwaters indicate aquifer interactions. In one case this is related to well construction, and in others it appears the water from an overlying unconfined sandstone aquifer is entering a production coal seam.

11. Research and development of a GIS-based data management and model integration tool for coal mine permitting and reclamation in Wyoming. (T.W. Kohley, Beartooth Mapping, Inc.; R.C. Warner, Surface Mining Institute; J.D. Hamerlinck, Wyoming GIS Center, University of Wyoming; P.J. Schwab, Civil Software Design; G.E. Jones Powder River Coal Company; L.E. Vicklund; RAG Coal West, Inc., WY)

    The primary objective of this research was to develop a prototype GIS-based software application for the management, analysis and reporting of data associated with major components of the bond release processes for coal mine reclamation in Wyoming. Research resulted in the design and development of two prototype GIS software application tools for coal mine land reclamation activities – SedPrePro and RMT.

    SedPrePro Overview. SedPrePro is an ArcView 3.2 extension that was developed to assist pre-processing for the SEDCAD surface water model. SedPrePro provides functionality to develop continuous raster elevation surfaces, predicted stream networks, NRCS Type storm layers, NRCS Curve Number grids, hydrologic structure regimes and user delineated subwatersheds. SedPrePro utilizes these data sources in conjunction with customized time of concentration (Tc) and flow routing algorithms to calculate physical and geometric properties of the watersheds and aggregate these properties into SEDCAD parameter input files.

RMT Overview. The Reclamation Management Tool (RMT) is the combination of an ArcView 3.2 user-interface and a standardized relational database designed to track virtually all elements of reclamation history, from initial disturbance dates to topsoil replacement, re-vegetation and bond release status. The RMT allows end users to query and visualize past and present reclamation activities and easily generate standardized reports and maps for inclusion in annual reports and bond release documents.

The SedPrePro and RMT applications demonstrate the opportunity for GIS implementation in coal mine land reclamation. SedPrePro provides a valuable tool for parameter development and management with the most widely used stormwater design and sediment control modeling systems in the mining industry. RMT provides a comprehensive, spatially-referenced database management infrastructure for tracking environmental requirements for post-mine bond release.

12. Updating the Handbook of Western Reclamation Techniques. (Laurel E. Vicklund, Philip C. Dinsmoor, McVehil-Monnett Associates, Inc.)

    In 1996 the Handbook of Western Reclamation Techniques was written by more than two dozen authors on topics ranging from hydrologic design to revegetation techniques. The chapters represented the accumulated knowledge of one or more experts on techniques that have proved successful in the reclamation of coal mined land in the western United States. Since its initial publication, the Handbook has undergone numerous printings and has now been published on CD ROM. According to the Office of Technology Transfer within the Office of Surface Mining Reclamation and Enforcement, this Handbook has been the most requested product in the federal ACMLRP library. It is being used as a field reference, classroom text, and guidance document throughout the world. In November of 2000, the Wyoming ACMLRP Steering Committee suggested updating the handbook. It was believed that the first edition technologies have evolved, new technologies have been developed, and new reclamation issues have come to the forefront to be addressed. The Steering Committee was also interested in having a second edition that was user friendly to a wider range of disciplines. Initial work was focused on project organization, contacting authors, and identifying which materials needed to be updated and what new information would be added. The general consensus of the Handbook committee is that revisions are warranted in the topic areas of reforestation, grazing, topsoil, vegetation, land use, seed, and wildlife. New work is desired in the areas of wetlands mitigation and creation, coal and oil/gas interaction, sagebrush establishment, GIS, hydrology, and soil amendments. In addition, it has been suggested that revegetation equipment be addressed.

CURRENT PUBLICATIONS AND PAPERS

Anderson, J.D. and P.D. Stahl 2002. Ecological indicators of mine soil recovery. Proceedings of the 19th Annual Meeting of the ASMR. Lexington, Kentucky.

Bowen, C.K., R.A. Olson, G.E. Schuman and L.J. Ingram. 2002. Long-term effects of variable topsoil depths on vegetation characteristics of reclaimed mined lands. Proceeding of the 19th Annual National Meeting of the ASMR. Lexington, Kentucky.

Frost, C.D. 2001. Sr isotopic characterization of coal and sandstone aquifers, Powder River Basin, Wyoming: monitor of aquifer interactions in an area of active coalbed methane development. AAPG Annual Meeting Abstracts v. 10, p. A-67.

Frost, C.D., B.N. Pearson, K.M. Ogle, E.L. Heffern and R.M. Lyman. 2001. Sr isotopic tracing of aquifer interactions in an area of coal and methane production, Powder River Basin, Wyoming. Geology, (In review)

Frost, C.D., J.E. Viergets, B.N. Pearson, E.L. Heffern, R.M. Lyman and K.M. Ogle. 2001. Sr isotopic identification of coal and sandstone aquifers and monitoring of aquifer interactions in an area of active coal bed methane production, Powder River Basin, Wyoming. Wyoming Geological Association Annual Field Conference (In press)

Frost, S.M., P.D. Stahl and S.E. Williams. 2001. Long term reestablishment of arbuscular mycorrhizal fungi in a drastically disturbed semi-arid surface mine soil. Arid Land Research and Management 15: 3-12.

Mummey, D.L. and P.D. Stahl. 2002. Soil microbiological properties 20 years after surface mine reclamation: spatial analysis of reclaimed and undisturbed sites. Abstracts of to the Western Soil Science Society, Ft. Collins, CO.

Mummey, D.L. and P.D. Stahl. 2002. Microbial biomarkers as an indicator of ecosystem recovery following surface mine reclamation. Abstracts of the Western Soil Science Society, Ft. Collins, CO.

Mummey, D.L., P.D. Stahl and J.S. Buyer. 2002. Microbial biomarkers as an indicator of ecosystem recovery following surface mine reclamation. Applied Soil Ecology (In press)

Mummey, D.L., P.D Stahl and J.S. Buyer. 2002. Soil microbiological and physicochemical properties 20 years after surface mine reclamation: comparative spatial analysis of reclaimed and undisturbed ecosystems. Soil Biology and Biochemistry (In review)

Pearson, B.P. and C.D. Frost. 2001. Strontium isotopes as tracers in groundwater systems related to coalbed methane production, Powder River Basin, Wy. AAPG Bulletin v. 85, p. 2057.

Pearson, B.P., C.D. Frost and J.E. Viergets. 2001. Strontium isotopes as indicators of regional variation in groundwater systems in an area of coalbed methane production, Powder River Basin, Wyoming. Geological Society of America Abstracts with Programs v. 35, p. A-111.

Peel, J., K.J. Reddy, P.D. Stahl and J.D. Rodgers. 2001. Phytoremediation as a means of groundwater protection: an overview. Student-Faculty Forum on Environment and Natural Resources, University of Wyoming.

Schladweiler, B.K., R. Haroian and G.F. Vance. 2002. Influence of variable topsoil replacement depth on soil and plant characteristics at a coal mine in northeastern Wyoming. Proceedings of the 19th Annual Meeting of the ASMR. Lexington, Kentucky.

Schuman, G.E., G.F. Vance and K.D. Edinger. 2001. Long-term effectiveness of bentonite mine spoil amendment in aiding revegetation. In: Land Restoration Success and Sustainability. Society for Range Management 54:114

Sharmasarkar, S. and G.F. Vance. 2002. Soil and plant selenium at a reclaimed uranium mine. Journal of Environmental Quality (September-October issue)

Skinner, C.P. and G.F. Vance. 2001. Soil-geology selenium relationships in disturbed and native ecosystems. In: R. Barnhisel and B. Buchanan (eds.) Land Reclamation - A Different Approach. ASSMR, Lexington, KY. Issue 18:300-316.

Skinner-Martin, C.P. and G.F. Vance. 2002. Plant-soil selenium in disturbed and native ecosystems. In: R. Barnhisel (ed.) Reclamation with a Purpose. ASMR, Lexington, KY. Issue 19:141-162.

Skinner-Martin, C.P. and G.F. Vance. 2002. Use of GIS for predicting areas with seleniferous soils and plants. Agronomy Abstracts.

Stahl, P.D., B.L. Perryman, S. Sharmasarkar, and L.C. Munn. 2002. Stockpiling vs. exposure to traffic: Best management of topsoil on in-situ uranium wellfields. Restoration Ecology.

Vance, G.F. 2001. Wyoming Reclamation Ecology Center: A new research, education and outreach initiative. American Society for Surface Mining and Reclamation Issue 18:328

Vance, G.F. 2002. Undergraduate minor and graduate certificate programs in Reclamation and Restoration Ecology. In: R. Barnhisel (ed.) Reclamation with a Purpose. ASMR, Lexington, KY. Issue 19:1173-1182.

Vance, G.F. 2002. Potential impacts and alternatives to land application of coalbed methane product water. Western Society of Soil Science Proceedings p.18

Vance, G.F. and C.P. Skinner. 2001. GIS applications for predicting areas with seleniferous soils and plants. Western Society of Soil Science Proceedings p.11

Williams, M.I., G.E. Schuman, A.L. Hild, and L.E. Vicklund. 2002. Wyoming big sagebrush density: effects of seeding rates and grass competition. Restoration Ecology (In press)

You, Y., H. Zhao and G.F. Vance. 2002. Sodium-Zinc Exchange Selectivity on Wyoming Montmorillonite in Different Background Anion Solutions. Pedosphere (In press)

WYOMING

HIGH PLAINS GRASSLANDS RESEARCH STATION

USDA Agricultural Research Service
\WCC21 Progress Report

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INTRODUCTION

This report summarizes the revegetation, seed ecology and general reclamation research of the Rangelands Resources Research Unit at Cheyenne, Wyoming and Fort Collins, Colorado. Portions of this research are cooperative with the University of Wyoming, Department of Renewable Resources and the mining industry. Partial funding for portions of this research comes from the Wyoming Abandoned Coal Mine Land Research Program, University of Wyoming and the Abandoned Mine Land Program, Wyoming Department of Environmental Quality.

ONGOING RESEARCH

1. Grass competition and sagebrush seeding rates: Influence of sagebrush seedling establishment (G.E. Schuman, A.L. Hild and L.E. Vicklund; USDA, ARS, High Plains Grasslands Research Station, Cheyenne, WY; Department of Renewable Resources, University of Wyoming, Laramie, WY and RAG Coal West Inc., Belle Ayr Mine, Gillette, WY)

   This study examines the effect of grass competition and sagebrush seeding rate on establishment of Wyoming big sagebrush. The study site is at the Belle Ayr Coal Mine south of Gillette, WY. The experimental design was a split, split plot with four replicate blocks. Seven grass seeding rates (0, 2, 4, 6, 8, 10, and 14 kg PLS/ha) were used to assess effects of grass competition and three sagebrush seeding rates (1, 2, and 4 kg PLS/ha) were used to assess effects on sagebrush seedling density and canopy volume and survival. This study was initiated in 1999. Sagebrush seedling density and canopy volume data were collected in June 2002. Sagebrush seedling density was 4.4, 3.5, 3.7, 2.7, 3.1, 3.1, and 1.8 plts/m^2 for the 0, 2, 4, 6, 8,

10, and 14 kg PLS/ha grass seeding rates, respectively. The seedling density for the 14 kg PLS/ha grass seeding rate was significantly lower than all other grass seeding rates and the density for the 0 kg/ha grass seeding rate was significantly greater than the higher than the 14 kg/ha seeding rate with no significant differences evident between the 4-10 kg/ha grass seeding rates. Seedling densities were significantly different for all three sagebrush seeding rates; 4.9, 3.3, and 1.4 seedlings/m^2 for 4, 2, and 1 kg PLS/ha sagebrush seeding rates. Sagebrush canopy volume was significantly higher for the 0 kg/ha grass seeding rate than all other grass seeding rate treatments. These data point out the significant impact grass competition has on Wyoming big sagebrush establishment and growth. Based upon the effects of grass competition on sagebrush seedling establishment and growth and the fact that no differences in grass biomass was evident in 2000 and 2001 between 4-14 kg/ha grass seeding rates we would recommend a grass seeding rate and sagebrush seeding rate that achieves 3.0 sagebrush seedling/m^2 and as large a plant as possible to aid in survival. Based on the data from this research we might recommend a grass seeding rate of 2-8 kg/ha and a sagebrush seeding rate of 2 kg/ha. A sagebrush seedling density of 3 seedlings/m^2 and a long-term survival of 59% reported by Schuman and Belden (2002) will ensure a density adequate to meet bond release unless severe drought conditions for a prolonged period occurred.

2. Relationship between soil organic matter content and sustainable nutrient cycling in reclaimed soils. (L.J. Ingram, G.E. Schuman, P.D. Stahl, and L.K. Spackman; Department of Renewable Resources, University of Wyoming, Laramie, WY; Department of Renewable Resources, University of Wyoming, Laramie, WY; USDA, ARS, High Plains Grasslands Research Station, Cheynne, WY; Department of Environmental Quality, Land Quality Division, Cheyenne, WY)

   Surface mining invariably leads to a reduction in soil organic matter (SOM), which in turn can lead to poor plant establishment and longer term sustainability and production. This is because of the critical importance of SOM in the plant-soil relationship by sustaining microbial activity, nutrient cycling and soil stability. The aim of this research was to a) examine the relationship between soil organic matter and number of other indicators of sustainable nutrient cycling (i.e. microbial respiration, microbial biomass, and N-mineralization potentials), and b) examine a new, fast, and reliable method (the three-day CO_2 flush method) that correlates well with other indicators of nutrient cycling. In the summer of 2000 and 2001, soils from three different sites (two reclaimed areas and an undisturbed native site) at each of three different mines were sampled at depths of 0-2.5 cm, 2.5-15 cm, and 15-30 cm□s. Soils were then analysed for microbial respiration after three and 21 days, microbial biomass and N-mineralization potential. Regression relationships between organic C and indicators of nutrient cycling were all highly significant ($r^2 > 0.63$, $P < 0.0001$). The three-day CO_2 flush method was highly correlated with the other indicators of sustainable nutrient cycling ($r^2 > 0.80$, $P < 0.0001$). The three-day CO_2 flush appears then to offer a relatively cheap, reliable, and fast way by which to predict the ability of soil to provide SOM in sufficient amounts to sustain nutrient

cycling. In turn this will assist the mining industry and regulatory agencies to develop guidelines that will ensure the long-term sustainability of reclaimed ecosystems.

3. Long-term plant community responses to topsoil replacement depth on reclaimed mined land (C.B. Bowen, R.A. Olson, G.E. Schuman, and L.J. Ingram; USDA, ARS, High Plains Grasslands Research Station, Cheyenne, WY and Department of Renewable Resources, University of Wyoming, Laramie, WY)

   Using a study site established in 1977 on Pathfinder Mining Corporation's Shirley Basin Uranium Mine this study evaluates the long-term effects of variable topsoil depth replacement on vegetative community parameters. Topsoil was replaced on the site in a wedge configuration ranging in depth from no topsoil replacement to 600mm of topsoil. Plant species cover, biomass, richness (number of species), and diversity assessed at topsoil depths of 0, 200, 400, and 600mm. Cover was estimated using a modified Daubenmire method and species were recorded prior to clipping. Clipped samples were dried and weighed to determine aboveground biomass. A Shannon Weiner Diversity Index was calculated for each plot using importance values derived from relative frequency, canopy cover, and biomass. Canopy cover was evaluated as a whole and by seeded species. Total canopy cover was greatest at the 400 and 600 mm depths and least for no topsoil. Seeded species canopy cover and biomass were greatest at the 400 mm depth. Total aboveground biomass was highest and similar at the 400 and 600 mm topsoil depths and lowest at the 200 and 0 mm depths. Both plant species richness and diversity were highest at 0 mm of topsoil and lowest at the 600 mm replacement depth. These data indicated that variable topsoil replacement depth can enhance reclamation success by increasing plant species richness and diversity; however care must be taken to ensure adequate ground cover in order to protect against soil erosion.

4. Impacts of Wildlife Utilization on Big Sagebrush Survival on Reclaimed Mined Lands (K.A. Strait, R.A. Olson, and G.E. Schuman, Dept. of Renewable Resources, University of Wyoming and USDA-ARS, High Plains Grasslands Research Station, Cheyenne, WY

   Ensuring Wyoming big sagebrush *(Artemisia tridentata* Nutt ssp. *wyomingensis* Beetle & Young) survival remains a challenge years after initial establishment on reclaimed mine lands. Wildlife utilization and browse may be a major influence on big sagebrush survival. A wildlife-proof exclosure was erected on a portion of an existing sagebrush establishment research site initiated by Schuman and colleagues in 1990 at the North Antelope/Rochelle Complex mine in northeastern Wyoming. Investigations focused on the influence of wildlife utilization of big sagebrush and vegetative community composition as affected by grass seeding rates of the original study and the newly constructed exclosure. Results indicate no significant differences in sagebrush density between grass seeding rates and inside or outside of the exclosure in 2001 or 2002. Mean percent cover of grasses and total vegetation were significantly different between grass seeding rates inside the exclosure in 2001, but were not significant between grass seeding rates in 2002.

Diversity indices were not significantly different among grass seeding rates inside or outside the exclosure, but were significantly different between years, 2001 and 2002. Greater big sagebrush leader growth occurred inside the exclosure compared to outside of the exclosure in both years. Big sagebrush leaders inside the exclosure have continued to grow, while leaders on plants outside the exclosure have continued to decrease. Winter and summer utilization impacted this significant difference in mean leader lengths between exclosure treatments.

PUBLICATIONS

Booth, D.T. 2002. Seed longevity and seeding strategies affect sagebrush revegetation. J. Range Manage. 55:188-193.

Booth, D.T. and T.A. Jones. 2001. Plants for ecological restoration: a foundation and a philosophy for the future. Native Plants Journal 2:12-20.

Booth, D.T. and S. Sowa. 2001. Respiration in dormant and non-dormant bitterbrush seeds. J.Arid Environments 48:35-39.

Booth, D.T. and Y. Bai. 2001. Seeds and seedling establishment of Wyoming big sagebrush. p.24-31 *In:* Proceedings symposium, Sagebrush establishment on mined lands, 2000 Billings Land Reclamation Symposium. Published by the Office of Surface Mining, Denver, CO.

Bowen, C.K., R.A. Olson, G.E. Schuman, and L.J. Ingram.2002. Long-term plant community responses to topsoil replacement depth on reclaimed mined land. In: Proc. 19th Annual Meeting American Society of Mining and Reclamation, June 9-13, 2002, Lexington, KY.

Ingram, L.J., G.E. Schuman, P.D. Stahl. 2002. Can we use Short-term Microbial respiration as an Indicator of Soil Quality in Reclaimed Coal Mine Soils of NE Wyoming? Proc. ASA-CSA-SSSA Ann. Meet., Nov. 10-14, 2002, Indianapolis, IN. ASA-CSA-SSSA, Madison, WI.

Ingram, L.J., G.E. Schuman, P.D. Stahl. 2003. Use of three day microbial respiration as an indicator of soil quality in reclaimed coal mine soils of northeastern Wyoming. Proc. VII Int. Rangeland Cong. 26 July-1 Aug. 2003, Durban, South Africa.

Schuman, G.E., L.E. Vicklund, and S.E. Belden. 2001. Establishing Wyoming big sagebrush on mined lands.pp. In: Proc., 18th National Meeting, Am. Soc. of Surface Mining and Reclamation. June 3-7, 2001. Albuquerque, NM. Am. Soc. Surface Mining and Reclamation, Lexington, KY.

Schuman, G.E. and E.F. Redente. 2002. Rehabilitation of Mined Surfaces. pp.147-156. In: A.C. Grice and K.C. Hodgkinson (eds).Global Rangelands: Progress and Prospects. Int'l Rangeland Congress, July 19-24, 1999. Townsville, QLD, Australia. CABI Publishing, A Divivion of CAB International, Oxon, UK

Schuman, G.E. and S.E. Belden.2002. Long-term survival of direct seeded Wyoming big sagebrush seedlings on a reclaimed mine site. Arid Land Research and Management. 16:309-317.

Schuman, G.E. 2002. Mined land reclamation in the Northern Great Plains: Have we been successful? In: Proc., 19th Annual Meeting of the American Society of Mining and Reclamation. June 9-13, 2002, Lexington, KY.

Strait, K.A., R.A. Olson, and G.E. Schuman. 2001. Impacts of Wildlife Utilization on Big Sagebrush Survival on Reclaimed Mined Lands. Proceedings of the Thirteenth Project Review Seminar, Casper, Wyoming, 5 Decemeber 2001. Abandoned Coal Mine Lands Research Program.

Williams, M.I., G.E. Schuman, A.L. Hild, and L.E. Vicklund. Wyoming big sagebrush density: Effect of seeding rates and competition. Restoration Ecology. 10(2):385-391. 2002.