

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

Natural Resource Management and Environmental Sciences in the Great Basin and Sierran Ecosystems

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships			14%	
112	Watershed Protection and Management			4%	
121	Management of Range Resources			41%	
122	Management and Control of Forest and Range Fires			10%	
123	Management and Sustainability of Forest Resources			10%	
133	Pollution Prevention and Mitigation			10%	
211	Insects, Mites, and Other Arthropods Affecting Plants			10%	
216	Integrated Pest Management Systems			1%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	2.5	0.0
Actual Paid	0.0	0.0	5.0	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	404466	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	401324	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Bark Beetle Management through Biochemistry - controlling invasive forest species.

Research efforts have been directed towards understanding hydrocarbon production in bark beetles' exoskeletons (shells) that eventually leads to desiccation and animal death. Over the past year, Cytochrome P4G55 and P4G56 were cloned, then fused together to create on long protein that serves as a fatty acid enzyme. This fused protein is now being expressed in Sf9 cells (a cell derived from Armyworms). The team continues to assay these genes for their ability to convert aldehydes to hydrocarbons. In addition, two fatty acid synthetases, one of which is believed to be involved and producing methyl branched fatty acids has been expressed and the team is in the process of assaying them.

A second research effort is working to better understand the biochemical mechanisms beetles use to detoxify turpentine resin found in pine forests. Mountain Pine Beetle (MPB) and Jeffrey Pine Beetle (JPB) are sister species that co-exist in the Sierra Nevada, but infest different host trees. Thus, they provide an excellent opportunity for comparative analysis. Genomic resources for MPB were completed in prior years. To date, JPB were collected and RNA was extracted and currently being analyzed using Illumina-base RNA-sequencer.

Testing Competitiveness of Native Plant Verses the Invasive Species Cheatgrass

Root characteristics are now the main focus of the project. The team has completed field data collection across five common garden sites (3 in NV, 1 in OR, 1 in ID), where they tested the performance of seeds from 25 wild populations in natural settings. The team screened each population for early-root growth characteristics by growing seedlings for 10 days in a greenhouse environment, and then assessed performance in natural settings. Data analysis is ongoing.

Application & Utility of the Ecological Site & Condition Concept for Monitoring Rangeland Ecological Status

This project is testing the vegetative response of post-burn plant communities to different grazing treatments at the disturbance response group level - that is, a level that is to scales relevant to land managers. The team has finished state and transition models for clay-pan and loamy ecological sites with the NRCS's Owyhee High Plateau (MLRA 25). Quantitative data collected from these ecological sites in 2013 and 2014 have been used to identify State (stable, long-term ecological conditions) and Community Phases (dynamic ecological conditions) prior to and post wildfire burns.

Hydrologic And Vegetative Response To Pinyon Juniper Treatment At The Watershed Scale

This project adds to an ongoing project that represents the first, fully instrumented watershed scale research effort in Nevada. Two sagebrush sites were instrumented for sap flow monitors during summer 2014 for a total of 16 sagebrush plants. A GSFlow model of the groundwater recharge at the watershed scale was completed and is being utilized to support development of a watershed scale water budget. The NRCS SCAN weather station was upgraded to a SNOTEL station thus providing snow information. PhenoCams were strategically located to provide photos of vegetation green up and photos of snow depth.

Sustainability Of Mowing Fuel Breaks: Resilience Of Sagebrush Rangelands

Investigators have located 18 individual sagebrush mowing projects conducted within the Carson City and Ely BLM Districts totaling over 12,800 treated acres. Through the use of GIS to determine feasibility and appropriateness of sites, 9 projects totaling 1,600+ acres were included in the Carson City BLM District and 9 projects totaling 6,200+ acres in the Ely BLM District. Following the data collection protocols developed by Ag Experiment Station, basal and foliar cover data were analyzed to determine the differences between mowed and unmowed paired locations.

Post Fire Riparian Monitoring For Return Of Livestock Grazing

Riparian multiple indicator monitoring methodology (Burton et al. 2011) has recently become a new standard for measureable riparian monitoring by the BLM. This research was designed to inform practitioners of MIMM about the rates of change and some of the factors that would influence those rates. Focusing on post wildfire riparian responses, data was collected from 25 streams in eight separate fires within the Great Basin using the MIMM. Preliminary analysis has begun, but further data is needed to build a robust argument as to whether or not this is a reasonable estimate of when to return livestock.

Long-Term Influences of Adaptive Management Practices on an Eastern Sierran Pine Forest

To date, this project continues monitoring pre- and post- prescribed fire treatments of two forests that neighbor Lake Tahoe region and the effects of different methods of forest thinnings. The 11th annual evaluation of long-term stand health, productivity, soil nutrients, watershed hydrological parameters, and understory fuel loads was conducted to better understand the effects of controlled burn sites and a combination of thinning practices. Data collected this past year has been combined with similar pre-treatment data collected at mid study to continue the analyses of intermediate and long-term forest responses to treatment.

Monitoring Changes in Nevada's Pinyon-Juniper Woodlands

For 2014, NAES researchers have made good progress in refining remote sensing methodology for mapping changes in pinyon-juniper woodlands tree canopy cover over the past 30 years, and have also begun to develop methods for simultaneous mapping of understory vegetation and bare ground cover. The team is using spectral mixture analysis (SMA) of Landsat imagery as the primary approach to remote sensing classification, and are comparing lab-derived with image-derived spectra for vegetation and land cover types. Protocols for atmospheric, geometric and topographic correction have been resolved, along with starting the process of calibrating remote sensing methods using field data on vegetation cover that the team has previously collected.

A second research effort is resampling permanent plots established back in 2004-2005. This NAES team of scientists has resampled 37 of the 172 plots, across 3 of the 11 mountain ranges, collecting data for over 1000 trees. Individual trees were marked and delineated with permanent understory transects. The team also obtained precise GPS locations for each tree, to facilitate detailed analysis of woodland structure using point pattern analysis. Additional sampling protocols were also implemented that were not used in 2004 - 2005, including more detailed quantification of pinyon pine and juniper seedling regeneration, allowing for more in-depth regeneration dynamics studies.

2. Brief description of the target audience

The target audiences for research and educational programming are livestock producers, veterinarians, environmentalists, local governments, state and federal agency personnel, and biotechnology companies.

3. How was eXtension used?

NAES rangeland scientist Sherm Swanson is jointly appointed with Nevada Cooperative Extension.

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	265	0	210	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2014
Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	0	17	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer reviewed scientific publications, publications in natural resource and environmental organization publications, presentations at scientific meetings, presentations at stakeholder, Native American and agency meetings.
Not reporting on this Output for this Annual Report

Output #2

Output Measure

- Demonstrations, Field Days, and Workshops Conducted

Year	Actual
2014	7

Output #3

Output Measure

- Newsletters Produced

Year	Actual
2014	1

Output #4

Output Measure

- Leveraged Research Projects

Year	Actual
2014	612017

Output #5

Output Measure

- Web Sites Created or Updated

Year	Actual
2014	2

Output #6

Output Measure

- Manuals and Other Printed Instructional Materials Produced
Not reporting on this Output for this Annual Report

Output #7

Output Measure

- Number of Graduate Students or Post-Doctorates Trained

Year	Actual
2014	6

Output #8

Output Measure

- Number of Undergraduate Students Involved in Research

Year	Actual
2014	33

Output #9

Output Measure

- Databases, Models, Protocols, and Research Materials

Year	Actual
2014	5

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	New fundamental or Applied knowledge
2	Improved skills of students, post-doctorate, and stakeholders
3	New or improved methods
4	Adopt and use new methods or improved technology
5	Actively apply practical policy and decision-making knowledge
6	Increase economic competitiveness
7	Improve water quality and a sustainable environment
8	What Seeds to Plant in the Great Basin?
9	Effects of Management Practices on Eastern Sierran Pine Forest

Outcome #1

1. Outcome Measures

New fundamental or Applied knowledge

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Improved skills of students, post-doctorate, and stakeholders

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

New or improved methods

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Adopt and use new methods or improved technology

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Actively apply practical policy and decision-making knowledge

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Increase economic competitiveness

Not Reporting on this Outcome Measure

Outcome #7

1. Outcome Measures

Improve water quality and a sustainable environment

Not Reporting on this Outcome Measure

Outcome #8

1. Outcome Measures

What Seeds to Plant in the Great Basin?

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Implementing successful restoration in the Great Basin is challenging, especially in the driest and more resource-limited areas. Agronomic suitability, site appropriateness, and restoration performance are important for selecting plant material of the highest quality and usefulness. The goal of this project is to provide information about the current state of wildland seedings in the Great Basin.

What has been done

NAES scientists collected data on the frequency and amount of seeds used in recent seedings (2006-2009), focusing on post-fire rehabilitation projects, a major source of seeding in the Great Basin, which took place on public US Bureau of Land Management lands in Nevada over a four-year period. Next they presented information on traits highlighted in descriptions of most of the commercially available grass, forb, and shrub cultivars and other native plant releases commonly used as seed materials in the Great Basin, gathering data from plant release documents and plant brochures. Finally, they conducted a series of field and greenhouse experiments that were designed to discern which phenological and morphological traits increase perennial native grass performance in disturbed Great Basin systems, and summarized the fit between these results and current restoration practice.

Results

Maintaining diverse native plant communities in the Great Basin under continuing disturbances such as invasive species, changing climate and fire regimes, and shifts in grazing pressure is a challenge for land managers. Improvements to restoration through changes in seed source selection are relatively attainable.

Traits prioritized in commercially available cultivars and native seed material releases included, in order of frequency: forage quality and yield, seed yield, seedling vigor, ability to establish and persist, and drought tolerance, with many other traits mentioned with less frequency. Traits that had consistent support for improving native perennial grass performance in the field were related to early phenology, small size, and higher root allocation.

NAES range scientists have published their finding and made it available to both ARS and NRCS for future considerations of site appropriate seed. ARS's in Logan, Utah is now looking at root allocation when considering seeding candidate plants.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
121	Management of Range Resources
122	Management and Control of Forest and Range Fires

Outcome #9

1. Outcome Measures

Effects of Management Practices on Eastern Sierran Pine Forest

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

A prominent forest type in the eastern Sierra Nevada is that of Jeffrey pine, and at mid and low elevations where soils are typically dry during the growing season, these pine forests dominate. Because of extensive harvesting during the Comstock era, coupled with fire exclusion during the 20th century, many Jeffrey pine stands today are of poor quality with large numbers of small stems, little spacing between trees, and high canopy closure.

Thinning removing weak stems so that desirable trees have greater access to water and nutrients, wildfire mitigation, increased water yield, and enhanced wildlife habitat. Also, because this practice produces commercial wood fiber and/or biomass suitable as an alternative energy feedstock, a monetary return on the investment can be realized that offsets implementation costs.

Approaches to forest thinnings have improved substantially in recent years, affording such choices as cut-to-length systems and whole-tree harvesting. Prescribed fire in the form of controlled under-burning may, with the exception of the fiber and biomass yield, provide many of the same benefits as thinning. Prior to widespread use of either of these practices in the eastern Sierra Nevada, however, an assessment of their long-term impacts on stand health and productivity, nutrient cycling, and water quality is required to optimize their use for maximum benefit.

What has been done

This project is the continuation of a long-term study that began in 2003 with the initial treatments of thinning, mastication, and prescribed burns. Data was collected post-treatment in 2004 on fuel loads, forest health, soil nutrients, and runoff water quality. Over the past year, the same data was collected to determine the effects of these management practices.

Results

Information gathered over the past decade on the management practices in eastern Sierran pine forest has led to seven scientific publications in 2014. This set of data is the only fuel numbers available for the entire Sierra Nevada Mountains. Now available to the public, forest recovery data is being used by the USFS for environmental assessments and environmental impact statement reports. Lake Tahoe Basin Management Unit and the Nevada Division of Forestry are using the data for projected fuel loads.

4. Associated Knowledge Areas

KA Code	Knowledge Area
---------	----------------

102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
122	Management and Control of Forest and Range Fires
123	Management and Sustainability of Forest Resources

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Competing Programmatic Challenges
- Other (Budgetary Restraints)

Brief Explanation

Nevada annual average precipitation continues to decline, with the past three winters scoring some of the driest on record. This extreme drought is effecting a number of our rangeland studies, examples include: native seed establishment trials, seed coating trials, effectiveness of herbicides in limiting invasive annual grasses, developing water budgets for pinyon-juniper watersheds, post-fire monitoring for the return of livestock grazing.

A currently lack the funding resources to pursue how fuel conditions and potential fire risk change over the course of Pinyon-Juniper woodland stand development will not be completed. This was not expressed as a priority by BLM staff.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Quantitative data collected from ecological sites within NRCS's Owyhee High Plateau (MLRA 25) has identified State (stable, long-term ecological conditions) and Community Phases (dynamic ecological conditions) prior to and post wildfire burns.

A GSFlow model (couples ground and surface water flow, vegetation coverage, and topography) at the watershed scale was completed and is being utilized to support development of a watershed scale water budget for BLM. The team has also begun modeling snow supplimation for Pinyon-Juniper woodlands - current models are based on pine forest.

To test the applicability of MIMM's use in rangeland riparian systems, data was collected on 25 riparians from 8 different wildfires.

Data sets collected on mechanized thinning and prescribed burns in the eastern sierras is one-of-a-kind resource of USFS and Nevada Division of Forestry conducting environmental assessments and environmental impact statements.

Our long term studies on changes to Pinyon-Juniper woodland over the decades has resulted in a method for simultaneous mapping (GIS) of canopy, understory, and bare

ground coverage using spectral mixture analysis from Landsat imagery. Protocols were established for correcting remote sensing issues due to atmospheric, geometric and topographic. The team has resampled 37 of the 172 original sites, geo-tagging over 1,000 trees, and collecting understory and soil samples.

Key Items of Evaluation

- Published the findings on the influence of roots traits of native grass species in competition with the invasive species cheatgrass.
- Constructed a database to store native grasses competitive performances and seedling traits against invasive cheatgrass.
- State and Transition Models were completed for clay-pan and loamy ecological sites within NRCS's MLRA 25
- A GSFlow model of the groundwater recharge at the watershed scale was completed.
- Numerous contributions and upgrades to USDA-ARS's DIMA (database for inventory, monitoring and assessment, a.k.a "the rangeland database")
- Seven peer-review journal articles were published on the effects of mechanized thinning and prescribed burns in the eastern sierras.
- A database for tracking temporal changes in Pinyon-Juniper woodlands was developed.