

2009 University of Nevada Research Annual Report of Accomplishments and Results

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I. Report Overview

1. Executive Summary

This Annual Report for the Nevada Agricultural Experiment Station (NAES) for 2009 reports on select program impacts which reflect unique benefits to a diversity of clientele and stakeholders in Nevada. No attempt was made to include all programs or all program impacts since they are too extensive.

The mission of NAES is to build and support research capacity to advance understanding of biological, environmental, natural resource and social systems to enhance agriculture, community and economic vitality in compliance with State and Federal Legislation. Research is conducted in the laboratories of the Max C. Fleischmann College of Agriculture, Knudsen Resource Center, Howard Medical Sciences, Bureau of Mines building, and the Sarah Fleischmann College of Human and Community Sciences.

Six field laboratory sites are also utilized for research, including: Main Station Field Laboratory, which houses the large animal surgical facility and laboratory and the meats laboratory; Valley Road Plant Sciences Field Laboratory, which houses the experimental winery and vineyard and the brand new state of the art NAES Greenhouse Complex; Newlands Research and Extension Center; Gund Ranch Rangeland Research Center; and the Jay Dow Sr. Wetlands Research Laboratory.

The NAES Priority grants program involves Hatch and Multi-State Research Programming which is driven by peer and stakeholder review and embraces the Federal State partnership directed by the Hatch Act and subsequent Farm Bill provisions. The overarching goals of the NAES include:

- Agricultural Production in a Semi-Arid Environment;
- Economic Development with Emphasis in Rural Areas;
- Natural Resource Management and Environmental Sciences in the Great Basin and Sierran Ecosystems;
- Nutrition and Health;
- Childhood Obesity Prevention;
- Climate Change;
- Food Safety;
- Sustainable Bioenergy.

The research program and facilities of the NAES provide the foundation for graduate training activities and undergraduate research opportunities for undergraduate students in Animal Biotechnology, Biochemistry and Molecular Biology, Natural Resources and Environmental Sciences, Resource Economics and Nutrition. Through an extensive outreach program involving town hall meetings, rural tours, impact reporting, news release, web based reporting of research progress, pamphlet and annual reports and a directed advisory committee, the progress of the NAES research program is communicated with stakeholders on a regular basis and feedback is obtained to provide direction to future research projects.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	27.5	0.0
Actual	0.0	0.0	25.2	0.0

II. Merit Review Process

1. The Merit Review Process that was Employed for this year

- Expert Peer Review

2. Brief Explanation

Scientific peer review drives the initial selection of research projects that comprise the NAES research portfolio. NAES solicits applications from CABNR/NAES scientists in a general call for proposals that identifies the priority areas. Faculty submit the proposals through an NAES web based application process and the individual contributing departments are responsible for obtaining scientific peer review. We have initiated a web based peer review process for department peer review and Experiment Station administrative use for evaluating the proposed research for the Nevada Agricultural Experiment Station. The department will submit their ranked evaluation of the research proposals for that respective department, and the Director, in consultation with the Associate Director, will approve the research projects based on the departmental recommendations, peer review rankings and comments and stakeholder input.

III. Stakeholder Input

1. Actions taken to seek stakeholder input that encouraged their participation

- Use of media to announce public meetings and listening sessions
- Targeted invitation to traditional stakeholder groups
- Targeted invitation to non-traditional stakeholder groups
- Targeted invitation to traditional stakeholder individuals
- Targeted invitation to non-traditional stakeholder individuals
- Targeted invitation to selected individuals from general public
- Other (Conduct Field Lab Days at our Field Stations)

Brief explanation.

We have and will continue to conduct tours throughout the state for the purpose of obtaining stakeholder input. During these tours we invite participants to town hall meetings through general press coverage in the local newspapers, and we invite stakeholder groups and individuals through personal contact, i.e., email, telephone, etc., to attend. We hold an annual "Field Lab Day" at our Main Station Field Laboratory and the Gund Range Research Station where there is an excellent dialog between stakeholders and NAES faculty and administrators.

2(A). A brief statement of the process that was used by the recipient institution to identify individuals and groups stakeholders and to collect input from them

1. Method to identify individuals and groups

- Use Advisory Committees
- Use Internal Focus Groups
- Use External Focus Groups
- Open Listening Sessions
- Needs Assessments
- Other (Informal discussions with key stakeholders)

Brief explanation.

We currently have a broadly based CABNR/NAES advisory committee that meets and provides advice 1-3 times per year. In addition, we have an associate dean for outreach and his office schedules and coordinates town hall meetings throughout the state with the purpose of obtaining direct input to the NAES research portfolio. The primary responsibility of the associate dean for outreach is to connect the CABNR/NAES teaching and research programs to the citizens of Nevada. Our partnership with Nevada Cooperative Extension provides assistance and access to stakeholders. Informal discussions with key stakeholders provide important input into our programs.

2(B). A brief statement of the process that was used by the recipient institution to identify individuals and groups who are stakeholders and to collect input from them

1. Methods for collecting Stakeholder Input

- Meeting with traditional Stakeholder groups
- Survey of traditional Stakeholder groups
- Meeting with traditional Stakeholder individuals

- Meeting with the general public (open meeting advertised to all)
- Meeting specifically with non-traditional groups
- Meeting specifically with non-traditional individuals
- Meeting with invited selected individuals from the general public
- Other (Conduct Field Lab Day for stakeholders)

Brief explanation.

Stakeholders include all federal, state and county non-governmental organizations that are involved in agricultural production and environmental stewardship. Individual stakeholders are identified through personal contact with producers, town hall meetings, attendees at field lab days, and connections with extension and college outreach personnel. Input is received verbally or written.

3. A statement of how the input will be considered

- In the Budget Process
- To Identify Emerging Issues
- Redirect Research Programs
- In the Staff Hiring Process
- In the Action Plans
- To Set Priorities

Brief explanation.

The stakeholder input is relied upon to establish the research portfolio for NAES, and that includes identification of priority areas, identifying important new issues and the actual approval and funding of new and continuing projects.

Brief Explanation of what you learned from your Stakeholders

The overwhelming message is that stakeholders want more help in research and its applications. Nevadans desire information necessary to make decisions related to rangeland resources and rural development. Bio-renewable energies and water quality have risen to the forefront as areas of particular importance for our Nevadan stakeholders. This in turn, is leading to development of research programs in those particular areas.

IV. Expenditure Summary

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)			
Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	1335968	0

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	0	0	1335968	0
Actual Matching	0	0	2229737	0
Actual All Other	0	0	776588	0
Total Actual Expended	0	0	4342293	0

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from				
Carryover	0	0	0	0

V. Planned Program Table of Content

S. No.	PROGRAM NAME
1	Agricultural Production in a Semi-Arid Environment
2	Natural Resource Management and Environmental Sciences in the Great Basin and Sierran Ecosystems
3	Economic Development with Emphasis in Rural Areas
4	Nutrition and Health
5	Childhood Obesity
6	Climate Change
7	Sustainable Energy
8	Food Safety

V(A). Planned Program (Summary)**Program # 1****1. Name of the Planned Program**

Agricultural Production in a Semi-Arid Environment

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
201	Plant Genome, Genetics, and Genetic Mechanisms			7%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants			21%	
204	Plant Product Quality and Utility (Preharvest)			3%	
206	Basic Plant Biology			12%	
301	Reproductive Performance of Animals			11%	
303	Genetic Improvement of Animals			16%	
304	Animal Genome			3%	
305	Animal Physiological Processes			1%	
307	Animal Management Systems			5%	
308	Improved Animal Products (Before Harvest)			5%	
311	Animal Diseases			7%	
511	New and Improved Non-Food Products and Processes			6%	
601	Economics of Agricultural Production and Farm Management			3%	
Total				100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	12.0	0.0
Actual	0.0	0.0	7.2	0.0

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

Extension		Research	
Smith-Lever 3b & 3c 0	1890 Extension 0	Hatch 626307	Evans-Allen 0
1862 Matching 0	1890 Matching 0	1862 Matching 1226376	1890 Matching 0
1862 All Other 0	1890 All Other 0	1862 All Other 0	1890 All Other 0

V(D). Planned Program (Activity)**1. Brief description of the Activity**

Conduct research to enhance agricultural production in Nevada, publish the research findings in peer reviewed journals, educate our stakeholders through outreach by conducting rural tours and participating in town hall meetings, holding field lab open houses to demonstrate our research findings, submit news releases on new findings, publish a quarterly bulletin entitled "Insights" News from the College of Agriculture, Biotechnology and Natural Resources and the Nevada Agricultural Experiment Station. Include publications on the CABNR/NAES web page, report impacts through a web based link entitled Nevada Dividends Impact Reports, and share results with extension faculty for inclusion in the extension outreach programs.

2. Brief description of the target audience

The target audience for research and educational programming is agriculture and livestock producers, veterinarians, agency personnel and local governmental organizations as well as students taking class or participating in research activities.

V(E). Planned Program (Outputs)**1. Standard output measures**

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	1500	4000000	350	500000
Actual	10283	18426	2290	0

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

Year: 2009

Plan: 0

Actual: 0

Patents listed**3. Publications (Standard General Output Measure)****Number of Peer Reviewed Publications**

2009	Extension	Research	Total
Plan	0	60	
Actual	0	41	41

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer reviewed journal articles, publications in commodity group publications, presentations at scientific meetings, presentations at stakeholder, native american and agency meetings.

Year	Target	Actual
2009	60	79

Output #2

Output Measure

- Demonstrations and Field Days Conducted

Year	Target	Actual
2009	{No Data Entered}	17

Output #3

Output Measure

- Newsletters Produced

Year	Target	Actual
2009	{No Data Entered}	2

Output #4

Output Measure

- Research Projects Conducted

Year	Target	Actual
2009	{No Data Entered}	40

Output #5

Output Measure

- Web Sites Created or Updated

Year	Target	Actual
2009	{No Data Entered}	8

Output #6

Output Measure

- Digital Media Created or Updated

Year	Target	Actual
2009	{No Data Entered}	4

Output #7

Output Measure

- Manuals and Other Printed Instructional Materials Produced

Year	Target	Actual
2009	{No Data Entered}	1

Output #8

Output Measure

- Number of Graduate Students or Post-Doctorates Trained

Year	Target	Actual
2009	{No Data Entered}	39

Output #9

Output Measure

- Number of Undergraduate Students Involved in Research

Year	Target	Actual
2009	{No Data Entered}	67

V(G). State Defined Outcomes**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	peer reviewed journal articles, publications, in trade journals, presentations at scientific meetings, stakeholder, native american and agency presentations
2	Alternative Crops for Nevada - Wine Grapes
3	Understanding Stress Tolerance by Exploring Photosynthetic Pathways in Desert Plants
4	Increasing Basin Wildrye for Wintering Livestock, Wildlife Habitat, and Seed Production
5	Developing a Vaccine for Epizootic Bovine Abortion
6	Controlling Feral Horse Population

Outcome #1**1. Outcome Measures**

peer reviewed journal articles, publications, in trade journals, presentations at scientific meetings, stakeholder, native american and agency presentations

Not Reporting on this Outcome Measure

Outcome #2**1. Outcome Measures**

Alternative Crops for Nevada - Wine Grapes

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	{No Data Entered}	1

3c. Qualitative Outcome or Impact Statement**Issue (Who cares and Why)**

Recent advances in plant biotechnology have led to the discovery of an important family of transcription factors called DREB/CBF that act as master regulators of gene expression that regulate abiotic (and biotic) stress tolerance in plants. An increase in stress tolerance of grapes will greatly improve the viability of an emerging viticulture and wine industry here in Nevada. This research will lead to the development of more stress tolerant wine grapes in Nevada vineyards. More stress tolerant vines will allow for a more robust and economically viable grape and wine industries in Nevada.

What has been done

In this project, the University of Nevada, Reno (UNR) investigation team isolated and tested the function of transcription factors (master regulators of gene expression) to determine whether or not they can improve the stress tolerance of grapevine as has been shown to occur in other plant species. In addition, the team has analyze the mRNA and protein expression patterns in these grapevines using technologies that have been optimized in UNR laboratories to identify other genes that might contribute to non-living factors (abiotic) and biotic stress tolerance. Currently, the team is evaluating the degree of stress tolerance displayed by these grapevines under greenhouse and field conditions.

Results

A major breakthrough in the discovery of a member of the subfamily DREB/CBF has shown great promise as a controlling factor in improved biotic and abiotic stress tolerance or resistance. The investigation team has developed six independent transgenic lines of grapevines. When tested, these lines for improvements in freezing and water deficit stress tolerance, showed significantly improved survival (84%) versus controls when subjected to 28°F for 24 hours. An amazing feat when considering a normal wine grape leaves shrivel in a matter of hours. When the team subjected the genetically modified grape leaves to a decreasing temperature gradient (32° to 10°

F) the transgenic vines appear to delay cell leakage by 2-3°F.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants

Outcome #3

1. Outcome Measures

Understanding Stress Tolerance by Exploring Photosynthetic Pathways in Desert Plants

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	{No Data Entered}	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Drought and excessively salty soil are the two most important limiting factors in crop productivity the world over. But for many crops, traditional breeding practices have fallen short of providing real prospects for further improvements in stress tolerance. Hence biotechnologists are studying plants that can cope with extremes, in the hope of finding the secret of their so-called 'osmotolerance' and then incorporating it into more 'osmotically vulnerable' plants. The long-term goals of this research are to identify the regulatory and signaling pathways essential for the circadian control of carbon sequestering (fundamentals of photosynthesis) and stomata functioning (the plant's pores).

Crassulacean Acid Metabolism (CAM), a photosynthetic pathway found in approximately 7% of all vascular plant species that improves water use efficiency up to 10-fold relative to C3 species provides an exquisite example of circadian and environmentally regulated photosynthetic adaptation.

Although the basic metabolic reactions required for CAM are well established, the molecular mechanisms that control the necessary circadian clock outputs of this important photosynthetic adaptation to drought-tolerant are poorly understood (e.g., molecular processes that prepares plant cells for desiccation and stress caused by sunlight).

What has been done

The Common Ice Plant, with its capacity to change metabolic strategies from typical house plant photosynthesis to a cactus like CAM process, adapts well to freezing temperatures (down to 14°F), withstands seawater concentrations in rooting soil, and is extremely drought-tolerant, researchers at the University of Nevada, Reno, chose them as a model to identify and functionally test key transcriptional regulators of circadian clock outputs that are responsible for the coordinate mRNA (molecule encoding a chemical "blueprint" for a protein product) expression events essential for the temporal functioning of CAM biochemistry and inverse stomatal behavior.

The team determined the environmentally induced circadian controlled changes in the plants mRNA between the two photosynthetic processes. These data, along with included ESTs (used for gene discovery), were combined to create EST contigs and singletons. The contigs were then used to design a custom, probe optimized, NimbleGen oligonucleotide microarray containing 133,848 probes (4 per gene). The custom array was then hybridized with cDNA from leaves sampled.

Results

Our research identifies and characterizes key structural and regulatory components of this important photosynthetic adaptation. Large-scale sequencing efforts and expression profiling using biotechnological techniques like micro-arrays are providing a rich source of sequence information for identifying novel genes or gene family members and expression patterns peculiar to CAM plants.

If these promising but preliminary results can be replicated and expanded upon, the unique CAM mechanisms of desert succulents could open new routes for engineering crops that are better able to cope with the harsh environments of semi-arid and arid regions that must be pressed into agricultural service in order to feed the world's exploding population.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants

Outcome #4

1. Outcome Measures

Increasing Basin Wildrye for Wintering Livestock, Wildlife Habitat, and Seed Production

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	{No Data Entered}	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Great Basin wildrye or basin wildrye is a native grass species that has been ignored for many years but has great potential for wintering livestock, wildlife habitat, and commercial seed production. By increasing the dominance of basin wildrye on private pastures, many Great Basin ranchers can improve their economic and environmental sustainability.

What has been done

Researchers from the University of Nevada, Reno used three ranches in Northern Nevada to evaluate the effects of burning plots, treating plots with herbicides, aerating the soil, and intensive livestock trampling during winter months. The thought was to reduce shrub cover and other non-grazable plant competition, releasing wildrye,

resulting in a higher yield of wildrye. Researcher also tested improving wildrye pastures effects on harboring more diverse and/or abundant wildlife species.

Results

To date, ranchers have been informed through both popular and extension publications and the Cattlemen's Update program on the finds generated from this project. A number of Nevada's livestock producers have already indicated they are adopting the projected results into their management plans. The general consensus by producers was that by increasing Great Basin wildrye production they: reduced winter livestock feeding costs; enhanced wildlife habitat; reduced soil erosion; and thought that wildrye might be out competing some invasive weeds.

"The potential as an alternative crop is plausible", states Dr. Perryman, the research team's lead investigator.

"The production of grass seed for commercial market could prove to be commercially viable."

4. Associated Knowledge Areas

KA Code	Knowledge Area
204	Plant Product Quality and Utility (Preharvest)
206	Basic Plant Biology
511	New and Improved Non-Food Products and Processes

Outcome #5

1. Outcome Measures

Developing a Vaccine for Epizootic Bovine Abortion

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	{No Data Entered}	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Epizootic Bovine Abortion (EBA), commonly known as Foothill Abortion, is one of the major diseases responsible for reducing calf production on ranches in western and northern Nevada, California, southern Idaho and southern Oregon. Although infected pregnant cows do not show visible signs of illness, many of them abort their fetuses at six to nine months of gestation. A significant number of infected cows carry their calves to term, but the calves delivered are weak, fail to thrive and tend to die within the first weeks of independent life. Following an abortion due to EBA, the effected cow appears to be refractory to subsequent abortion for an undetermined period. This protective immunity appears to wane unless the cows are periodically re-infected by the tick vector. The purpose of this project is to determine the length of time that this immunity remains protective following an EBA induced abortion.

What has been done

Having found the infectious vector responsible for EBA in a previous project, the research team at the University of

Nevada, Reno has developed a line of mice that play host to EBA in their spleens. After acquiring a herd of cattle for testing, the team followed the herd's responses to experimental infection by weekly evaluation of the blood of infected cattle, through complete blood counts, analysis of antibody production during infection, and for the presence of the bacterial pathogen that is the causative agent of the disease.

Results

One of the outcomes of this research has been a change in knowledge regarding the epidemiology of EBA. From our preliminary finding we have been able to detect a period of time during which all of the experimentally infected cows had the bacterial pathogen circulating in their blood stream. This is very important information since EBA is a tick borne disease and the pathogen must circulate in the blood of infected reservoir animals in order to transmit the disease to other tick vectors.

Through the integration of molecular techniques with basic clinical, this research has lead to the production of an inoculum that appears to be successful "stop gap" method of vaccination and protection in susceptible heifer calves. Over the past three years, heifers have been given inoculation shots of the new vaccine one month prior to pregnancy, with only those animals given placebos aborting. Results from this project have already been disseminated to cattle producers through educational programs such as the annual Nevada Cattleman's Update and the University of Nevada Cooperative Extension.

4. Associated Knowledge Areas

KA Code	Knowledge Area
311	Animal Diseases

Outcome #6

1. Outcome Measures

Controlling Feral Horse Population

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	{No Data Entered}	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Feral horses in the American West pose a complex and expensive management problem. Their populations continue to grow at a rate of 15-20% a year while their range continues to shrink. There is a need to control populations without adversely affecting the genetic diversity of the herd. Current management strategies of removal and adoption are expensive and logistically challenging. An efficacious, long duration, reversible contraception method would provide managers with a tool to economically manage the Northern Nevada horse populations. This project evaluates the behavioral effects of the contraceptive treatments; SpayVac, and GonaCon on mares in the wild setting.

What has been done

Over a two day period in the hills surrounding Reno, Nevada, 77 feral mares were rounded up and injected with either SpayVac or GonaCon, aged and then released in June of 2005. Injected mares were then observed weekly from February to December for the next five years to determine the efficacy of each treatment.

Results

Reduction of free-ranging horses by limiting fertility holds the greatest promise for economic, humane and effective population control. Contraception in feral horses should be safe and potentially reversible, cost effective, efficacious for several years with minimal handling required, and should not affect normal reproductive and harem maintenance behavior. Long-acting contraceptive approaches are urgently needed for feral horse population control. We have found that both of the contraceptive formulations significantly reduced fertility in all four years, suggesting that one injection was effective for up to four years.

Some treated females have returned to fertility, but most treated females have remained infertile for four years post-treatment. These injections would be beneficial for long term population control in large populations because they reduce the need for gathers for treatments. We discovered that monitoring females year-round increased our ability to detect early foal death or pregnancy loss, which is a method not normally used in efficacy studies, potentially inflating their results. Our results also showed minimal behavioral changes in treated females as it relates to mare-stallion relationships. We saw no adverse side-effects from either contraceptive treatment as treated and control females had similar social behavior.

This study has added significantly to the understanding of the behavior effects and duration of two different long-term contraceptive products. Either product will potentially add an economical tool for range management of wild and feral horse populations when compared to round-ups and adoptions.

4. Associated Knowledge Areas

KA Code	Knowledge Area
305	Animal Physiological Processes
307	Animal Management Systems

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Programmatic Challenges

Brief Explanation

Current State budget shortfalls will narrow the breadth of research programs in NAES. Fewer research projects will be supported and recruiting graduate students will be difficult. In addition, due to the Governor's hiring freeze and State budget shortfalls the College/NAES is prevented from moving forward and determining the areas of research most important to the state, nation and internationally.

Current cutbacks to our programs will also affect how we determine the most important direction of the College/NAES to remain competitive with current research issues. Several of our senior faculty will be retiring and potential layoffs are looming, will cutbacks affect our ability to fill these positions or will we be forced to cutback our research efforts to concentrate on teaching our courses. All of these issues will determine the future of our research.

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- Before-After (before and after program)
- During (during program)

Evaluation Results

Faculty programs are evaluated annually and annual reviews of performance are prepared for each calendar year. Faculty have been productive and continued to carry out cutting edge research and in addressing agricultural production in Nevada.

Key Items of Evaluation

Publications in refereed journals, invited review articles, extension publications, invitations to talk at national and international meetings.

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

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

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			2%	
112	Watershed Protection and Management			20%	
121	Management of Range Resources			13%	
122	Management and Control of Forest and Range Fires			3%	
123	Management and Sustainability of Forest Resources			1%	
133	Pollution Prevention and Mitigation			4%	
135	Aquatic and Terrestrial Wildlife			3%	
136	Conservation of Biological Diversity			13%	
206	Basic Plant Biology			7%	
211	Insects, Mites, and Other Arthropods Affecting Plants			1%	
213	Weeds Affecting Plants			6%	
302	Nutrient Utilization in Animals			7%	
304	Animal Genome			2%	
305	Animal Physiological Processes			6%	
311	Animal Diseases			11%	
601	Economics of Agricultural Production and Farm Management			1%	
Total				100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	7.0	0.0
Actual	0.0	0.0	5.1	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	397920	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	399352	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	29773	0

V(D). Planned Program (Activity)**1. Brief description of the Activity**

To address these critical issues, NAES research will be conducted on evaluating long term vegetation changes in the Great Basin, measuring heavy metal contamination in Nevada's waterways, pheromone protection of forests, evaluating livestock grazing for noxious weed management, compatibility of wildlife and livestock grazing, evaluating post wildland fire restoration and grazing systems, evaluating forest wildfires and ecosystems recovery, studying the role of soil chemistry in natural production of perchlorate and soil transport properties using NAES field labs to conserve water and improve water quality and evaluating sage grouse and pygmy rabbit habitats and developing a conservation plan compatible with Nevada agriculture.

2. Brief description of the target audience

The target audiences for research and educational programming are livestock producers, veterinarians, environmentalists, local governments, native american groups and agency personnel.

V(E). Planned Program (Outputs)**1. Standard output measures**

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	1500	4000000	350	500000
Actual	2802	6690135	169	0

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

Year: 2009

Plan: 0

Actual: 2

Patents listed

1. Nitrogen Fixation by Titanium Dioxide
2. Hydrocarbon-forming oxidative decarboxylase enzyme, hydrocarbons produced thereby, and method of use

3. Publications (Standard General Output Measure)**Number of Peer Reviewed Publications**

2009	Extension	Research	Total
Plan	0	25	

Actual	4	84	88
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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.

Year	Target	Actual
2009	25	365

Output #2

Output Measure

- Field Days Conducted

Year	Target	Actual
2009	{No Data Entered}	1

Output #3

Output Measure

- Newsletters Produced

Year	Target	Actual
2009	{No Data Entered}	2

Output #4

Output Measure

- Research Projects Conducted

Year	Target	Actual
2009	{No Data Entered}	52

Output #5

Output Measure

- Web Sites Created or Updated

Year	Target	Actual
2009	{No Data Entered}	29

Output #6**Output Measure**

- Digital Media Created or Updated

Year	Target	Actual
2009	{No Data Entered}	1

Output #7**Output Measure**

- Manuals and Other Printed Instructional Materials Produced

Year	Target	Actual
2009	{No Data Entered}	2

Output #8**Output Measure**

- Number of Graduate Students or Post-Doctorates Trained

Year	Target	Actual
2009	{No Data Entered}	81

Output #9**Output Measure**

- Number of Undergraduate Students Involved in Research

Year	Target	Actual
2009	{No Data Entered}	43

V(G). State Defined Outcomes**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	Peer reviewed journal articles, presentations at scientific meetings, articles in natural resource and environmental science magazines, presentations at stakeholder, native american and agency meetings.
2	Invasive Species in Lake Tahoe
3	Economics Analysis of Forest Infestations
4	Anthropomorphic Effects on Vegetation
5	Understanding Nevada's Terminus River Systems
6	Controlling Bark Beetle Infestation
7	Controlling Pinyon-Juniper Encroachment into Sagebrush Habitat

Outcome #1**1. Outcome Measures**

Peer reviewed journal articles, presentations at scientific meetings, articles in natural resource and environmental science magazines, presentations at stakeholder, native american and agency meetings.

Not Reporting on this Outcome Measure

Outcome #2**1. Outcome Measures**

Invasive Species in Lake Tahoe

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	{No Data Entered}	3

3c. Qualitative Outcome or Impact Statement**Issue (Who cares and Why)**

In the last 140 years, Lake Tahoe has experienced a series of intentional and unintentional (illegal) nonnative species introductions. Of recent concern are the establishments of invasive species in the near-shore environment, which is a location important for rearing of native fishes and maintenance of the lake's biodiversity and function. The scientific community believes we are already seeing invasion facilitation in the near shore of Lake Tahoe. This project will examine the expansion of warm-water fishes (e.g. largemouth bass) around the lake and how warmer water temperatures observed in the near shore due to climate change combined with increased availability of food resources from introduced crayfish and habitat availability from invasive plants are helping the invasion.

What has been done

In an effort to prevent and control proliferation of warm-water invaders in Lake Tahoe, University of Nevada, Reno investigation team: a) determined current distribution and relative abundance of warm-water non-native species within Lake Tahoe, b) collected basic ecological information from two established populations in Tahoe Keys and Taylor creek, c) developed empirical predictive models that reconstruct historical and predict future surface water temperatures of Lake Tahoe under climate change scenarios (increase in atmospheric CO₂), d) identified where in Lake Tahoe's near-shore largemouth bass are likely to establish given current conditions of temperature and habitat (vegetation), e) estimated how predation pressure on native fishes will vary among those locations, and f) determined the movement of warm-water non-native species in Tahoe Keys to determine if this location may be the source populations to other locations in the lake.

Results

In recent years, warm-water fishes occur at 58% of the 16 locations monitored in Lake Tahoe. Their establishment in the south (e.g. Tahoe Keys) has led to the continued decline of native fishes since 1999; when non-natives are present, often no native fish are caught during the surveys.

An Establishment Likelihood Model was developed for largemouth bass based on limnological and satellite data. Temperatures observed in this study revealed the entire near shore is thermally suitable for warm water fish spawning, and that future establishment is currently limited by the distribution of aquatic plants.

A Bioenergetics Model was also developed to determine the potential impact of largemouth bass on native fishes. After numerous simulations the model indicates these predators could eliminate 100% of fish biomass at 37- 80% of sites examined. Fortunately the movement and establishment of warm water fishes is still in its early stages and fish exhibit generally slower growth rates, allowing for the potential control of these populations.

Both models along with distribution maps and ecological data have now been incorporated into the "Aquatic Invasive Species Management Plan". The plan is part of a multi-stakeholder collaborative effort to minimize the deleterious effects of nuisance and invasive aquatic species in the Lake Tahoe Region.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
135	Aquatic and Terrestrial Wildlife
136	Conservation of Biological Diversity

Outcome #3

1. Outcome Measures

Economics Analysis of Forest Infestations

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	{No Data Entered}	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Unprecedented numbers of oak tree mortality were noted in Northern California in the early 1990s. Local residents coined the phrase "Sudden Oak Death" to describe the apparently rapid tree mortality they observed. Hundreds of thousands of oak trees have been killed by SOD. This project will focus on property value losses and out-of-pocket expenses accrued because of SOD.

What has been done

Researchers from the University of Nevada, Reno (UNR) and the US Forest Service assembled existing information on the economic costs and losses from tree pests (insects and diseases) with a focus on non-timber losses. UNR's team then evaluated the robustness of existing information for estimating the different use and non-use impacts that SOD may be having. They then followed up by linking the economic impact findings with forecasts of likely future damages based upon existing models of SOD spread.

Results

This research provided estimates of the costs and economic losses that accrue from SOD. These values allow the forecasting of the impacts of SOD across communities in Northern California. They also provided an estimate of the impacts of SOD on housing values as SOD moves across the landscape.

The full economic impact of Sudden Oak Death is still being tallied, and our estimates put losses in the many tens of millions of dollars. Direct losses are going to be greatest in the horticultural nursery industry, where thousands of plants have been destroyed to stop the spread of disease. The oak trees affected are valuable timber trees, but our investigation for both California and Oregon outbreak areas, heavily effects the amenity value of trees around homes can be great.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
601	Economics of Agricultural Production and Farm Management

Outcome #4

1. Outcome Measures

Anthropomorphic Effects on Vegetation

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	{No Data Entered}	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The Lake Tahoe Basin is world renowned for its natural beauty, water clarity, and winter sports activities. However, the increasing resident population and visitor use require clear roadways during the winter and hence the application of anti-icing and de-icing salts. During 1990, salt effects on vegetation adjacent to highways in the Tahoe Basin were studied. 15% of trees were salt-affected, but 1/3 of these trees had evidence for other damage. 30% of trees exhibited damage from non-salt related causes, and 55% did not exhibit any symptoms of salt, drought, disease, insect, or other damage. Thus, salts negatively impact roadside vegetation, but previous drought conditions may have made plants more susceptible to salt injury. Furthermore, salt content of soils was not abnormally high. Thus, although salts play some role in roadside vegetation damage, existing data from the Tahoe Basin also suggest that the role may be minor.

Comparisons of results from our new study with those obtained from the previous study will be used to evaluate the potential long-term impact of salts on roadside soil salinity, the health trends of vegetation along highways, and the maximum potential impact of salts on vegetation in the Tahoe Basin. Our improvements in sampling protocols (e.g. addition of new control plots, additional sampling of targeted soils and species) will strengthen the research and improve our ability to discern the damage due to salts.

What has been done

Scientists at the University of Nevada, Reno determined the degree of salt injury to roadside vegetation and the long-term impacts of de-icing salts on roadside vegetation in the Tahoe Basin. Study plots were established in Nevada and California among three land use categories (rural, urban, and control) and located among five different soil groups. During the field seasons, plots were established and trees were surveyed for disease and salt damage. Visual surveys revealed salt damage apparent to some degree on 48% of roadside trees, and 1/3 of those trees also exhibited signs of diseases and insects. Chemical analysis of soil and vegetation samples were performed on samples collected from a 1/3 of plots.

Results

After three years of data collection, the team has built a statistical model to help determine factors mainly responsible for the salt damage on the conifers in the Tahoe Basin. This knowledge is now being used to design mitigation measures. One of the prominent management alternatives could be to remove salt damaged trees from roadsides, thus favoring the more salt tolerant firs.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
206	Basic Plant Biology

Outcome #5

1. Outcome Measures

Understanding Nevada's Terminus River Systems

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	{No Data Entered}	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

In Nevada, our water supply comes from two main sources: groundwater aquifers, and surface water from streams and rivers. These two sources provide vital water for communities, natural ecosystems, agriculture and wildlife. Because water resources are so precious in Nevada, it is important for planners and government officials to understand the interactions of groundwater and surface water.

What has been done

Scientists from University of Nevada, Reno, (UNR) and the Desert Research Institute (DRI) conducted research on groundwater-surface water exchange on the Truckee and Carson rivers, located along the eastern sierra front. The goal of the research was to better understand the influences of this hyporheic exchange zone on conditions in the river bed and the adjacent floodplain.

The team has collected aerial images using heat-sensing cameras to help identify locations of groundwater influence. They also used variations in water level and temperature as a tool to track the movement of water through the rivers and the floodplain. The team evaluated the extent to which the distribution of aquatic life (such as plants, insects and fish) may be influenced by these exchanges between ground and surface water.

Results

Natural interactions between surface and groundwater yield benefits to both human communities and the stream ecosystem. On the other hand, a lack of knowledge of these processes can lead to adverse human activities that degrade the river's ability to function. Findings from these studies have contributed to a better understanding of how the river ecosystems function, which will in turn be allowing Carson City, and Washoe, Douglas, Lyon Counties to manage more effectively to sustain the aquatic habitat, biodiversity and flow volume.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management

Outcome #6

1. Outcome Measures

Controlling Bark Beetle Infestation

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	{No Data Entered}	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The mountain pine beetle causes the annual loss of billions of board feet of lumber. It is the most devastating insect pest of North American coniferous forests. Despite the economic importance of this beetle, very little is known about its biochemistry or molecular biology. This project will investigate biochemical and molecular mechanisms this bark beetle uses to communicate and deal with the tree it lives in. Genes involved in these processes may become targets for future directed control strategies. That is, use them to identify genes involved in pheromone biosynthesis, endocrine signaling, and tree bark detoxification.

What has been done

Separating the wheat from the chaff, researchers at the University of Nevada, Reno have created a stable complementary DNA library from both male and female bark beetles. Starting with over 12,000 potential DNA sequences, the team trimmed the number of genes down to a little over 4,000 tentatively unique genes. Sequence and microarray clustering analyses (finds groups of genes that are similar) were combined to identify putative pheromone biosynthetic genes. The genes were then cloned into expression vectors (used to introduce a specific gene into a target cell to produce large amounts of stable messenger RNA) for functional characterization. The sequence data have been deposited into NIH's genetic sequence database "GenBank" and the microarray data has been submitted to National Center for Biotechnology Information's Gene Expression Omnibus web site.

Results

In the realm of bark beetles, and for that matter the beetle sub-family Scolytidae, this is the first functional genomics analysis to date. The database created by the research team at the University of Nevada is a resource for all researchers working to identify unique targets for future control strategies. Some novel, apparently bark beetle-specific genes have been identified. These novelty genes are excellent candidates as targets against which methods to mitigate mountain pine beetle population explosions may be developed.

The team also developed a website to facilitate comparative analyses of beetle family Coleopteran genomics "BarkBeetleBase". The data is now being shared with a research group headed by Joerg Bohlmann and Christopher Keeling (University of British Columbia).

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
211	Insects, Mites, and Other Arthropods Affecting Plants

Outcome #7

1. Outcome Measures

Controlling Pinyon-Juniper Encroachment into Sagebrush Habitat

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	{No Data Entered}	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Pinyon-juniper woodlands and sagebrush shrubland occupy a majority of the productive regions of the Great Basin. Over the past few centuries the woodlands have gradually increased in range and density, while there has been a corresponding decrease in the extent of sagebrush shrubland and grassland. The shifting boundary (ecotone) between these two vegetation types has led to management concerns over the loss of habitat for sagebrush obligate species. As a result, there has been increased use of various types of woodland reduction treatments. Prescribed fire and mechanical tree removal by chaining are commonly used to counter the effects of expanding woodlands and simultaneously emulate natural fire, a process believed to have historically controlled pinyon-juniper woodland distribution. Although these methods are often justified by claims that the treatments would emulate natural processes, there have been relatively few studies to compare successional processes following chaining, prescribed burning, and wildfire.

What has been done

This study compared vegetation structure and composition, and rates of vegetation recovery (succession) following chaining, prescribed burning, and wildfire disturbance types over a multi-decadal period. The research team compared the long-term (30-year) responses of vegetation to prescribed fire and chaining using a combination of

field investigations and remote sensing. The team used remote sensing analysis of archival Landsat imagery to compare rates and patterns of woody cover increase among the two management treatments and with wildfires occurring during similar time periods. Spectral mixture modeling was employed to estimate tree and shrub cover values across the treated and burned areas at 5-year intervals across a 20-30 year time period. This data was then incorporated into statistical models for identifying particular types of sites where chaining is most likely to produce a long-term effect of a type desired by land managers, as well as sites where the converse is true.

Results

It is critical that management plans for restoring woodlands consider the variability in pre-settlement woodland structure and the extent of old-growth woodlands. This requires an understanding of landscape-scale influences on tree establishment, productivity gradients, and historical fire regime. Not all dense woodlands are in need of active restoration, and the appropriate restoration treatments should fit the underlying disturbance regime.

This project is providing long-term responses of the sagebrush ecosystems and woodlands to the different treatments, identifying how pre-treatment conditions affected the long-term outcomes, and modeling the influences of vegetation, topographic variation, and seeding on short-term and long-term community and fuel load responses.

The University of Nevada, Reno hopes the results will be used to provide guidelines for the selection of, and planning for, optimal treatment strategies to achieve desired long-term management outcomes when restoring sagebrush ecosystems, and reducing fuel loads.

4. Associated Knowledge Areas

KA Code	Knowledge Area
121	Management of Range Resources
122	Management and Control of Forest and Range Fires
136	Conservation of Biological Diversity
213	Weeds Affecting Plants

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Programmatic Challenges

Brief Explanation

Due to the Governor's hiring freeze and State budget shortfalls the college/NAES is prevented from moving forward and determining the areas of research most important to the state, nation and internationally. Current cutbacks to our programs will also affect how we determine the most important direction of the college/NAES to remain competitive with current research issues. Several of our senior faculty will be retiring and potential layoffs are looming, will cutbacks affect our ability to fill these positions or will we be forced to cutback our research efforts to concentrate on teaching our courses. All of these issues will determine the future of our research.

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- Before-After (before and after program)
- During (during program)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)**Program # 3****1. Name of the Planned Program**

Economic Development with Emphasis in Rural Areas

V(B). Program Knowledge Area(s)**1. Program Knowledge Areas and Percentage**

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
123	Management and Sustainability of Forest Resources			1%	
307	Animal Management Systems			38%	
602	Business Management, Finance, and Taxation			9%	
605	Natural Resource and Environmental Economics			3%	
608	Community Resource Planning and Development			25%	
610	Domestic Policy Analysis			12%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities			6%	
805	Community Institutions, Health, and Social Services			6%	
	Total			100%	

V(C). Planned Program (Inputs)**1. Actual amount of professional FTE/SYs expended this Program**

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	6.0	0.0
Actual	0.0	0.0	2.7	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	140317	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	357601	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	1071	0

V(D). Planned Program (Activity)**1. Brief description of the Activity**

Nevada scientists will continue to conduct economic analysis of various rural labor and public policy issues, research improving childcare and diverse needs of custodial grandparents in Nevada. Research will continue in economic development through the economic development center and analysis and development of rural healthcare.

2. Brief description of the target audience

Educators, community leaders, decision-makers, parents, native american organizations and health care organizations.

V(E). Planned Program (Outputs)**1. Standard output measures**

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	1500	4000000	350	500000
Actual	1797	15880	433	0

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

Year: 2009

Plan: 0

Actual: 0

Patents listed**3. Publications (Standard General Output Measure)****Number of Peer Reviewed Publications**

2009	Extension	Research	Total
Plan	0	24	
Actual	14	28	42

V(F). State Defined Outputs**Output Target****Output #1****Output Measure**

- peer reviewed scientific journal articles, publications on economic development , presentations at scientific meetings, presentations at stakeholder, native american, health care organizations, agency and local government meetings.

Year	Target	Actual
2009	24	153

Output #2**Output Measure**

- Field Days Conducted

Year	Target	Actual
2009	{No Data Entered}	1

Output #3**Output Measure**

- Newsletters Produced

Year	Target	Actual
2009	{No Data Entered}	2

Output #4**Output Measure**

- Web Sites Created or Updated

Year	Target	Actual
2009	{No Data Entered}	14

Output #5**Output Measure**

- Number of Graduate Students or Post-Doctorates Trained

Year	Target	Actual
2009	{No Data Entered}	35

Output #6**Output Measure**

- Number of Undergraduate Students Involved in Research

Year	Target	Actual
2009	{No Data Entered}	9

Output #7**Output Measure**

- Research Projects Conducted

Year	Target	Actual
2009	{No Data Entered}	23

V(G). State Defined Outcomes**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	Peer reviewed scientific journal articles, publications on economic development, presentations at scientific meetings, presentations at stakeholder, native american, health care, agency and local government meetings,
2	Estimating the Cost in Wildfire Equipment Allocation
3	Effects of Home Libraries on Educational Advantage

Outcome #1**1. Outcome Measures**

Peer reviewed scientific journal articles, publications on economic development, presentations at scientific meetings, presentations at stakeholder, native american, health care, agency and local government meetings,

Not Reporting on this Outcome Measure

Outcome #2**1. Outcome Measures**

Estimating the Cost in Wildfire Equipment Allocation

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	{No Data Entered}	1

3c. Qualitative Outcome or Impact Statement**Issue (Who cares and Why)**

Predictive Services has evolved into a respected and widely-used resource for land management agencies, however, the program has never been able to associate an economic value on the products and services provided. This project will look at a single process where Predictive Services is thought to have an economic impact; providing decision support tools to aid in the pre-positioning of Initial Attack assets (e.g. Single Engine Airtankers (SEATs), heavy tankers, engines, smokejumpers, etc.). By focusing on this narrowly defined aspect, we hope to be able to place a value on decision support products of the Predictive Service program.

What has been done

The University of Nevada, Reno investigation team selected the Western Great Basin as a case study. Members of the team input relevant data from historical records (weather, terrain, etc.) to a fire spread model that takes into account the effect of Initial Attack. A decision problem was developed to determine if a particular allocation of fire suppression resources is an efficient arrangement given a set of fire potential probabilities.

Results

Given current budget restraints, it seems prudent to plan for a scarcity of suppression resources over many geographic areas. Given scarcity, it then becomes important to understand not only how fire managers decide to deploy Initial Attack resources but the value of the information upon which those decisions are made. Fire suppression models have long confirmed the notion that Initial Attack response times affect a wildfire's final size and overall suppression costs, but more importantly, the investigation team determined that knowledge of future fire conditions and acting on this knowledge significantly affects total dollars spent on fire suppression.

This study shows that optimal positioning is not just about being closer to areas of greater risk, but also about minimizing distances to all protection areas. Most importantly, within the context of the stylized landscape it was

found that using Predictive Services' 7 Day Outlook can reduce fire agency suppression costs by up to 35% if optimal positioning is implemented.

The information provided by this investigation are currently being used by US Forest Service and BLM land managers and Nevada Division of Forestry to preposition firefighting equipment and resources to reduce the time it takes to arrive at a fire.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
608	Community Resource Planning and Development

Outcome #3

1. Outcome Measures

Effects of Home Libraries on Educational Advantage

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	{No Data Entered}	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Throughout the world, education is the key to good jobs and high incomes, and hence a central concern of our educational institutions, parents and governments. Does measuring parents' scholarly culture in a consistent manner by the number of books in the home have an impact on children's education only in a handful of rich Western nations at the end of the 20th century, or whether it is important in all rich nations, or in all market economies, or under Communism, or only in recent decades rather than in past generations.

It is not yet clear why scholarly culture has an impact. If it is an elite conspiracy using essentially arbitrary cultural signals to recognize fellow members and to exclude others, it is likely to be important only in a few nations under particular historical circumstances and vulnerable to changes in government policy.

But if scholarly culture provides skills and knowledge that are central to literacy and numeracy, and hence valuable in schools everywhere, it is likely to be important throughout the world and little affected by historical circumstance or government policy.

What has been done

The researchers used data from the World Inequality Study, which pooled information from a series of representative national samples. In most nations, survey participants (a total of more than 73,000 people) were asked to estimate the number of books in their parents' home when they were 14 years old. The scholars compared that figure with other factors influencing educational achievement, including the education levels of one's parents.

Results

After examining statistics from 27 nations, University of Nevada, Reno researchers found the presence of book-lined shelves in the home -- and the intellectual environment those volumes reflect -- gives children an enormous advantage in school.

"Home library size has a very substantial effect on educational attainment, even adjusting for parents' education, father's occupational status and other family background characteristics," University of Nevada, Reno's Dr. Mariah Evans. "Growing up in a home with 500 books would propel a child 3.2 years further in education, on average, than would growing up in a similar home with few or no books.

"This is a large effect, both absolutely and in comparison with other influences on education," adds the research team, led by Dr. Evans. "A child from a family rich in books is 19% more likely to complete university than a comparable child growing up without a home library."

"In short, families matter not just for the material resources they provide, not just because of parents' formal educational skills, but also - often more importantly - because of the scholarly culture they embody."

4. Associated Knowledge Areas

KA Code	Knowledge Area
803	Sociological and Technological Change Affecting Individuals, Families, and Communities

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Programmatic Challenges

Brief Explanation

Current State budget shortfalls will narrow the breadth of research programs in NAES. Fewer research projects will be supported and recruiting graduate students will be difficult. In addition, due to the Governor's hiring freeze and State budget shortfalls the College/NAES is prevented from moving forward and determining the areas of research most important to the state, nation and internationally.

Current cutbacks to our programs will also affect how we determine the most important direction of the College/NAES to remain competitive with current research issues. Several of our senior faculty will be retiring and potential layoffs are looming, will cutbacks affect our ability to fill these positions or will we be forced to cutback our research efforts to concentrate on teaching our courses. All of these issues will determine the future of our research.

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- Before-After (before and after program)
- During (during program)

Evaluation Results

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Nutrition and Health

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
133	Pollution Prevention and Mitigation			21%	
134	Outdoor Recreation			3%	
703	Nutrition Education and Behavior			22%	
724	Healthy Lifestyle			8%	
802	Human Development and Family Well-Being			40%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities			1%	
901	Program and Project Design, and Statistics			5%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	2.5	0.0
Actual	0.0	0.0	2.6	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	171424	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	246408	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

Our POW goal is to conduct research to better understand healthy life style habits, and educational programs that focuses on healthy life style habits. NAES research is focusing on stem cell transplantation to treat human disease, nutritional

intervention in the treatment of cancer, nutritional protection from side stream cigarette smoke, evaluating the beneficial effect of functional foods, studying school education programs on children's nutrition, and studying youth development.

2. Brief description of the target audience

The target audience for educational programming is consumers, health care personell, agency personnel, local school boards, and nutrition support groups.

V(E). Planned Program (Outputs)

1. Standard output measures

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	1500	4000000	350	500000
Actual	538	56898	0	0

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

Patent Applications Submitted

Year: 2009
 Plan: 0
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2009	Extension	Research	Total
Plan	0	28	
Actual	0	28	28

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer reviewed scientific publications, publications in health and nutrition organization publications, presentations at scientific meetings, presentations at stakeholder, agency, school board, native american, and local governmental meetings.

Year	Target	Actual
2009	28	73

Output #2

Output Measure

- Newsletters Produced

Year	Target	Actual
2009	{No Data Entered}	2

Output #3

Output Measure

- Research Projects Conducted

Year	Target	Actual
2009	{No Data Entered}	17

Output #4

Output Measure

- Web Site Created or Updated

Year	Target	Actual
2009	{No Data Entered}	3

Output #5

Output Measure

- Number of Graduate Students or Post-Doctorates Trained

Year	Target	Actual
2009	{No Data Entered}	19

Output #6

Output Measure

- Number of Undergraduate Students Involved in Research

Year	Target	Actual
2009	{No Data Entered}	36

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Peer reviewed scientific publications, publications in natural resource and environmental organization publications, presentations at scientific meetings, presentations at stakeholder, nutrition and health, school board, local governmental and Federal and State agency meetings.
2	Mercury in Nevada's Fish Populations
3	Determining the Source of Nevada's Leukemia Cluster

Outcome #1**1. Outcome Measures**

Peer reviewed scientific publications, publications in natural resource and environmental organization publications, presentations at scientific meetings, presentations at stakeholder, nutrition and health, school board, local governmental and Federal and State agency meetings.

Not Reporting on this Outcome Measure

Outcome #2**1. Outcome Measures**

Mercury in Nevada's Fish Populations

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	{No Data Entered}	2

3c. Qualitative Outcome or Impact Statement**Issue (Who cares and Why)**

There are more consumption advisories for mercury (Hg) than any other contaminant in the United States, with 44 states issuing advisories and 21 of these being statewide advisories. In 2007, the Nevada Department of Wildlife, Fisheries Bureau issued an annual project report that indicated that fish from Rye Patch Reservoir and Washoe Lake, both exceeded the consumption advisory concentration set by the Environmental Protection Agency.

This project focused on the measurement of a variety of parameters that are linked to formation of methyl mercury, the type of mercury that is bio-accumulated in food webs. Through collection of data at number of reservoirs with different water quality and management applications scientists are developing a scientific basis for understanding the cause of elevated Hg concentrations in fish tissues in reservoirs of Nevada.

What has been done

The team of scientists (Dept. of Natural Resources and Environmental Science, University of Nevada Cooperative Extension and Nevada Department of Wildlife) collected data that was used to understand the sources of Hg and factors promoting methyl Hg production and elevated fish Hg concentrations in Nevada reservoirs. It is expected that this data will provide the basis for some understanding of those factors corresponding with and impacting methyl Hg concentrations in fish tissue.

The team also developed fact sheets and a workshop / presentation protocol for providing information on Hg biogeochemical cycling and Hg in fish for stakeholders, and a separate protocol used for public information meetings.

Results

This project provided information that is useful for those trying to mitigate consumption advisories in the state of Nevada. In general, total and methyl mercury concentrations in these water bodies were low and similar to those associated with pristine systems. Thus it is important to understand other factors that would be enhancing the mercury uptake and methyl mercury production.

Because the source of Hg cannot be controlled it is recommended that water levels and aquatic food webs in these highly managed systems are potential means of control that may be exercised by watershed managers to reduce fish Hg concentrations.

UNCE explored fish consumption patterns in Nevada through surveys of two different populations-fisherman and general consumers. Surveys were done in cooperation with Nevada Division of Wildlife
The team convened a workshop of Nevada Stakeholders June 24, 2009 that consisted of 6 presentations including an outside speaker from the Minnesota Dept. of Health. Fifty people from local, state and federal agencies attended.

We are expecting that this project would, given the importance of Hg and the high numbers of fish consumption advisories across the nation, result in a database that could be used to make advisory reports more exacting.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
134	Outdoor Recreation
703	Nutrition Education and Behavior

Outcome #3

1. Outcome Measures

Determining the Source of Nevada's Leukemia Cluster

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	{No Data Entered}	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

In a period from 1997 until the end of 2001, a total of 15 children, diagnosed with lymphocytic leukemia, were reported in Churchill County, Nevada. A CDC investigation of the cancer cluster demonstrated elevated levels of arsenic and tungsten in the urine of study participants and tap water samples. Extremely high levels of alpha radioactivity in numerous domestic wells used for drinking water in the Fallon area were also found which could not be accounted for by naturally occurring uranium activity in the area and were subsequently determined to come from polonium-210 contamination. This study determined if consumption of drinking water from one or more sources high in one or more of these chemicals from Churchill County Nevada could induce oxidative stress in test

animals.

What has been done

The University of Nevada, Reno investigating team collected and analyzed both groundwater and well water from around Churchill County, NV for arsenic, tungsten and polonium-210, all potentially carcinogenic compounds. Using this water from sources determined to be high in one or all of these compounds, the investigators provided the water to mice as their source of drinking water. The team monitored these mice over ten weeks for a variety of biological markers indicative of oxidative stress and the onset of leukemia.

Results

The results of this study are providing valuable information regarding the potential for various Churchill County, NV water sources to increase the risk of developing leukemia. The study also provided valuable information regarding the distribution of polonium-210 in the Churchill County water supply to regional water authorities.

"While the study suggests biological damage can result from exposure to the four elements, it's unclear whether the damage itself could lead to leukemogenesis or make individuals more sensitive to other leukemia triggers", Dr Chris Pritsos, lead investigator.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
724	Healthy Lifestyle

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Programmatic Challenges

Brief Explanation

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- Before-After (before and after program)
- During (during program)

Evaluation Results

Key Items of Evaluation

V(A). Planned Program (Summary)**Program # 5****1. Name of the Planned Program**

Childhood Obesity

V(B). Program Knowledge Area(s)**1. Program Knowledge Areas and Percentage**

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
703	Nutrition Education and Behavior			74%	
724	Healthy Lifestyle			21%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities			1%	
901	Program and Project Design, and Statistics			4%	
	Total			100%	

V(C). Planned Program (Inputs)**1. Actual amount of professional FTE/SYs expended this Program**

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Actual	0.0	0.0	2.1	0.0

Actual	0.0	0.0	2.1	0.0
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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	0	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	0	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**

Scientists are developing a community weight control model for use in Nevada's city clinics. Investigation has begun into the effects of distance to parks, trails, food outlets, etc. in relation to amount of vegetable consumed and obesity. The Washoe County School District has implemented a Student Wellness Policy; researchers are identifying best practices at the school and classroom level, and reporting on its execution and effectiveness.

2. Brief description of the target audience

Educators, health professionals, general public and policy-makers

V(E). Planned Program (Outputs)

1. Standard output measures

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
Actual	230	0	0	0

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

Patent Applications Submitted

Year: 2009

Plan:

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2009	Extension	Research	Total
Plan			
Actual	0	11	11

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer reviewed journal articles, publications in commodity group publications, presentations at scientific meetings, presentations at stakeholder, Native American and agency meetings.

Year	Target	Actual
2009	{No Data Entered}	28

Output #2

Output Measure

- Newsletters Produced

Year	Target	Actual
2009	{No Data Entered}	2

Output #3

Output Measure

- Research Projects Conducted

Year	Target	Actual
2009	{No Data Entered}	9

Output #4

Output Measure

- Web Sites Created or Updated

Year	Target	Actual
2009	{No Data Entered}	3

Output #5

Output Measure

- Number of Graduate Students or Post-Doctorates Trained

Year	Target	Actual
2009	{No Data Entered}	7

Output #6

Output Measure

- Number of Undergraduate Students Involved in Research

Year	Target	Actual
2009	{No Data Entered}	30

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Evaluation Of Obesity, Diet and Nevada's Built Environments

Outcome #1**1. Outcome Measures**

Evaluation Of Obesity, Diet and Nevada's Built Environments

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	{No Data Entered}	1

3c. Qualitative Outcome or Impact Statement**Issue (Who cares and Why)**

We live in an obesogenic environment that relies heavily on fast food, automobiles and remote controls - all of which can be labeled as 'toxic' to maintaining a healthy body weight. Urban designers have created an "obesogenic environment" by planning public spaces around motorized transportation. Transport systems that made it easier to drive than to walk, cycle or take public transport are some of the worst contributors to obesity.

Obesity, physical inactivity and inadequate consumption of fruits or vegetables are common in Nevada adults. This study aims to identify built environmental attributes (e.g. distance/number of parks, bike paths, walking trails, food outlets, etc.) that encourage or discourage physical activity through newly developed methodology.

What has been done

The research team first retrieved Nevada's dataset from the Behavioral Risk Factor Surveillance System - an ongoing telephone health survey system, tracking health conditions and risk behaviors in the US. The dataset was then geo-coded for inclusion into a GIS database. A second set of data was collected that included the majority of community-based variables (e.g. distance/number of parks, bike paths, walking trails, food outlets, etc.). This set was then geo-coded, and inputted to the GIS database.

GIS spatial analysis and weighted multiple logistic regression statistics were carried out to determine the relationships between distance and number of built environmental variables.

Results

Obesity is costing employers over \$13 Billion dollars a year nationally. Employees are missing millions of work days due to illness related to obesity. Interventions should be developed from the individual to the neighborhood level, specifically focusing on the effects of eliminating barriers and making neighborhood level improvements that would facilitate the elimination of obesogenic environments.

Taking their lead from the research team at the University of Nevada, Reno, the city of Fallon, NV has begun to develop policy and environmental change initiatives that make healthy choices in nutrition and physical activity available, affordable, and easy, with the understanding that these efforts will likely prove most effective in combating obesity.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
724	Healthy Lifestyle

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Public Policy changes
- Government Regulations
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)**Program # 6****1. Name of the Planned Program**

Climate Change

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%	
104	Protect Soil from Harmful Effects of Natural Elements			9%	
112	Watershed Protection and Management			23%	
206	Basic Plant Biology			35%	
302	Nutrient Utilization in Animals			19%	
	Total			100%	

V(C). Planned Program (Inputs)**1. Actual amount of professional FTE/SYs expended this Program**

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Actual	0.0	0.0	4.2	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	0	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	0	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	500788	0

V(D). Planned Program (Activity)**1. Brief description of the Activity**

Scientists are investigating: avian and forest vulnerability, the effects of elevated nitrogen on forest, the effects of nutrients and carbon fluctuations across aquatic and desert ecosystems, the effects on soils at the rain-snow transition zone, and creating educational programs that stimulates transformative research, education and outreach on effects of regional climate change on ecosystem resources.

2. Brief description of the target audience

Scientific community, resource managers, Nevada System of Higher Education faculty, students, and constituents, and policy makers.

V(E). Planned Program (Outputs)

1. Standard output measures

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
Actual	260	0	0	0

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

Patent Applications Submitted

Year: 2009

Plan:

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2009	Extension	Research	Total
Plan			
Actual	0	47	47

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer reviewed journal articles, publications in commodity group publications, presentations at scientific meetings, presentations at stakeholder, Native American and agency meetings.

Year	Target	Actual
2009	{No Data Entered}	166

Output #2

Output Measure

- Research Projects Conducted

Year	Target	Actual
2009	{No Data Entered}	54

Output #3

Output Measure

- Number of Graduate Students or Post-Doctorates Trained

Year	Target	Actual
2009	{No Data Entered}	65

Output #4

Output Measure

- Number of Undergraduate Students Involved in Research

Year	Target	Actual
2009	{No Data Entered}	58

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Effects of Increased CO2 Levels on Desert

Outcome #1**1. Outcome Measures**

Effects of Increased CO₂ Levels on Desert

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	{No Data Entered}	3

3c. Qualitative Outcome or Impact Statement**Issue (Who cares and Why)**

Current global models predict that carbon dioxide (CO₂) levels in the atmosphere will double pre-industrial levels by the year 2050. Increasing atmospheric CO₂ may lead to global warming and other climate changes. By the processes of photosynthesis and respiration, CO₂ is exchanged between the atmosphere and the land where it is sequestered as wood and other organic forms in the soil. Elevated CO₂ also increases productivity particularly in desert ecosystems.

Information is needed on the exchange process in order to predict climate change. Will there be changes in the rate at which plants grow over the next hundred years? Will the storage of carbon in the desert ecosystem change? Will water balance change in this arid environment? Will species composition of desert plant communities change?

What has been done

To examine responses of arid ecosystems to elevated atmospheric CO₂, a host of contributors established the Nevada Desert FACE (Free Air CO₂ Enrichment) Facility in the Mojave Desert of southern Nevada, which is the driest area of North America.

Over the past ten years, University of Nevada, Reno's investigation team have determined the effect of elevated CO₂ on key physiological processes that affect primary production in an intact Mojave Desert ecosystem. They have determined the effect of elevated CO₂ on seasonal and inter-annual variations in climate constraints on primary production in an intact Mojave Desert ecosystem. They have established how elevated CO₂ may impact ecosystem water balance, and therefore the water limitation to primary production, in this water-limited system. They have ascertained the effects of elevated CO₂ on nitrogen dynamics, including N-fixation, volatilization and nitrification rates, and litter decomposition. They have established the effect of elevated CO₂ on total belowground respiration in a Mojave Desert ecosystem.

The team evaluated the impacts of elevated CO₂ on plant reproductive patterns in an intact Mojave Desert ecosystem to provide the link between species performance and population reaction to elevated CO₂, while also, assessing the impacts of elevated CO₂ on fine roots: their occurrence, length, area density, population dynamics and biomass production.

Results

Arid ecosystems are some of the most important biomes globally on a land surface area basis, are increasing in

area at an alarming pace, and have a strong coupling with regional climate. These water-limited ecosystems also are predicted to be the most sensitive to elevated CO₂, in part because they are stressful environments where plant responses to elevated CO₂ may be amplified.

Results from the University's work at the Nevada Desert FACE Facility have provided significant insight into the complex responses of an intact desert ecosystem to elevated CO₂. This project is helping land managers and ecologists: (1) understand the structure and function of desert ecosystems; (2) how elevated atmospheric CO₂ will affect the structure and function of desert ecosystems; and (3) is providing guidance to land managers and users on actions that will adversely affect deserts in the short- and long-term.

4. Associated Knowledge Areas

KA Code	Knowledge Area
206	Basic Plant Biology

V(H). Planned Program (External Factors)

External factors which affected outcomes

Brief Explanation

{No Data Entered}

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)**Program # 7****1. Name of the Planned Program**

Sustainable Energy

V(B). Program Knowledge Area(s)**1. Program Knowledge Areas and Percentage**

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
204	Plant Product Quality and Utility (Preharvest)			7%	
206	Basic Plant Biology			69%	
511	New and Improved Non-Food Products and Processes			24%	
	Total			100%	

V(C). Planned Program (Inputs)**1. Actual amount of professional FTE/SYs expended this Program**

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Actual	0.0	0.0	1.7	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	0	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	0	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	243567	0

V(D). Planned Program (Activity)**1. Brief description of the Activity**

Scientists are currently determining best algal species (survival and growth rates, fat and starch content) for production of oils that will then be processed into biofuels. Investigation into Nevada's highly prolific rabbit brush as a good candidate for production of industrial (i.e., rubber, plastics, coatings, lubricants and adhesives) and energy feedstocks (i.e. biodiesel and cellulosic-based liquid fuels).

2. Brief description of the target audience

Those most effect by this research include the general public, energy and chemical industry, potential producers.

V(E). Planned Program (Outputs)

1. Standard output measures

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
Actual	15	0	85	0

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

Patent Applications Submitted

Year: 2009

Plan:

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2009	Extension	Research	Total
Plan			
Actual	0	9	9

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer reviewed journal articles, publications in commodity group publications, presentations at scientific meetings, presentations at stakeholder, Native American and agency meetings.

Year	Target	Actual
2009	{No Data Entered}	37

Output #2

Output Measure

- Demonstrations and Field Days Conducted

Year	Target	Actual
2009	{No Data Entered}	4

Output #3

Output Measure

- Number of Graduate Students or Post-Doctorates Trained

Year	Target	Actual
2009	{No Data Entered}	3

Output #4

Output Measure

- Number of Undergraduate Students Involved in Research

Year	Target	Actual
2009	{No Data Entered}	0

Output #5

Output Measure

- Research Projects Conducted

Year	Target	Actual
2009	{No Data Entered}	1

V(G). State Defined Outcomes**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	Evaluating Algae's Potential as Feed Stock for Biofuel Production
2	Developing Better Plants for Biofuel Production
3	Rabbit Brush Potential for Domestic Rubber Production

Outcome #1**1. Outcome Measures**

Evaluating Algae's Potential as Feed Stock for Biofuel Production

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	{No Data Entered}	3

3c. Qualitative Outcome or Impact Statement**Issue (Who cares and Why)**

Existing oilseed feed stocks derived from terrestrial plants (e.g. soybeans) cannot satisfy the current or projected transportation fuel needs of the U.S. Biofuel producing algae are one of the only avenues available for high-volume capture and reuse of CO₂ generated in biomass-, coal- or natural gas-fired power plants and can provide the intermountain west with a major new "cash crop" without putting additional demands on freshwater supplies needed for residential, industrial and agricultural use. Nevada researchers and producers are uniquely enabled to leverage the geothermal, high solar radiation, ample land area, and salt basins to produce algae in a scalable and economically viable manner. The goal of this research is to explore alternative strains of algae for use as biofuel feed stocks and new nutrient mediums in which to grow algae.

What has been done

Building upon previous strains of salt-loving algae, analysis of growth rates, lipid content, and insoluble starch content has been completed for 11 strains of freshwater algae and 12 brackish water strains. In cooperation with Truckee Meadows Water Reclamation Facility (TMWRF) in Sparks, NV, large industrial centrifuges were used to remove wastewater sludge from Sparks' sewage. The water leaving a centrifuge after most of the solids have been removed (centrate) was then collected, added to algae growth solution. Research is in progress to identify the optimal centrate loading for algal use as well as water quality analyses to establish the product water quality following algae harvesting.

Algal stains have been tested and shown to be able to grow in up to 20% centrate while removing more than 50% of N and P content. Selection of algal strains that can tolerate higher concentrations of centrate is also in progress. Large-scale production trials of algae on centrate have been completed at the 2,000 L raceway ponds. Productivities are about 60% of those obtained by control fertilizer media. Kilogram quantities of algal paste have been produced for solvent extraction trials.

Genetic analysis of these strains is now in progress as are continued rounds of selection. Total genomic DNA and RNA from *Dunaliella salina* (a salt-loving, pink micro-algae) was submitted to the Joint Genome Institute for genomic sequencing and annotation. This information will be instrumental in improving the accuracy of genome annotation and mRNA expression analysis to test the effects of nutrient deprivation or other stress conditions on lipid production.

Results

The University of Nevada, Reno investigation team needing high concentrations of nitrogen, phosphorus and

inorganic carbon, key nutrients required for algae growth, have setup an alliance with TMWRF to accept a secondary wastewater product (citrate). At present, TMWRF produces approximately 250,000 gallons of centrate per day, which is recycled to the head of the treatment facility. Utilizing this liquid stream for beneficial purposes as a nutrient source for algae growth would save the treatment facility about \$4,400/day and \$2,900/day for nitrogen and phosphorus removal, respectively, or \$2.7 M annually while generating ~1,600 gallons of oil per day assuming a 30% lipid content of the algae.

After 20 rounds of reiterative density gradient centrifugation, investigators have been able to increase lipid content by 39% and starch content by 227%. In addition, a room-size "demonstration" scale production facility is now operational to educate scientists, investors, and the lay public about the potential feasibility of the algae-to-biodiesel conversion process and related technologies.

4. Associated Knowledge Areas

KA Code	Knowledge Area
206	Basic Plant Biology
511	New and Improved Non-Food Products and Processes

Outcome #2

1. Outcome Measures

Developing Better Plants for Biofuel Production

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	{No Data Entered}	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The Department of Energy (DOE) has requested the scientific community to increase the energy density of nontraditional oil crops by understanding and manipulating the metabolic and genetic circuits that control accumulation of oils and other easily digestible, energy-rich compounds in plant tissues. In response, University of Nevada, Reno scientists are focused on how different cellular pumps can potentially be used to alter a plant cell's membrane structures and increase lipid content for use in biofuels. With one of the primary goals of the DOE's "Energy Mission" being to explore the potential of using lipid enzymes to trigger the formation of novel lipid storage organelles, this project is trying to understand the biological functions of different P-type ATPases (ion pumps or membrane pumps) in nontraditional crops.

What has been done

Using a genetic engineering technique call the "double knockout mutation" a vacuole calcium pump has been found to develop leaves in test plants with large numbers of necrotic lesions. This advancement is important for several reasons, including the potential to use these mutants as a screening/measuring technique for targeting information that directs calcium pumps to the vacuole. This will allow scientists to add or mutate potential targeting information to a cell's outer wall calcium pump and test whether it can be relocated to other areas within the plant.

In collaboration with the Palmgren group, the University of Nevada, Reno identified the first plant phenotype for a gene knockout of a lipid enzyme pump. Plants harboring a disruption of this gene grow more slowly and have reduced biomass. The team obtained evidence that the underlying cause of this defect is related to a defect in secretory activity of selected cell types.

Progress has also been made on determining the effects on membrane lipid profiles caused by gene disruptions in three different subfamilies of enzyme pumps; determining whether gene disruptions for supposed enzyme pump subunits will result in phenotypes that match earlier mutations; and, identifying changes in cellular functions caused by over-expression/activity of enzyme pumps.

Results

The success of the U.S. biofuel industry depends, to a large degree, on the quantity and quality of biomass available, and on the industry's ability to cost-effectively utilize biomass for energy production. Advances resulting from this project will provide the knowledge needed to develop new bio-based products, methods, and tools that the emerging biofuel industry can use.

Research efforts at the University of Nevada, Reno have opened the door to creating this genetically modified biofuel. If new invaginations (or membrane compartments) can be induced in lab plants, this represents a potential strategy to increase the lipid content of any photosynthetic cell, and thereby increase its value as a feedstock for biodiesel production.

4. Associated Knowledge Areas

KA Code	Knowledge Area
206	Basic Plant Biology

Outcome #3

1. Outcome Measures

Rabbit Brush Potential for Domestic Rubber Production

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	{No Data Entered}	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Global warming and decreasing oil reserves have mandated the development of renewable and sustainable alternatives to petroleum-based products. Plants, which produce zero balance carbon emission energy feedstocks, represent a particularly attractive alternative to fossil fuels. Furthermore, due the high degree of chemical diversity present in plant kingdom, many plant species are being investigated as replacement for the production of petroleum-based industrial chemicals.

One such plant species is *Chrysothamnus nauseosus* (rabbit brush). Rabbit brush is a highly prolific perennial shrub that is endemic to Nevada and the Great Basin region of the United States. This plant species produces significant amounts natural rubber, soft resins and plant based ethanol. As such, while most plants are utilized for single applications, rabbit brush could be exploited for both the production of industrial (i.e., rubber, plastics, coatings, lubricants and adhesives) and energy feedstocks (i.e. biodiesel and cellulosic-based liquid fuels).

The goal of this project is to examine the potential of rabbit brush as a multi-use industrial crop for biomaterial and bioenergy applications.

What has been done

Rubber was extracted by centrifugation and/or alginate-creaming agents. Rubber quantities were determined gravimetrically and molecular weights were determined by HPLC gel permeation chromatography. Rubber samples were also subjected to NMR analyses to determine sample purity.

Proteins were removed from extracted rubber and quantified. Rabbit brush rubber associated proteins were then separated according to their molecular weight, and subjected to an analytical technique to detect specific proteins found in rubber tree latex allergens.

Analyses determined the antigenicity of rabbit brush rubber in regards to rubber trees latex allergies. In collaboration with the Desert Research Institute and Energy Parks Incorp., we were able to obtain and make operational a BIOMAX biomass gasifier and electrical generation system. The BIOMAX will be used in future studies to estimate the energy content of rabbit brush biomass.

Results

One of the major food safety and human health concerns raised in connection with agricultural biotechnology is the issue of allergenicity. These studies showed that rabbit brush rubber has a lower allergenicity and low protein content. "This is a good thing", said Dr. David Shintani, "indicating that it could serve as a source of hypoallergenic rubber".

Dr. Shintani: "There are about 300 medical devices that require natural rubber. Many occupations require people to wear gloves and the rabbit brush rubber does not appear to produce the allergic reactions because of fewer proteins."

4. Associated Knowledge Areas

KA Code	Knowledge Area
204	Plant Product Quality and Utility (Preharvest)

V(H). Planned Program (External Factors)

External factors which affected outcomes

Brief Explanation

{No Data Entered}

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)**Program # 8****1. Name of the Planned Program**

Food Safety

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
308	Improved Animal Products (Before Harvest)			3%	
601	Economics of Agricultural Production and Farm Management			96%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins			1%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Actual	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	0	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	0	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	1389	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Provide agricultural producers in Nevada with information about the risks associated with food safety in terms of direct marketing, including legal, financial, and marketing risks. In-depth cattle handling workshop are being performed that targets the Spanish speaking workers to increased production and improved animal health through decreased stress.

2. Brief description of the target audience

This program is targeting Nevada's agricultural producers with emphasis on Spanish speakers.

V(E). Planned Program (Outputs)

1. Standard output measures

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
Actual	9328	0	1633	0

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

Patent Applications Submitted

Year: 2009

Plan:

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2009	Extension	Research	Total
Plan			
Actual	9	3	12

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer reviewed journal articles, publications in commodity group publications, presentations at scientific meetings, presentations at stakeholder, Native American and agency meetings.

Year	Target	Actual
2009	{No Data Entered}	45

Output #2

Output Measure

- Research Projects Conducted

Year	Target	Actual
2009	{No Data Entered}	6

Output #3

Output Measure

- Number of Graduate Students or Post-Doctorates Trained

Year	Target	Actual
2009	{No Data Entered}	4

Output #4

Output Measure

- Number of Undergraduate Students Involved in Research

Year	Target	Actual
2009	{No Data Entered}	9

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Healthy People 2010 Program for Nevada

Outcome #1**1. Outcome Measures**

Healthy People 2010 Program for Nevada

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	{No Data Entered}	0

3c. Qualitative Outcome or Impact Statement**Issue (Who cares and Why)**

This program underscores the goal of Healthy People 2010, "preventing food-borne illness and death and substantially reducing food-borne disease outbreaks". One in every five individuals in the U.S. falls into one of the at-risk categories. Because of Nevada's growing elderly and young populations and the economic dependency on food service related tourism, we are particularly vulnerable for food-borne illness. One objective of this program is to strive to improved communication between all the entities within our state that are held accountable for food safety and security. In addition, we are striving to help ensure that new and developing food entities in Nevada have the necessary materials to prevent food-borne (FBI) illnesses, such as; school lunch programs, valued added foods in Nevada, and hydroponically grown fruits and vegetable from Nevada. One high priority area identified by the Nevada Food Safety Task Force (NFSTF) was the need for better Food borne Illness (FBI) communication in Nevada, i.e., emergency identification of serious outbreaks in Nevada between regulatory agencies, academic institutions and food industry. Our goal is to provide education and information regarding food safety for clients interested in developing Nevada based value added products

What has been done

Data regarding communication of food-borne illnesses (FBI) outbreaks between food safety entities has been statistically analyzed and project reports (manuscripts) are in draft status. We will be working towards submitting manuscripts to peer-reviewed journals this coming year. Work regarding developing food safety information for clients interested in developing Nevada based value added products is ongoing. We have done further evaluation of the data regarding FBI communications and have summarized the data in a manuscript detailing our findings. Our findings have also served, as a partial needs assessment, for which was used as preliminary data to develop grant funding requests (see research) directed at a RFA from the USDA (see Contracts, Grants, Sponsored Research and Commissions section of DM). Working with NFSTF, we hope to identify other projects that require research-based activities.

Results

UNR researchers have identified gaps in FBI communication and based on Task Force's recommendations, steps have been taken to improve food safety communication in the state of Nevada. One critical issue that has been identified in our attempts to improve food safety communications is the problem of budget cutbacks and loss of keep personnel which introduces in gaps in the communication network. In 2008 we initiated a UNR alliance of faculty who are interested in food safety research, teaching and outreach. The alliance is composed of faculty member from College of Ag, Cooperative Extension, and School of Community Health. The alliance is working to increase financial resources devoted to food safety.

4. Associated Knowledge Areas

KA Code	Knowledge Area
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

V(H). Planned Program (External Factors)

External factors which affected outcomes

Brief Explanation

{No Data Entered}

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}