WERA 40 Meeting
4 October 2013
Las Vegas, Nevada

Meeting minutes.

Attendance:

Barry Perryman UNR (Chair), Mike Smith UWy, Mike Borman OSU, Doug Ramsey USU, Jeff Fehmi UA, Bret Hess UWy (monitor)

General business:

On 3 October 2013, we had a day-long tour of the Nevada Test Site with the land manager. This tour was outstanding in all respects and led to many good discussions about land condition, reclamation activities, what constitutes land in good condition, and site potential

Jeff was elected Chair-elect and got stuck doing the minutes immediately after the election, and will become Chair after the meeting. He will arrange the tour/meeting next year.

Elect a secretary (to become Chair-elect after the meeting): suggest Craig Carr? Barry will contact him given that he was not at the meeting to accept. Mike Borman will be the alternate Chair-elect in case Craig declines the opportunity.

WERA 40 charter document was reviewed. (Perhaps from: http://nimss.umd.edu/homepages/outline.cfm?trackID=14696)

Next year the tentative tour would be of mine reclamation in the morning and range improvement at the Empire/ Las Cienegas BLM in the afternoon. Both are in the vicinity of Tucson AZ. The tour and meeting would be in the first week of October.

Accomplishments this year:

There is a state and transitions link in Rangelands West.

This year's meeting, tour, discussions, and presentation.

Rebuilt membership

Solidified plan for poster session and out reach activities.

Future work:

We will propose a poster session on Ecosystem gains and losses – case study based from several perspectives, especially that of range improvements. Working title: State and transitions examples of ecosystem services. Sacramento SRM meeting 2015. (Jeff will push in April). We will invite producers. We will try to get some resource economics people involved, perhaps reaching out to former Economic WERA.

Have the geo-referenced photos with narratives from the poster session put up with Rangelands partnerships as well (Doug).

FFA or 4H was suggested as a place to talk about S&T as part of the activities (Barry).

Increase membership: occasional participation by USGS and ARS (EPA?) we need to reach out.

Including a wider S&T bibliography as part of the report and onto Rangelands West (Doug).

Current email list: Perryman, Barry <BPerryman@cabnr.unr.edu>; Limb, Ryan <ryan.limb@ndsu.edu>; Abbott, Laurie <labbott@ad.nmsu.edu>; Marlow, CB <cmarlow@montana.edu>; Patricia.Johnson@sdstate.edu; Launchbaugh, Karen <klaunchb@uidaho.edu>; R. Douglas Ramsey <doug.ramsey@usu.edu>; Maria Fernandez-Gimenez <gimenez@warnercnr.colostate.edu>; Borman, Michael <michael.borman@oregonstate.edu>; Hess, Bret <brethess@uwyo.edu>; Smith, Mike <pearl@uwyo.edu>; jmharper@ucanr.edu; Fehmi, Jeffrey S - (jfehmi) <jfehmi@email.arizona.edu>; labbott@nmsu.edu; DeKeyser, Edward <Edward.Dekeyser@ndsu.edu>; lhardest@wsu.edu; Schultz, Brad <schultzb@unce.unr.edu>; dwbailey@nmsu.edu; Vermeire, Lance <Lance.Vermeire@ars.usda.gov>

Submitted reports from members:

Nevada Agricultural Experiment Station
University of Nevada, Reno

General Update 2012

CABNR and NAES fared better during 2012 than the previous few years. The AG Experiment Station saw modest budge increases and we were fortunate to get our line item back in the state budget. CABNR consists of 3 departments: Agriculture, Nutrition, and Veterinary Sciences; Biochemistry; and Natural Resources and Environmental Science. Two former Resource Econonomics faculty were moved to the Economics department. Cooperative Extension has emerged from a 72% budget cut, but they also saw their line item put back in the state budget. There are no longer any State Extension Specialists in Nevada. The forced shift from A to B contracts has been completed although legal action has been taken by many faculty. Things have stabilized and we are initiating faculty searches to fill program needs. Positions have been filled in biochemistry (1), soils (2), human nutrition (1), animal nutrition (1), and sustainable food systems (1). Additional positions may be forthcoming due to agreements made between the Dean's Advisory Council and the University President over experiment station property that was sold for use on other University building projects.

The interdepartmental rangeland ecology program now has 12 students and is growing. We have updated our range curriculum to meet OPM 454, CPRM, and SRM accreditation requirements. Drs. Barry Perryman and Sherm Swanson have been named co-directors of the new Rangeland Ecology and Management Program. The Range Club is still very active and membership is up substantially.

Status of the Main Station Farm has stabilized. The locally grown food stakeholders stood up for CABNR and stopped the plan to sell the property, although a new city council did approve a new zoning designation to allow the sale in the future. The eastside connector road project is slowly moving along, meaning that a portion of the property will eventually be taken out of production. The Corps of Engineers flood project on the north end of the property is now on hold due to federal budget considerations.

Research Update:

Biomaterial and Biofuel uses for Chrysothamnus nauseosus (rabbitbrush) – NEV00344

Investigator Name(s) Last Name and Intitials)

1. Shintani, D. 2. Perryman, B. 3. McMahan, C. 4. Coronella, C. 5. Sheldon, J.

Goals/Objectives/Expected Outputs

Project Objectives The long term goal of this research is to develop a novel high value crop for Nevada agriculture. The immediate goal of this proposal is to evaluate rabbitbrush's potential as a commercially viable biomaterial and bioenergy crop for Nevada and the Great Basin region. The rationale for choosing

rabbit brush for this research is as follows: 1) Rabbitbrush is native to the Great Basin and has evolved to thrive in Nevada's high desert environment. 2) Rabbitbrush produces significant quantities of rubber for the manufacture of tires. 3) Rabbitbrush produces large amounts of oleoresins which can be used for biodiesel applications. 4) Rabbitbrush is a highly productive woody perennial which has great potential as a renewable cellulosic feedstock for bioenergy applications. 5) Because it grows on marginal soils under dry conditions, it will not compete with current Nevada crops for resources including arable land and water. The specific objectives of this research are to 1) Evaluate the material and immunogenic properties rabbitbrush rubber. 2) Evaluate the energy content of rabbitbrush oleoresins and materials derived from whole plants and post-extraction bagasse (i.e. the fibrous material remaining after the extraction process). 3) Evaluate the feedstock potential of materials derived from whole plants and post-extraction bagasse for pyrolysis based conversion to syngas for energy production. 4) Evaluate the time required for harvested stands of rabbitbrush to regenerate rubber, oleoresin and biomass stores to preharvest levels. Research Question The goal of this research is to investigate the development of rabbitbrush into a multi-use biomaterial/bioenergy crop for Nevada. The primary research questions to be addressed through this research are: 1) Are the rubber, oleoresins and biomass materials produced in rabbitbrush of high enough quality to justify the commercial development of this plant species? 2) Can rabbitbrush be used as a feedstock for biomass thermochemical conversion applications? 3) How much time is required before significant quantities of rubber, oleoresin and cellulosic material be obtained from previously harvested stands of rabbitbrush?

Outputs:

Research: 1) In order to obtain enough material for material, biofuel and biomass analyses, we developed a plant for the pilot scale extraction of natural rubber and oleoresins from rabbitbrush. 2) We and Colleen McMahan (USDA ARS) ran a series of material properties test on rabbitbrush rubber samples obtained the large scale rubber extraction procedure described in the previous CRIS Report. a) APA 2000 Analysis: The APA 2000 analyses measures dynamic mechanical properties of polymers as a function of temperature, frequency, and strain. Our results showed that rabbitbrush rubber generated very little torque, hence very low viscosity, due to the presence of a material that melts below 100C. Upon removal of the test specimen from the dies, the material oozed out. The material has a waxy consistency, and is probably a natural product that is co-extracted with the solvent. b) Gel Content Determination: According to current theory, the outstanding physical properties of natural rubber are due to strain-induced crystallization on deformation, which is caused by formation of a "gel" network by polymer-protein and polymer-lipid linkages. The extent of formation of this network is measured by determination of % gel. The % gel is an important determinant of polymer green strength and is thus related to the utility of specific polymers in high performance applications. Hevea rubber, the industry standard has a typical % gel value of 50 to 60%. Our analysis showed that rabbitbrush rubber contained between 25 and 50% gel. c) Gel Permeation Analyses: Gel permeation analysis is used to determine the molecular weight of the rubber polymer. High performance rubbers typically have molecular weights ranging from 500,000 to 1,000,000 daltons. The rabbitbrush rubber obtained through our large scale extraction procedure yield rubber with molecular weights averaging 650,000 daltons. This differs slightly from previous analysis of small scale rabbitbrush rubber extractions where average molecular weights of

approximately 800,000 daltons were observed. It is possible that the large scale extraction procedure resulted in some polymer degradation due to harsher conditions. We have changed our large scale protocol to include an antioxidant compound in our solvent to decrease oxidative damage that can result in short rubber strands. 3) Energy Content of Rabbitbrush Biomass: We have been collaborating with Dr. Curtis Robbins from the Desert Research Institute to determine the energy content of rabbitbrush biomass prior to and after solvent extraction. For these studies, calormeteric studies were conducted on ground biomass from whole plants and solvent extracted material. The results showed that there was little difference in energy content between the pre- and post-extracted material (pre-extracted = 21.32 MJ/Kg; post-extracted 20.80 MJ/Kg). These values are similar to the energy content of commercial biomass source including Jeffery Pine (20.32 MJ/Kg) and Loblolly Pine (20.28 MJ/Kg). Events: CABNR Valley Road Field Day, Biochemistry Graduate Seminar Series, Bioenergy Journal Club, CABNR Newsletter and Website

Outcomes/Impacts:

1) We have established a pilot solvent extraction plant for rabbitbrush oleoresin/rubber production. This plant can also be used by other investigators for the extraction of valuable phytochemicals from other plant species. 2) Preliminary material analyses of rabbitbrush rubber suggest that it has potential as a source of natural rubber for industrial applications. We did however find out that additional work needs to be done to produce higher quality rubber that is devoid of contaminating non-rubber components and is less prone to polymer degradation. This will be a major focus in future work. 3) Our studies have shown that rabbitbrush biomass has energy contents that are comparable to commercial biomass sources. Furthermore we were able to show that once oleoresins and rubber are extracted, the remaining lignocellulosic baggasse maintains the majority of the energy present in the pre-extracted material. As such, the post-extacted material could be used a valuable source of biomass for energy production.

Biomass and biofuel production from plants suited for Nevada's arid environment – NEV003HK

Investigator Name(s) Last Name and Intitials)

1. Shintani, D. 2. Miller, G.

Goals/Objectives/Expected Outputs

Long-term project goals: The long-term goals of the proposed research are to establish the resinous arid land plant species Grindelia squarrosa (gumweed) and Euphorbia lathryis (gopherweed) as bioenergy crops for Nevada. Supporting objectives: Objective 1. Develop agronomic parameters for optimal field cultivation. Task 1. Determine minimum moisture requirements for each species Task 2. Determine minimum nitrogen, phosphorous, potassium fertilizer requirements Task 3. Determine how biomass yields are affected by water quality Task 4. Evaluate whether treatments with gibberellins and auxin can enhance the biomass production of gumweed and gopherweed. Objective 2. Characterize oleoresin fractions from each species. Task 1. Determine the developmental stage for highest oleoresin

production Task 2. Develop protocols for pilot scale extraction of oleoresins Task 3. Identify principle chemical components of oleoresin extracts Objective 3. Evaluate energy content of whole plant, oleoresin extracts, and post-extraction lignocellosic bagasse. Task 1: Perform calorimetric analyses of whole plant, oleoresin and bagasse fractions Task 2: Examine the potential of whole plant and bagasse fractions for syngas production using Biomax 15 gassifer. Task 3: Develop protocols to prepare pelletized whole plant and bagasse samples for syngas conversion.

Outputs:

The objective of this research is to evaluate arid land plant species for their utility as energy crops for Nevada and the Great Basin Region. We are in the process of developing the agronomic and processing infrastructure required to evaluate potential arid land energy crop species on a scale large enough to evaluate their commercial potential. Research: 1) We have developed a pilot plant to extract biofuel and biomaterial compounds from desert plant species. 2) Large scale garden plots were established for the controlled cultivation of potential energy crops appropriate for Nevada's arid environments. These include Euphorbia lathyris (gopherweed), Grindelia squarrosa (gumweed), Chrysothamnus nauseousus (rabbitbrush) and agave. 3) Minimal water requirements were determined for gumweed and agave. 4) Energy content determinations were performed on gumweed and rabbitbrush to determine its value as a biomass source. 5) Energy densification studies using torrefaction approaches were conducted using lignocellulosic material isolated from rabbitbrush and gumweed. 6) The chemical content and composition was determined for gumweed. 7) Established protocols to pelletize rabbitbrush and gumweed biomass. Events: CABNR Field Day; Bioenergy Journal Club; NVREC Conference Products: Establishment of pilot plant chemical extraction plant

Outcomes/Impacts:

This research will enhance Nevada's ability to compete in the area of renewable energy research by developing the expertise and infrastructure required for the pilot scale evaluation of existing and future bioenergy feedstocks. While Nevada System of Higher Education faculty are currently capable of laboratory scale processing and analyses of plant feedstocks, our ability to scale up our research is limited. As such our ability to attract funding from commercial sources is severely hampered. The primary hurdle is the lack of processing equipment capable of handling large quantities of biomass. Therefore for the proposed research we are requesting funds to purchase a pilot scale hammer mill with a 200 lb per hour capacity and a large scale solvent extractor with a 50 lb capacity.

Hydrologic and Vegetative Response to Pinyon Juniper Treatment at the Watershed Scale – NEV00742

Investigator Name(s) Last Name and Intitials)

1. Stringham, T. 2. Freese, E. 3. Weltz, M. 4. Synder, K.

Goals/Objectives/Expected Outputs

The long-term goal of this watershed scale project is to build a comprehensive understanding of the mutiple impacts of pinyon-juniper encroachment on Great Basin rangelands. Specifically, the overall project will develop predictive models of pinyon-juniper water use at the watershed scale, improve existing hillslope and watershed scale erosion models, quantify groundwater recharge from watershed scale PJ treatments and develop management prescriptions for PJ treatments aimed at improving rangeland health for multiple users. Objectives 1. Determine the amount of precipitation intercepted by trees of various sizes under four rainfall intensities. 2. Determine the amount of precipitation partitioned to stemflow by trees and whether or not stemflow benefits the tree at the expense of the understory vegetation. 3. Determine the effects of tree removal on soil moisture, evaporation, infiltration and surface runoff. 4. Determine the effects of tree presence or removal on vegetation diversity, biomass and cover. Outputs Multiple (8 plus) journal articles and agricultural experiment station bulletins will be produced from this research. Three master level graduate thesis will be written and at least one journal publication from each thesis will be published. Additionally, agricultural experiment bulletins intended for land managers will be produced discussing the issues of water yield, soil erosion, plant production and treatment options. EDUCATION 1. Awareness of PJ impact on watershed hydrology leading to informed management decisions at the watershed scale on the projected response to PJ treatment. 2. Learning opportunities for graduate students (3) and undergraduate students (3) in research methods and data analysis. 3. Learning opportunities for public land management agencies and land managers through educational tours and workshops. 4. Information gained through this research will enhance learning materials in courses such as Rangeland Restoration and Ecohydrology. COMMUNITY 1. Increased understanding of rangeland health and the impact of PJ encroachment on ecosystem services: wildlife habitat, forage production, diversity, water yield and agriculture. 2. Increased knowledge of where and how to treat PJ stands to improve rangeland health and the desired ecosystem services. 3. Increased knowledge of the cost of treating PJ encroached rangelands. All sectors of Nevada's public, from urban to rural, stand to be impacted by the knowledge gained from this long-term, watershed scale project. Water is a scarce resource in the West and particularly in the Great Basin with demand increasing and supply declining. Many believe removal of PJ woodlands will lead to increased groundwater recharge and thus water for human use. The data gained from this project will provide scientific knowledge on the question of groundwater recharge from PJ treatment along with data on other ecosystem services impacted by pinyon-juniper encroachment. Additionally, predictive watershed scale models of potential water use and soil erosion will improve management decisions on PJ treatment options.

Outputs:

The long-term goal of this watershed scale project is to build a comprehensive understanding of the multiple impacts of pinyon-juniper encroachment on Great Basin rangelands. Outcomes for 2011 include finalization of the data collection to determine the amount of precipitation intercepted by pinyon-juniper trees of various sizes including how these trees partition rainfall into stemflow, throughfall and interception. Additionally, data collection on the effect of pinyon-juniper treatment (completed in 2009) on soil erosion utilizing small plot rainfall simulation techniques was completed. Furthermore the first year of data collection on sap flux and pre-dawn measurements were completed

to determine what water source the trees are utilizing. Two field tours were completed in 2011 with particpants from the Bureau of Land Management, U.S. Forest Service, USDA Natural Resource Conservation Service, Nevada Dept. of Wildlife, U.S. Fish and Wildlife, USGS, Nevada Wilderness Society, private landowners, Congressional staff, UNR faculty and private industry. In total over 70 individuals experienced the research efforts currently underway at the Porter Canyon Experimental Watershed. Additionally, one invited presentation was given at the Great Basin Consortium first annual conference and three graduate students will present results at the Society for Range Management meetings in 2012. The rainfall interception results were presented to over 100 producers in Nevada during the January 2012 Cattlemen's Update tour. Data analysis is underway with the projected completion of two master level thesis in 2012 and two journal articles submitted by the end of 2012.

Outcomes/Impacts:

No outcomes or inpacts to report at this time.

Motivation for Private Landowner Investment to Reduce Risk and Costs of Rangeland Fires in Nevada – NEV05160A

Investigator Name(s) Last Name and Intitials)

1. Rollins, K. 2. Evans, M.

Goals/Objectives/Expected Outputs

The objectives are to better understand property-owner risk preferences and attitude towards rangeland wildfire threat, to determine to what extent Nevadans are aware of the recommended fire-safe actions that they can implement on their property to reduce the risk of losses due to rangeland wildfire, to examine the degree to which property owners have already engaged in fire-safe actions, to better understand factors that affect decisions with respect to implementing fire-safe actions, assess impacts of community characteristics (ecological, social and economic) on individuals' fire-safe actions, to examine the benefits, in general, in the agricultural and ranching communities from reduction of wildfire risk as a consequence of private actions. This information will facilitate policy-makers with the US forest Service and the BLM in the process of predicting the level of private investment in fire-safe actions which ultimately can reduce overall wildfire suppression costs on public lands.

Outputs:

During spring and summer 2011 all of the field assessments for wildfire risk were completed for a sample of residential areas located in the Wildland/Urban Interface (WUI) for communities across Nevada. Assessments included vegetation condition on private and public lands, and defensible space on private residential lots. Also included in the data set are the latitute and longitudes for each house (points taken from the road at the point were the driveway or access to private land starts). Communities sampled were chosen to represent a range of ecosystem and vegetation condition types,

and community characteristics. Photographs of vegetation type and typcial streetscape and residential defensible space conditions were taken with GPS points. A total of just over 9,300 houses were assessed for deenisble space. From summer through fall of 2011, the data were cleaned, digital way points for each dwelling were moved to correspond with dwellings, using GIS maps. Tax assessor data were obtained for all counties where data were sampled. From this data, we added to our data set: owener's name and address, ownership status, lot size, assessed values, age of dwelling, and other data were obtained. Initial models were developed to evaluate criteria for determining for each observation whether the property fell into one of four categories: High-high, high level of Defensible space (DS)amidst neighbors that also exhibit high DS; high-low, high level of DS amidst neighbors that exhibit low levels of DS; low-low, low DS amidst neighbors that are also low in DS; and low-high, low ds amidst neighbors who exhibit high levels of DS. We theorize that there are multiple incentives at work that influence the choice of defensible space to create and maintain. These hypthoses are: cost of DS (both direct and indirect costs) is a private disincentive, benefits of decreased probability and cost of loss in the case of wildfire is a private incentive. The observation that others have done a lot around a given homeowner is both a strategic incentive through role-modeling and social network effects, and a strategic disincentive due to the ability to free-ride on the actions of others. The observation that others have done very little DF is a strategic incentive through the additional risk posed by neighbors to one's own property, and a strategic disincnetive through a perceived decreased sense of social pressure, and the percieved lower risk through observation of others. We plan to test these by use of spatially explicit regression analysis and by augmenting this data with data from a survey of households in the sample.

Outcomes/Impacts:

New knowledge: The four patterns described in the outputs section (High-high; high-low; low-low; low-high) are clearly observable in our preliminary analysis, and these patterns are statitically signficant. This allows us to conclude that there may be strategic interactions that innfluence homeowner's decisions to create and maintain defensible space. The next phase of the research will use the data to determine the sources of the strategic interactions as described above. The expected impacts from our findings will include recommendations to streamline and target efforts by public agencies to more effectively influence landowner decisions. For example, approaches can be tailored to communities according to the comobintations of incentives and disincentives typcial for that area.

Wild horse and burro marketing study – NEV051CR

Investigator Name(s) Last Name and Intitials)

1. Harris, T. 2. Englin, J. 3. Price, M.

Goals/Objectives/Expected Outputs

Specific objectives are: a)To estimate the value individuals place or the different characteristics of wild horses and burros offered at BLM auctions, and b)To analyze alternative auction procedures that will enhance wild horse and burro adoptions and increase auction revenues.

Outputs:

A Ph.D. dissertation was completed and accepted that investigated the potential opportunities for alternative systems of adoption for wildhorses and burros.

Outcomes/Impacts:

Results of the dissertation are currently being developed into a public document

Economics of annual grass invasion – NEV051DD

Investigator Name(s) Last Name and Intitials)

1. Rollins, K.

Goals/Objectives/Expected Outputs

To conduct an economic analysis of efforts to reduce the risk of invasive annual grasses on selected Great Basin watersheds.

Outputs:

An economic flow model that outlines in a 'how-to' apporach the steps for assessing benefits and costs of invasive weed management on western rangelands was produced. This model consists of a series of documents written to use as a web-based interactive tool that is intended for use by ARS, BLM and other agencies to evaluate costs and benefits of potential programs. The model has been submitted to the ARS's EBIPM program, where it will be set up on the program website.

Outcomes/Impacts:

The draft version of the economic flow model described in the 'Outputs' section above was used by ARS researchers as supportive material in writing a grant proposal to NIFA to fund a project that aims to improve rangeland ecological condition (The project is described briefly at: http://www.ars.usda.gov/research/projects/projects.htm?ACCN_NO=422684 and at http://www.ars.usda.gov/is/pr/2012/120120.htm). An evaluation of the economic benefits of ARS's rangeland research on the control of invasive weeds was produced for and used by the ARS in a larger co-authored document edited by Mark Weltz and submitted to Congress to support ARS programs in the Western Great Basin. A summary of the economic models developed to measure benefits of ecological-based invasive weed management, along with results, was presented to a meeting of USDA ARS directors and stakeholders in February for use in evaluating ARS programming.

Enhancing Ecosystem Services From Agricultural Lands: Management, Quantification, And Developing Decision Support Tools – NEV051DZ

Investigator Name(s) Last Name and Intitials)

1. rollins, K.S. 2. Kobayashi, M. 3. Taylor, M. 4. Stringham, T.

Goals/Objectives/Expected Outputs

Expected Results, Benefits, Outputs, and Outcomes Results/Outputs 1. Documentation of the common ecological framework - the state-and-transition framework - used in all of the economic studies. The document will also explain its main advantages over alternative frameworks: (1) It is consistent with the current ecological models used to represent ecological change; (2) It describes ecological conditions in a manner that corresponds with current data collection protocols by federal agencies in the western U.S. (e.g., USDA NRCS); and (3) It fits the data needs and assumption of different types of economic studies, including stochastic dynamic programming, contingent valuation, and regression analysis of wildfire suppression costs. 2. Dissemination of research results through the ARS Area-wide project outreach efforts and the project's websites EBIPM.org. The dissemination will deliver the results of our research to: (1) rangeland scientists and other rangeland professionals that would be interested in the results of our research, but who would not necessarily be inclined to read articles in academic economics journals; (2) Rangeland professionals in the BLM, NRCS, etc., who will attend workshops put-on by the Area-wide project; and (3) Local weed management groups and ranchers who are, ultimately, the intended audience of the Area-wide project's outreach effort. 3. A suite of decision support tools designed to help land managers efficiently direct scarce resources for invasive weed treatments over space on the lands under their supervision. 4. At least 3 academic journal articles will be generated from this proposed research: (1) documentation 1 above; (2) application of the common ecological framework to address the welfare consequences of ecological change caused by invasive weeds on Great Basin watershed; and (3) development and application of our scoring methodology that assigns a score to a spatial pattern of vegetation on a landscape and evaluate policy questions related to the optimal spatial placement of invasive weed treatments on a landscape. Benefits/Outcomes 1. Empirically-sound estimates of the cost of invasion generated in this proposed study will facilitate formulating efficient public policy for invasive annuals, which requires that the expected benefits of any policy (in terms of costs avoided) be weighed against the expected costs. 2. The decision support tools developed in this study will assist managers in developing strategies that more effectively contain the spread of invasive weeds and mitigate their damages in terms of wildlife habitat loss, increased wildfire activity, increased soil erosion, and reduced grazing productivity. 3. By assisting land managers in this way, our research outputs will improve the long-run ecological health of the Great Basin and support the continued economic viability of ranching and of the agricultural communities in the Great Basin that ranching supports.

Outputs:

Developed the framework for determining scope and scale of ecosystem services to be valued for Great Basin Rangelands, for use in ex post non market valuation. Wrote an article to be published in the Western Economics Forum, that describes this framework.

Outcomes/Impacts:

Contributed to a report submitted by the Agricultural Research Service to congress that describes the need for rangeland treatment. Our part of the report provides monetary estimates of the benefits of treatments in terms of the wildfire suppression costs averted from resilient rangeland ecosystems. The impact of the contribution is that as a monetary estimate of the benefits of healthy/resilient rangeland ecosystems. These add additional context to the descriptions of the biophysical benefits contributed by other researchers, and therefore will help decision makers in Congress evaluate the benefits of these treatment projects using measurement units (dollars) that are common to other uses of these federal resources.

Sustainability of Mowing Fuel Breaks: Resilience of Sagebrush Rangelands – NEV05272

Investigator Name(s) Last Name and Intitials)

1. Swanson, S. 2. McAdoo, K. 3. McCuin, G. 4. Schultz, B. 5. Swanson, J. 6. Leger, E. 7. Stringham, T.

Goals/Objectives/Expected Outputs

Objectives This proposal is an addition to the larger "Synergistic Monitoring for Adaptive Vegetation Management in the Sagebrush Ecosystem of the Great Basin" (SymMon) project, which involves the harvesting and analysis of past wildfire and land treatment implementation, location, and monitoring data from numerous agencies, academia, and other organizations. Using SynMon data, we will focus on specific ecological sites that are most vulnerable to loss of resiliency and change in flammability due to invasion by cheatgrass and other annuals. We will study the operational characteristics of lands subjected to ongoing multiple use management that cause them to increase resilience when treated by mowing to create fuels breaks. Or conversely, to express loss of resilience as they further transition across an irreversible threshold to cheatgrass and other invasive plants. The objectives of this study are to: 1) Compare the response of vegetation to wildfire and to mowing of sagebrush to create fuel breaks by measuring the change in cover of bare soil, litter, rock, cryptogam, basal area, % live and dead or decadent shrubs, native graminoids, introduced grasses, native forbs and exotic forbs, each by species. 2) Determine the pre-treatment conditions that predict post-treatment response. 3) Determine how these effects vary across ecological sites within the Wyoming big sagebrush zone. 4) Determine how treatment effects differ through time. 5) Search for response patterns related to ancillary factors including season, duration, or intensity of livestock use; agency horse management; other human disturbances such as off highway vehicles; weed infestations; topography or elevation; and timing of the treatment.

Outputs:

NW Nevada/NE California Field Studies (Humboldt, Pershing, Washoe, Modoc Counties). (Lead Investigator: John Swanson). Planned, coordinated and implemented field studies on 45 different wildfire and land treatment event sites. Consolidated data and shared with all collaborators. Completed

the following for the data collected on the 45 NW Nevada/NE California wildfire and land treatment event sites: All data organized and entered onto digital spreadsheet. Compiled data shared with collaborators. Data arcsine-transformed for normalization purposes. Initial regression and correlation runs completed; statistically significant parameter pairs identified. Also worked with one mathematics professor and three mathematics graduate students during the preliminary analysis of the 2010 NE Nevada field data.

Outcomes/Impacts:

Swanson, J., S. Swanson, K. McAdoo, B. Schultz, G. McCuin. 2011. 2010 Field Studies - NE Nevada Wyoming Big Sagebrush Event Sites. Oral presentation delivered at Science Delivery Project/Nevada Partners in Conservation Workshop: Vegetation Resilience. Winnemucca, NV. Swanson, J., S. Swanson, K. McAdoo, B. Schultz, G. McCuin. 2011. State and Transition Model Applications: Wildfire and Preventative Land Treatments. Oral presentation at annual meeting of the Nevada Section of SRM. Winnemucca, NV. In December, 2011, Northeastern Nevada Stewardship Group representatives invited me to give an oral presentation at their February 2012 meeting in Elko. Swanson, J., S. Swanson, K. McAdoo, B. Schultz, G. McCuin. 2011. 2011 Sharebook. Data base for all SynMon field data collected to date. Has been shared with all project collaborators. Swanson, J. 2011. Some SynMon Project Results. Impromptu oral presentation to NRCS, UNR participants, State and Transition Modelling Workshop. Reno, NV.

Effects of Shrubsteppe Vegetation Structure on Reproductive Success of Sage Grouse – NEV052QUA

Investigator Name(s) Last Name and Intitials)

1. Sedinger, J.

Goals/Objectives/Expected Outputs

The principal objective of this project is to understand how vegetation structure influences reproductive success of sage grouse breeding in central nevada. Shrub structure and cover combined with that of understory vegetation is hypothesized to influence nest success of sage grouse. This hypothesis has been assessed in relatively few locations, which are generally more mesic than is the case for central Nevada. Thus, the general hypothesis requires additinal assessment as does it's applicability to sage grouse in central Nevada

Outputs:

We used mark-recapture, lek observations, nest & brood monitoring, vegetation sampling, and radio telemetry to estimate key demographic parameters. A total of 1165 unique individual sage grouse have been banded during the first eight years of the study. From 2003-2007, counts of common ravens along the transmission line corridor and raven-associated disturbances at leks increased dramatically, however, in 2008 raven counts declined to levels observed immediately following line construction, and increased

but remained low in 2009 and 2010. A Program MARK known fate analysis showed that population, month, season of capture, and breeding success influenced female survival. Monthly survival was lowest during the months of September (0.92 +/- 0.02 SE) and April (0.91 +/- 0.02 SE). Survival was higher for birds associated with the Roberts Creek Mt. population than for the Cortez population, and hens that successfully fledged broods were predicted to experience lower survival than hens that did not. Females that were captured during the spring breeding season had higher annual survival than those captured during the fall trap (.591 +/- .025 SE and .541 +/- .041 SE). We conducted additional known-fate analyses to evaluate temporal, spatial and habitat impacts on fall survival. We found substantial temporal and spatial variation in fall survival both within and among years that was best characterized by trends in weekly survival. These results showed that survival tended to increase, decrease, or remain stable within populations and years, irrespective of conditions in the adjacent population or during previous years. Additionally, we evaluated data from a subset of females that were followed more closely on the ground. Habitat conditions at female locations that most influenced survival, as well as temporal patterns in predator communities responsible for female mortality, suggest that top-down forces may regulate survival of females during the fall. Nests were monitored to estimate success, with nest site vegetation characteristics measured after hatch and evaluated as covariates in a nest success analysis in Program MARK. Model results showed a population-level effect on nest success; hens from the Roberts Creek Mt. population had higher nest success than hens from the Cortez population (0.214 +/- 0.045 SE and 0.178 +/- 0.032 SE, respectively). Additionally, we found interactive effects between wildfire impacts and road density, such that nest success was lowest in areas impacted by roads, and highest in non-burned roadless areas. We used Pradel models in Program MARK to directly estimate population growth, as well as survival and seniority from male capture/recapture/resight data. Male survival varied by year, and ranged from a low of 0.568 (+/-0.06 SE) in 2006 to a high of 0.801 (+/- 0.06 SE) in 2004. A robust-design analysis of our male capture-recapture data has shown that variation in breeding propensity may be largely responsible for annual variation in lek counts. Our results continue to support demographic differences between the Roberts Creek and Cortez populations, and suggest that sage grouse in the Cortez Range are at higher risk.

Outcomes/Impacts:

This project will provide the first rigorous assessment of the effects of transmission lines on sage-grouse.

Dynamics of Sage Grouse populations in response to transmission lines in central Nevada – NEV052SM

Investigator Name(s) Last Name and Intitials)

1. Sedinger, J.

Goals/Objectives/Expected Outputs

Our goal is to continue a 10-year study of the sage grouse population in Eureka County to assess the effects of the Falcon to Gondor transmission line on the local sage-grouse population. Hall and Haney (1997) proposed three possible impacts of transmission lines on sage grouse. One impact could be a

decrease in adult survival due to predation on adults. A second impact could be a reduction in nest success due to nest predation. The third impact could be increased dispersal by sage grouse due to the perceived threat of increased predation. The study will involve monitoring of the population during the lekking, nesting and brood rearing periods. Before and during the lekking and nesting seasons birds will be captured. Leks will be monitored to estimate numbers of males using each lek and dynamics of lek size over time. We will encounter marked grouse on leks to assess movement among leks and estimate survival rates. We will also use lek counts and observations of marked individuals on leks to estimate numbers of individuals on leks and lek dynamics. A sample of females captured during this period will also be fitted with radio transmitters to assist in finding nests and monitoring movement during lekking and brood rearing and to assist in finding nests and broods. During brood rearing, females and juveniles will be located using transmitters.

Outputs:

The long-term goal of this ten-year study is to assess the impact of NV Energy's Falcon-Gondor transmission line on sage grouse demography and population dynamics. A total of 1165 unique individual sage grouse have been banded during the first eight years of the study. From 2003-2007, counts of common ravens along the transmission line corridor and raven-associated disturbances at leks increased dramatically, however, in 2008 raven counts declined to levels observed immediately following line construction, and increased but remained low in 2009 and 2010. A Program MARK known fate analysis showed that population, month, season of capture, and breeding success influenced female survival. Monthly survival was lowest during the months of September (0.92 +/- 0.02 SE) and April (0.91 +/- 0.02 SE). Survival was higher for birds associated with the Roberts Creek Mt. population than for the Cortez population, and hens that successfully fledged broods were predicted to experience lower survival than hens that did not. Females that were captured during the spring breeding season had higher annual survival than those captured during the fall trap (.591 +/- .025 SE and .541 +/- .041 SE). We found substantial temporal and spatial variation in fall survival both within and among years that was best characterized by trends in weekly survival. Survival tended to increase, decrease, or remain stable within populations and years, irrespective of conditions in the adjacent population or during previous years. Additionally, we evaluated data from a subset of females that were followed more closely on the ground. Habitat conditions at female locations that most influenced survival, as well as temporal patterns in predator communities responsible for female mortality, suggest that top-down forces may regulate survival of females during the fall. Nests were monitored to estimate success, with nest site vegetation characteristics measured after hatch and evaluated as covariates in a nest success analysis in Program MARK. Model results showed a population-level effect on nest success; hens from the Roberts Creek Mt. population had higher nest success than hens from the Cortez population (0.214 +/- 0.045 SE and 0.178 +/- 0.032 SE, respectively). Additionally, we found interactive effects between wildfire impacts and road density, such that nest success was lowest in areas impacted by roads, and highest in non-burned roadless areas. We used Pradel models in Program MARK to directly estimate population growth, as well as survival and seniority from male capture/recapture/resight data. Male survival varied by year, and ranged from a low of 0.568 (+/- 0.06 SE) in 2006 to a high of 0.801 (+/- 0.06 SE) in 2004. A robust-design analysis of our male capture-recapture data has shown that variation in

breeding propensity may be largely responsible for annual variation in lek counts. Overall our results continue to support demographic differences between the Roberts Creek and Cortez populations, and suggest that sage grouse in the Cortez Range are at higher risk.

Outcomes/Impacts:

Results from this study will be the first rigorous long-term assessment of the impacts of transmission lines on sage-grouse.

Assessing hydrologic response of plant communities in the Great Basin – NEV052TS

Investigator Name(s) Last Name and Intitials)

1. Saito, L.

Goals/Objectives/Expected Outputs

We hypothesize that alternative stable vegetative states (i.e., cheatgrass dominated sites) will have different hydrologic responses in processes such as infiltration rates, peak discharge rates, and sediment loads than historical Wyoming sagebrush plant communities. We further hypothesize that sites that have been revegetated will be intermediate in hydrologic response to the historical and disturbed site conditions.

Outputs:

We hypothesize that alternative stable vegetative states (i.e., cheatgrass dominated sites) will have different hydrologic responses in processes such as infiltration rates, runoff, peak discharge rates, and sediment loads than historical Wyoming sagebrush plant communities. We further hypothesize that sites that have been revegetated will be intermediate in hydrologic response to the historical and disturbed site conditions. Data from instrumented wildlife water developments (wildlife guzzlers) were collected. Runoff collectors were installed at Smith Creek Ranch. Snow sensors were installed at two guzzler sites.

Outcomes/Impacts:

Information regarding runoff and performance of the runoff collectors was collected and will be used in future project work

Persistence and evolution of native plants in cheatgrass invaded systems – NEV052UW

Investigator Name(s) Last Name and Intitials)

1. Leger, E. 2. Goergen, E. 3. Schierenbeck, K.

Goals/Objectives/Expected Outputs

Plant communities around the world are experiencing exotic species introductions and subsequent invasions, and there is no evidence that either of these processes will subside soon. One dramatic example is the transition of the native Great Basin flora into a cheatgrass (Bromus tectorum) dominated community. An estimated 20,000 km2 is currently invaded, and approximately 45% of land in the Great Basin is at moderate to high risk of being converted to cheatgrass. It is unrealistic to expect that land management can control invasion on this scale. Therefore, the long-term diversity and persistence of native communities experiencing such wide-spread invasion depends on the ability of native species to adapt to the presence of invaders. Native species that persist in invaded systems may possess traits that are the product of simultaneous selection from different factors, including fire, grazing, soil, climate and the local flora, including invasive species. While artificial selection can be used to create plant materials that excel at growing under one or a few conditions, it is difficult to mimic the process of natural multivariate selection, which favors genotypes that can respond to a variety of simultaneous challenges, including rare events such as drought or pest outbreaks. The experiments proposed here can identify which traits are most successful in field conditions. Our first research question addresses surviving native individuals in highly invaded systems: do they possess adaptations that have allowed them to survive in a newly altered environment, or are we observing chance demographic or stochastic remnants? This is an important question for invaded systems because non-random survival (the result of natural selection for adapted genotypes) may indicate that native species have the capacity to evolve more competitive genotypes, possibly leading to long-term increase and spread of native plants that are adapted to invaded ecosystems. The first goal of this project is to document whether competitive genotypes of four ecologically and economically important native Great Basin plant species have been favored by natural selection in a cheatgrass-invaded landscape (evidenced by a higher frequency of competitive genotypes in invaded populations). The second goal of this research is to determine what ecological circumstances facilitate the most rapid evolutionary change by natives in an invaded landscape. Prior to embarking on these larger-scale research questions, we must first develop the molecular tools necessary to investigate the types of mating system and rates of gene flow in native Great Basin perennial grasses. No variable microsatellite markers have been identified in these species, and the development of these tools is key for verifying the mating system in these species. Microsatellite markers will be used to estimate current gene flow between invaded and uninvaded sites.

Outputs:

A competition experiment with Poa secunda and Bromus tectorum was implemented and completed during this time. Data analysis is ongoing of both the greenhouse study and the microsatellite study, with student completion of the project expected in 2012.

Outcomes/Impacts:

The graduate student on this project was trained in plant ecology methods, as were three additional

undergraduate students. The graduate student is learning graphical presentation and analysis of data, and is preparing to present results at a professional conference in 2012.

This study will provide the only demographic data from high latitude for Common Goldeneyes.

Adapted Indian ricegrass for the great basin – NEV052WD

Investigator Name(s) Last Name and Intitials)

1. Leger, E.

Goals/Objectives/Expected Outputs

1. Obtain Indian Ricegrass from diverse sites and ecological areas in the Great Basin. 2. Establish common gardens studies at Central Ferry WA and Reno NV of diverse Indian ricegrass representing Great Basin environmental diversity. 3. Measure a comprehensive set of growth and development factors on Indian ricegrass at both common garden sites. 4. Complete genecology studies linking environmental factors at seed source locations with genetic variation across the landscape to establish seed transfer zones. 5. Make source identified plant material available for utilization through the Western Regional Plant Introduction Station seed repository at the WRPIS and the National Plant Germplasm System.

Outputs:

528 Thurber's needlgrass seedlings were transplanted into a common garden at the University of Nevada, Reno in Fall of 2011. Plants are dormant, and data collection will begin in spring 2012. Plants were initially watered and the plot was weeded, but extremely cold and dry conditions have precluded further plant growth this fall/winter.

Outcomes/Impacts:

A UNR undergraduate student is being trained on plant care and data collection though this project.

Sagebrush monitoring – NEV052WP

Investigator Name(s) Last Name and Intitials)

1. Matocq, M. 2. Sedinger, J.

Goals/Objectives/Expected Outputs

In order to monitor sagebrush ecosystem health in Nevada, we seek to establish 40 sites throughout the state where we will conduct long term monitoring of ecosystem health indicators. The current proposal

will a) establish the sites, b) conduct the initial characterization of small mammals at each site, and c) conduct the initial characterization of vegetation structure at each site.

Outputs:

We have sampled the small mammal and vegetation communities at 37 sites for two consecutive years. These sites are located throughout Nevada's sagebrush ecosystem.

Outcomes/Impacts:

We have documented the occurrence of over 16 species of small mammals across the 37 sites sampled. We are currently analyzing these data to identify underlying climatic and vegetation characteristics that are associated with our documented patterns of mammalian biodiversity

Effects of repeated burning on soil nitrogen and cheatgrass biomass and reproduction – NEV052WY

Investigator Name(s) Last Name and Intitials)

1. Leger, E. 2. Johnson, D.

Goals/Objectives/Expected Outputs

Restoration of cheatgrass dominated rangelands depends on controlling cheatgrass while simultaneously providing the conditions necessary for native species establishment. The expansion and eventual dominance of exotic annual grasses and other invaders in semi-arid shrublands often has been attributed to fire and the increase in resource availability resulting from the death of fire intolerant shrubs (Young and Evans 1978, West and York 2002, Evangelista et al. 2004). Soil nutrients are inherently low in these systems, but can increase dramatically following fire, especially available N (NO_3^- and NH_4^+) (Stubbs and Pyke 2005) which can increase up to 12-fold (Blank et al. 1994, 1996). Cheatgrass can take advantage of the high N availability and produce significantly more shoot mass by maintaining higher growth rates than perennial grasses (Monaco et al. 2003). Recent field studies have shown the importance of available inorganic nitrogen in controlling cheatgrass establishment and growth (McLendon and Redente, 1991; Young et al., 1999). Although cheatgrass tends to thrive in a high nitrogen environment, it is inhibited in a low one (McLendon & Redente 1991; Redente et al. 1992; Young & Allen 1997; Young et al. 1999). A novel method to tie up mineral N might be to reduce total N supplies and, therefore, mineral N supplies by repeated burning. It is well documented that nearly all N contained in organic material that is burned is volatilized and lost from the system, potentially causing long-term declines in ecosystem N capital unless the N is replaced by atmospheric deposition, N-fixation, or fertilization (Blair, 1997; Neary et al., 1999; Raison et al., 1985). On the other hand, burning commonly causes short-term increases in soil ammonium levels because of the heat-induced denaturing of soil organic N (Neary et al., 1999; other refs). The pulse of ammonium is often followed by a pulse of nitrate and nitrate leaching once nitrifying bacteria occupy the site again. The short-term pulse of ammonium after fire is thought to be one factor favoring nitrophilic cheatgrass after rangeland fire

(Monaco et al. 2003). Over the long-term, however, one would expect that repeated burning without replacement of lost N could cause reductions in soil mineral N levels, at least after the initial post-fire pulse has passed. In 2008, a 5-year study was established north of Winnemucca, Nevada on cheatgrass dominated rangeland to examine the effects of repeated burning and surface litter on soil nutrient dynamics, cheatgrass biomass and reproduction, and establishment of native species. We hypothesized that repeated burning of cheatgrass dominated areas will cause: 1. Significant reductions in soil total and mineral N levels over time, including the magnitudes of the post-fire pulses of ammonium. 2. Significant increases in the C:N ratio of litter, which will further contribute to reductions in soil available N. 3. Significant reductions in cheatgrass biomass and seed production, increasing the potential for successful restoration of native species.

Outputs:

Field data was collected again this year, and will be completed in 2012. Initial results are being analyzed by the graduate student and collaborators on this project, in anticipation of graduation in 2012.

Outcomes/Impacts:

The graduate student has been trained on field methods and data analysis, and is working on developing a greenhouse extension of the project to be started in 2012.

Persistence of native species in cheatgrass invaded systems – NEV052XDA

Investigator Name(s) Last Name and Intitials)

1. Leger, E.A.

Goals/Objectives/Expected Outputs

The existence of remnant populations that can evolve in response to the presence of invaders has important implications for the restoration and management of degraded Great Basin rangelands. This project will both provide basic knowledge about the rate and importance of rapid evolution in invaded systems, as well as provide direction on how to proceed with management decisions and the development of restoration plant materials for degraded rangelands. Other areas of applied biology have benefited from an evolutionary perspective (such as the response of crop pests to pesticides, e.g. Denholm & Rowland 1992), however this perspective has yet to be applied to the management of rangelands. This proposal is based on a conceptual model of different trajectories that may be followed by native populations following the invasion of highly competitive, exotic species. While invasions of highly competitive species may cause local extinctions of some species, an alternate possibility is that invasions only decrease the relative abundance of species within a community, with some native species persisting at low densities in invaded landscapes (Parker et al. 1999, Seabloom et al. 2006, Stohlgren et al. 1999, 2003). Our first research question addresses these surviving native individuals: do they possess adaptations that have allowed them to survive in a newly altered environment, or are we observing

chance demographic or stochastic remnants? This is an important question for invaded systems because non-random survival (the result of natural selection for adapted genotypes) may indicate that native species have the capacity to evolve more competitive genotypes, possibly leading to long-term increase and spread of native plants that are adapted to invaded ecosystems. The first goal of this project is to document whether competitive genotypes of four ecologically and economically important native Great Basin plant species have been favored by natural selection in a cheatgrass-invaded landscape (evidenced by a higher frequency of competitive genotypes in invaded populations). This question is important for land managers because very different management actions are needed when adaptation occurs than when it does not. The second goal of this research is to determine what ecological circumstances facilitate the most rapid evolutionary change by natives in an invaded landscape). There are a variety of expectations about what conditions are likely to foster or hinder rapid evolutionary change. Prior to embarking on these larger-scale research questions, we must first develop the molecular tools necessary to investigate the types of mating system and rates of gene flow in native Great Basin perennial grasses. No variable microsatellite markers have been identified in these species, and the development of these tools is key for verifying the mating system in these species. During the course of this proposal, microsatellite markers will be used to estimate current gene flow between invaded and uninvaded sites.

Outputs:

Field and greenhouse work was completed during this reporting period, and data analysis is ongoing. The graduate student on the project is making progress towards graduation, expected in 2012.

Outcomes/Impacts:

The graduate student has learned lab skills (microsatellite development) and greenhouse skills related to native plant ecology and restoration. Results of this project will be presented by the graduate student in 2012.

Learning together: great basin science delivery – NEV052XJ

Investigator Name(s) Last Name and Intitials)

1. Leger, E.

Goals/Objectives/Expected Outputs

Improving the effectiveness of fire, fuels, and post-fire management in the fire-ruled sagebrush biome is essential to protecting Great Basin resources. Fire and fuels-related research in the Great Basin is providing much of the information needed to improve management (e.g., http://www.firescience.gov). However, the penetration of this information to public land managers and its application on the ground is uneven and often limited. Fire frequency and size are increasing and the invasive species are gaining ground. Participants of the 2006 "Workshop on Collaborative Research and Management in the Great Basin," the 2008 "Wildfire and Invasive Plants in American Deserts Conference," and the 111 land

managers who participated in the science needs assessment conducted for this project provided direction about the kinds of science information they need and delivery mechanisms they are more inclined to use. The goals of this project are to: Empower Great Basin land managers to identify their technical needs with respect to fuels, fire, and post-fire vegetation Develop information and technical tools to meet the these needs Provide the needed information and tools through venues most preferred by field staff, field office managers, and higher administrative levels. The Science Delivery Project proposes to meet these goals through: 1.Ongoing needs assessments 2.Information syntheses 3.Online training 4.Web-based clearinghouse of information 5.Network of experts from management agencies and research agencies 6.Field workshops 7.Evaluation.

Outputs:

This project received implementation funding in September of 2010, hence 2011 was this project's first full year of implementation. Significant activities during this period included development of the fall/winter webinar series, our first two-day fire and fuels workshop, our first field day, development of a 26-member interagency Great Basin Restoration Cadre, development of our website, and a transition of our list serve from a generic email format to the professional email service, Mail Chimp. We also hired a synthesis writer in the fall to write two syntheses for us, one on vegetation treatments and one on soils, which will be published in the summer/fall of 2012.

Outcomes/Impacts:

In 2011 we hosted seven webinars with a total of 450 attendees and 334 recorded webinar views. We had 85 people participate in our first workshop and field tour. Our Restoration Cadre has produced two blog discussions for the website. The number of unique visitors to the website has nearly doubled from 124 visitors in September of 2010 to 451 visitors in September of 2011. We have gained three new partners in the Great Basin Landscape Conservation Cooperative, the Association for Fire Ecology, and the National Wildfire Coordinating Group's Fire Behavior Subcommittee. We continue to receive positive feedback about our efforts from evaluations as well as unsolicited emails and phone calls from members of the Great Basin management and research community.

Improving Range Cattle Health Through DNA Paternity Identification – NEV05340A

Investigator Name(s) Last Name and Intitials)

1. Gomez-Raya, L. 2. Perryman, B. 3. Rauw, W. 4. Bruce, B. 5. Wuliji, T. 6. Thain, D.

Goals/Objectives/Expected Outputs

The authors have developed an accurate method to determine paternity in free range beef cattle (Gomez-Raya et al., 2008). The goals of this current project proposal are aimed at developing strategies that will increase the efficiency of DNA paternity testing programs by decreasing the time required to obtain results, analyzing test accuracy and decreasing the costs associated with DNA testing. The results

of this research will greatly aid in the development of a DNA paternity testing program at UNR which would be available for use by Nevada cattle producers for the lowest possible price. In order to accomplish the goals of this research we plan to complete the following research aims: 1. To evaluate the economic value of an optimized DNA paternity testing program using six Nevada beef cattle ranches which operate in a free range setting. 2. To investigate the benefit-cost ratios of using sire-dam-calf trios versus sire-calf duos in DNA paternity testing. 3. To investigate the ability to reduce genotyping costs using a sequential paternity rejection strategy. 4. To investigate the increased benefits of using DNA parentage information in heifer selection. 5. To develop methods to incorporate animal disease surveillance with a paternity testing program to allow for increased traceability of livestock carriers and reducing the incidence of disease outbreaks. Expected output is an economically efficient method for DNA paternity testing in free range beef cattle.

Outputs:

Ear notches samples were taken in 2011 at two free range beef cattle operations to estimate calves' paternity. We used a total of 24 microsatellites and the software CERVUS to assign paternities. We are currently using the results to compare the use of different microsatellite panels and individual microsatellites on the economic profitability of DNA paternity programs.

Outcomes/Impacts:

Preliminary data was presented to producers at the annual Cattlemen's Update program outlining characteristics of successful sires.

Bighorn Sheep Health – NEV05352

Investigator Name(s) Last Name and Intitials)

1. Thain, D. 2. Rink, A. 3. Atkinson, M. 4. Gomez-Raya, L. 5. Teglas, M. 6. Wuliji, T. 7. Bruce, B. 8. Perryman, B.

Goals/Objectives/Expected Outputs

1. Identify baseline health data for Bighorn Sheep (BHS) in Nevada. This will include normal baseline blood chemistry, serology, upper respiratory microorganism in normal BHS, trace mineral levels, internal and external parasites, and overall body condition as well as abnormal health data as determined by sampling of live or dead (natural mortality or hunter killed) BHS. 2. Determine the genetic relationship between populations of BHS in Nevada, both native and reintroduced. 3. Develop a database to store all data collected.

Outputs:

We have continued our collaboration with the Nevada Department of Wildlife (NDOW). We monitored three subpopulations of bighorn sheep located in the Sand Springs, Desatoya, and Clan Alpine Mountain

Ranges. Two of the subpopulations (Desatoya and Clan Alpine) appear to be in better health than the one that had a recent die-off (Sand Springs). The primary study objective is to assess the overall health of each subpopulation and to understand what factor(s) were driving this decline. Forage samples from 4 seasons have been collected and analysis is ongoing. We collected over 200 fecal samples for parasite identification and genetic analysis and analysis for forage consumption.

Outcomes/Impacts:

Bighorn sheep are an important big game species in the state of Nevada and several populations continue to decline across America. When changes occur to local populations within the state, it is essential to investigate impacts in order to manage the subpopulation and aid in the recovery.

Rehabilitation of a salt-desert shrub community:Herbaceous response to shrub removal and establishment of forage kochia and other plant species – NEV05356

Investigator Name(s) Last Name and Intitials)

1. Stringham, T.

Goals/Objectives/Expected Outputs

The goals of this project are to determine the potential of shrub removal, reduction of annual grass after disturbance, and seeding of forage kochia and grasses for rehabilitation of Great Basin salt-desert shrub communities. Immigrant forage kochia, experimental forage kochia germplasm, and selected grasses (crested and Siberian wheatgrass, intermediate and tall wheatgrass, Russian wildrye, Basin wildrye, creeping wildrye, wildrye hybrids, salt grass, and alkali sacaton) will be compared for their ability to establish, persist, and act as green fuel breaks. The objectives of this project are to determine: 1. The influence of shrub removal on diversity and abundance of herbaceous species and soil nutrient and water availability. 2. The effectiveness of Pseudomonas fluorescens strain D7 (Pf D7) and imazapic (Plateau)applications to limit annual grass invasion following shrub removal. 3. The establishment and persistence of forage kochia and several grasses. 4. If forage kochia will expand beyond the seeded area. 5. Plant traits that enhance seedling establishment and persistence, and the most efficient seeding protocol for the salt desert ecosystem. Tentative Schedule: FY 2011: Shrub removal study: Plot layout, collect baseline vegetation data, remove shrubs and apply imazapic and Pf D7. Build fence around both locations. Seeding Study: Install weather stations. Start space-plants (3-4,000 specimens) in greenhouse. Build fence around both locations. Conduct site preparation (roto-tilling, herbicide application). Plant space-plants and seeded trials. FY 2012: Shrub removal study: Collect vegetation and soil data. Seeding Study: Take seedling establishment data on seeded trials at both sites. Take forage samples for moisture content. FY 2013: Shrub removal study: Collect vegetation and soil data. Assess frequency of future data collection. Analyze data and begin working on publications. Seeding Study: Collect plant persistence data, forage and seed yield data on seeded and spaced-plant trials. Conduct seed threshing and deep seeding evaluation. Conduct forage quality. FY 2014: Shrub removal study: Submit manuscripts for peer-reviewed publication. Seeding Study: Collect plant persistence data, forage and seed yield data on

seeded and spaced-plant trials. Conduct seed threshing and deep seeding evaluation on selected grasses. Conduct forage quality. Begin writing manuscripts for submission to a peer-reviewed journal.

Outputs:

Seeding study: During 2011, the seeding trials were implemented. Prior to seeding, the study plots were treated with the herbicides glyphosate and 2,4-D for control of annual weeds. Herbicide treatment was applied by Charlie Clements with the USDA-ARS in Reno, Nevada. Plant species used in the seeding experiment were: Achnatherum thurberianum, Agropyron desertorum, Artemisia tridentata ssp. wyomingensis, Elymus elymoides, and Achnatherum hymenoides. Seeding treatments included: 1)Seeds coated with diatomaceous earth and agglomerated by species (~10 seeds/agglomerate); 2)seeds uncoated, seeded in clumps, 3)seeds uncoated, single seed planting with ~24 seeds/foot (did not include sagebrush); and 4)seeds coated, single seed planting with ~24 seeds/foot (did not include sagebrush). Seed coating was conducted by one of our collaborators, Dr. Matthew Madsen, at the USDA-ARS in Burns, Oregon. Five plots with treatments randomly assigned to each row were hand sown in November 2011. Data collection on seedling emergence, establishment, and biomass will be collected in 2012. Shrub removal study: data collection and data analysis are currently in progress.

Outcomes/Impacts:

This project is still in progress and no results are available at this time.

State-and-transition model development for Nevada upland and riparian ecological sites in major land resources – NEV053CY

Investigator Name(s) Last Name and Intitials)

1. Stringham, T. 2. Freese, E.

Goals/Objectives/Expected Outputs

The goal of this project is to lay the foundation for development of STMs for all MLRAs located within the state of Nevada. To facilitate this goal, UNR and NRCS have chosen one MLRA (24) as a test platform for determining and efficient methodology for writing quality STMs. 1. Evaluate the available personnel from outside UNR for area expertise and willingness to participate in state-and-transition model development. 2. Evaluate models from neighboring states for applicability to Nevada. 3. Evaluate individual ecological sites within MLRA 24 for similarity in soils, precipitation and plant community. Evaluate response to disturbance and develop response groups of ecological sites. 4. Produce STMs for the modal ecological site for each response group.

Outputs:

Conceptual state-and-transition models (STMs) for the upland ecological sites within the Nevada component of the Major Land Resource Area 24 have been developed, peer-reviewed and the final

report provided to the USDA, Natural Resource Conservation Service. The goal of this project was to lay the foundation for development of STMs for all MLRAs located within the state of Nevada. To facilitate this goal, UNR and NRCS have chosen one MLRA (24) as a test platform for determining and efficient methodology for writing quality STMs. This methodology has proven to be robust and contracts for the development of STMs for MLRA 25, 23, 28a and 28b are funded and work is underway.

Outcomes/Impacts:

The final report for State-and-Transition Models for MLRA 24 was delivered to the Nevada state office of the Natural Resource Conservation Service in June 2011. A workshop sponsored by the Nevada Society for Range Management was held in Winnemucca, NV in December 2011 with over 60 people participating. The majority of particpants were from the BLM and NRCS representing the organizations primarily responsible for the development of STMs and their application to management of the Great Basin rangelands. Additional impacts include BLM and NRCS funding of continued STM development for MLRA 23, 25, 28a and 28b.

Quantifying environmental benefits from implementing rangeland and conservation practices within the great basin – NEV053DC

Investigator Name(s) Last Name and Intitials)

1. Stringham, T.

Goals/Objectives/Expected Outputs

The University of Nevada at Reno, under the direction of Dr. Tamzen Stringham, is undertaking a cooperative project with the Agricultural Research Service and the Natural Resources Conservation Service to document the status of knowledge regarding the effect of conservation practices applied to rangelands within the Great Basin. The primary purpose is to construct the scientific foundation for the Conservation Effects Assessment Project (CEAP) by documenting what is known and what is not known about the environmental effects of conservation practices on rangelands hydrologic and plant growth processes. The work will focus on the effects of conservation practices applied to rangelands on the following environmental outcomes: water availability, water quality, soil quality, habitat, forage availability, and fuel reductions.

Outputs:

Rainfall simulation was completed on over 40 pinyon or juniper trees with 160 storms having been applied. Data analsysis to-date suggest over 75% of the variation in throughfall plus stemflow data can be explained by tree canopy area and storm size. Data analysis is on going. Twenty eight small plot rainfall simulations were conducted on four cover types: low vegetation, high vegetation, low vegetation with treatment slash and high vegetation with treatment slash. Preliminary results suggest both vegetation cover amount and slash are significant in reducing the amount of sediment production from

pinyon-juniper encroached rangelands. Data analysis is ongoing. Two field tours of the Porter Canyon Watershed were held in 2011 with over 70 individuals participating. USDA NRCS, BLM, USFS, USFWS, USGS, Nevada Dept. of Wildlife, Nevada Wilderness Society, Senator Reid's congressional staff, private individuals and businesses along with private land managers attended.

Outcomes/Impacts:

Two poster presentation on preliminary results were given at the University of Nevada, Reno Agricultural Experiment Station Field Day in September 2011. Additionally, an invited presentation was given at the Great Basin Consortium First Annual Conference and three professional papers will be presented at the Society for Range Management annual meeting in 2012. The rainfall interception results were presented to over 100 livestock producers on the recent UNR Cattlemen's Update tour.

Impact Of Contraceptive Treatment On Fertility And Behavior Of Feral Horses 5-7 Years Post-Treatment – NEV053DKA

Investigator Name(s) Last Name and Intitials)

1. Thain, D.S. 2. Gray, M. 3. Cameron, E. 4. Miller, L.

Goals/Objectives/Expected Outputs

This will be the first study to investigate long term efficacy and behavioral side effects in feral horses treated with contraception and a continued collaboration with experts in the fields of equine behavior and contraception. We aim to understand how long these contraceptive formulations last and when females return to fertility. Our long term goals are to understand how to better manage feral horse populations that minimizes behavioral or physiological side effects, which will most likely produce a shift in management away from gathers and towards contraception (see Figure 1). Our expected results should increase the use and research of contraceptive technologies. Ultimately, we hope to demonstrate the effectiveness and safety of long term contraceptive use in order to shift public perspectives towards a more positive view of using contraception as a management tool in feral horses and other overabundant species. Better management will result in lower costs, while maximizing horse and rangeland health, which benefits other wildlife and agricultural practices.

Outputs:

This is the 2nd year of funding for the project, but this research is a continuation of NEV053BS "Long term contraception in feral horse: Efficacy, safety and behavior". We monitored horses on a weekly basis for fertility status and band fidelity. We also recorded body condition and collected fecal samples. Data was collected and summarized for the year.

Dr. Mengqiang "Mike" Zhu, Soil Chemist, started August 20
Drs. Tom Thurow and Steve Williams retired June 30. Dr. Mike Smith retires March 2014.
Dr. Melanie Murphy, North American Colleges and Teachers of Agriculture Teaching Award of Merit
Dr. Jeff Beck, Range Science Education Council and Society for Range Management Early Career Undergraduate Teaching Award

Kelsey Welter, Gamma Sigma Delta Outstanding Female Freshman
Victoria Zero, Gamma Sigma Delta Outstanding Masters Student
Eric Wald, Gamma Sigma Delta Outstanding PhD Student
Chris Kirol, University of Wyoming Outstanding Master's Thesis Award
Guinevere Jones, John P. Ellbogen Outstanding Graduate Assistant Teaching Award
Rachel (and Brian) Mealor, Society for Range Management Outstanding Young Range Professional Award

Student numbers as of September 3, 2013

Undergraduate current enrollees	
Rangeland Ecology and Watershed Management	112
Agroecology	43
Undergraduate minors	44
Graduate current enrollees	
REWM MS	24
SOIL MS	7
ENTO MS	1
REWM PhD	5
SOIL PhD	2
ENTO PhD	4
PiE PHD	6
Reclamation and Restoration Ecology Grad Certificate	5
Water Resources MS	10
Hydrology PhD	5

Student Clubs

Range Club – Attended Society for Range Management annual meeting in Oklahoma City, held a regional competition Laramie with Montana State, Colorado State, Utah State, and Sheridan College.

ROaR – Worked on public service projects – tie plant remediation, Laramie River project, clean up and sign state lands section.

RenUW – Coordinating our department seminar series

SWCS Club – Student chapter of the Soil and Water Conservation Society. Public service project at Albany County library – runoff control and garden clean-up.

Currently in the hiring process for the Rangeland Extension Specialist. This position is a split between extension and herbivory research.

Faculty members are currently working on over $10 million in grant support. Projects include watershed management, water resources and water quality, produced water, evapotranspiration, native plant species ecology, pest management, invasive plant ecology, reclamation and soils, wildlife habitat, wildlife and

plant genetics, insect ecology and identification, carbon capture in flue gas, clean coal technology, sustainable agriculture, sustainable rangelands, and rangeland health assessment.

Extension and outreach programs have been put on in rangeland management, small acreages, entomology and pest management, soil science, water quality, reclamation and restoration, wildlife habitat, and sustainability.

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Oregon State University WERA 40 - Annual Report 2013

In 2013 the Department of Department of Animal and Rangeland Sciences continued to consolidate as a department following the 2012 merger between Animal Sciences and Rangeland Ecology and Management. The Rangeland Sciences Program has moved from its home of the past 20 years to co-locate with the Animal Science Program

The College of Agricultural Sciences has a branch program located at Eastern Oregon University in La Grande. The Rangeland Sciences program is nested within the OSU Agricultural Sciences program at EOU. Thus, the Rangeland Sciences program within the Animal and Rangeland Sciences department is located both in Corvallis at the main campus and in La Grande on the EOU campus.

The Rangeland Sciences program has 12 undergraduate students at the Corvallis campus and 40 undergraduate students in the Agricultural Sciences program at the EOU campus. These are reduced numbers resulting from faculty turnover at both locations and the transition to a combined department. Rangeland Sciences has 4 Ph.D. and 5 M.S. graduate students, all at the main campus in Corvallis.

Rangeland Sciences faculty ranks have been depleted via retirements and transfers. In 2003, we had 8 tenure-track or tenured faculty at the Corvallis campus and 2 tenured faculty at the EOU campus. In 2012 we have 1 tenured and 2 tenure-track faculty at the Corvallis campus and 1 tenure-track faculty at the EOU campus. Dr. Douglas Johnson retired effective September 30, 2013. We hired Dr. Carlos Ochoa effective July 2013 as our watershed/hydrology person housed at the Corvallis Campus. At the EOU campus Dr. Ryan Limb resigned and moved to North Dakota State University. We subsequently hired Dr. Lesley Morris to fill one of the two vacant Range faculty for the program at EOU. We plan to recruit for a second tenure-track faculty position at the EOU campus, and hope to have that faculty position filled by Fall 2014.

Current research programs include 1) cattle behavior changes with the reintroduction of wolves, 2) tracking livestock movement patterns in and around riparian areas, 3) computer analysis of digital photographs for monitoring vegetation structure and cover from fine to coarse scales, 4) plant community and wildlife habitat responses to juniper treatments, 5) watershed scale plant community and ground water responses to juniper removal, and 6) plant physiological responses to fluctuating water tables.

Outreach (Extension) programs focus on monitoring, livestock behavior, development of Candidate Conservation Agreements with Assurances for management related to sage grouse habitat on private land, invasive plant management strategies, comprehensive ranch management

planning with a focus on reducing winter feeding, management related to weedy annual grasses, management related to juniper encroachment, juniper treatment responses, and responses to large scale fires.

State-and-Transition theory, modeling, and uses for management planning are included in most of our Rangeland Sciences courses. Our courses attract students from Natural Resources, Environmental Sciences, Forestry, Environmental Engineering, and Animal Sciences in addition to our Range majors. So, STM concepts are being disseminated among a variety of natural resources oriented students across several academic programs.

Submitted by Michael Borman, WERA 40 representative, College of Agricultural Sciences, Oregon State University. michael.borman@oregonstate.edu, 541-737-1614

North Dakota State University
WERA-40
2013 Annual Report

Students

Undergraduate Students

Major

Range – 10
Natural Resource Management – 106

Minor

Range – 10

Graduate Students

Masters

Major
Range – 5
Natural Resource Management – 45

Doctoral

Major
Range – 1
Natural Resource Management - 12

Faculty

In the last year, the Range program had two faculty move to other universities or programs at NDSU and one retirement. We were able to replace two of the three positions immediately and will fill the third position after January 1, 2014. After we fill the vacant position, we will have 4 dedicated Range faculty. The Natural Resource Management program had one retirement last year and that position was immediately replaced maintaining 3 full time NRM faculty.

University of Arizona

2013 Report

Jeff Fehmi WERA 40 Representative

In the School of Natural Resources and Environment (SNRE) at the University of Arizona, we offer a Natural Resources degree at the Bachelors, Masters, and PhD levels. We have options in Ecology and Restoration of Rangelands, Wildlife and Fisheries Conservation and Management, Conservation Biology, Watershed Management and Ecohydrology, and Landscape Assessment. We have about 40 faculty members total. We have 142 current undergraduate majors and 94 graduate students. Elsewhere in the college, we now have a new School of Animal and Comparative Biomedical Sciences which has combined Animal Science, Veterinary Science, and Microbiology. They have about 30 faculty members.

There are 10 faculty officially affiliated with the Ecology and Restoration of Rangelands program: Steven Smith; Jeff Fehmi; George Ruyle; Mitch McClaran; Barbara Hutchinson; Larry Howery; Rachel Gallery; Laura Lopez Hoffman; Steven Archer; and Doug Tolleson.

Number of Undergraduates in Options within the Natural Resources Major

(All data for **Fall** Semester only.)

Year	Range	Wildlife Fisheries Sc/ConBio	Watershed Mgmt/Landscape Analysis	No Opt	TOTAL
2013	**15**	**113**	**11**	**3**	**142**
2012	23	120	14	4	161

Level	Major	Academic Subplan	2012	2013
PhD	Natural Resources	Ecol, Mgt, Restor Rangelands	2	2
		Nat Resource Studies	12	9
		Watershed Mgmt/Ecohydrol	7	8
		Wildlife and Fisheries	12	13
	Arid Lands		24	24
MS	Natural Resources	Rangeland Sci and Mgmt	8	3
		Nat Resource Studies	10	14
		Watershed Mgmt/Ecohydrol	17	18

Wildlife and Fisheries	28	21
Water, Society & Policy	3	6
SNRE Total Grads	99	94

All SNRE faculty are part of the Nat Resource Studies degree program.