V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Animals and their Systems

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
121	Management of Range Resources			10%	
135	Aquatic and Terrestrial Wildlife			42%	
136	Conservation of Biological Diversity			24%	
301	Reproductive Performance of Animals			2%	
302	Nutrient Utilization in Animals			13%	
307	Animal Management Systems			2%	
311	Animal Diseases			5%	
722	Zoonotic Diseases and Parasites Affecting Humans			2%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	2.5	0.0
Actual Paid	0.0	0.0	6.9	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
0	0	325722	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	300658	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

Epizootic Bovine Abortion Immunity Responses Longevity Trials
Over the past year, the team has been developing and validating an indirect fluorescent antibody test for determining exposure to the EBA. The expectation is this test will serve as a useful tool in the management of this disease. The serology assay is rapid, reproducible, and unaffected by fluid color or opacity. Total fetal immunoglobulin (antibody) was also evaluated as an aid for diagnosing EBA. The presence of IgG is a sensitive indicator of EBA and increases the specificity of serologic diagnosis when concentration of antibodies found in the animal are between 10 or 100. Taken together, serology and IgG analyses suggest that the incidence of EBA may be underestimated.

Understanding the Role of Animals in Maintaining and Transmitting Relasping Fever in Humans
UNR scientists in collaboration with Northern Arizona University, ran 284 microsatellites sequenced on 11 genes of Eastern Sierras chipmunks. Simulations were put through analysis of subpopulation structure through the program STRUCTURE, and Structure harvester. Model selection was then preformed within and between simulations and a single model was chosen to represent the results.

Analysis to pick up subpopulation structure in the sites separated on the basis of domestic versus wild habitat type suggests that while domestic sites may experience greater rates of migration, they do represent detectable subpopulations especially in comparison with the surrounding areas. Since the tick vectors for relapse fever stay at their nest or birthplace for a long time after birth, these locations may act as the focal point from which infection spreads to the surrounding areas. This could be the most important finding of this analysis due to its implications with public heath, and mitigation strategies to curb, or prevent spillover events from the wild population.

Rangeland Management Problems Associated With Cattle Foraging On Forage Kochia
This project has moved from focusing on the range science aspects of Forage Kochia as a viable forage to the animal nutrition laboratories of UNR. Two concurrent projects were conducted to clarify National Animal Nutrition Programs' Nutritional Requirements (2000) nutrient values of Forage Kochia in the Great Basin. A dual-flow continuous culture system was used to determine dry matter, organic matter, neutral detergent fiber, acid detergent fiber, ether extract, ash, fatty acids, and bacterial purines.

The second project utilized cannulated cattle to obtain omasal true digesta. Analyzes for total nitrogen, absolute dry matter, ash, organic matter, neutral detergent fiber, acid detergent fiber, neutral detergent insoluble nitrogen, and acid detergent insoluble nitrogen were conducted on feed samples as determined

by prior In Vitro studies.

Alternative Production Systems: Growing-Finishing Swine Northern Nevada Pastures
A growing interest in small farm swine production has led to the Experiment Station investigating cost effective methods to raise and finish hogs. Over the past year, Main Station Field Lab has improved its infrastructure to accommodate swine production. Animals were purchased, pins, sheds, and fencing have been installed. Feeding trials will begin spring of 2015.

Genetic Landscape of Big Horn Sheep Diseases
NAES scientists in collaboration with the Nevada Department of Wildlife have all genetic samples in hand and have developed collaborations and protocols for genotype-by-sequencing approaches to be used in this project. Analysis of the correlation of genetic diversity and population connectivity with disease prevalence was started using high-throughput sequencing and will continue into the spring 2015.

Impacts of Cattle and Feral Horses on Sage Grouse Survival
At the conclusion of the 2014 season, UNR's research team has marked a total of 843 sage-grouse. With data thus far, a multitude of population models have been designed (+2,800), used in predicting survival rates of adults, juveniles, chicks, and eggs. Vegetation models were also constructed using nest-side samples (+240) and random plots (+360) to determine favored nest site selection on part of the parents.

Land Use Practices and Climate Change Effects on Mule Deer Populations
Over the past year, NAES wildlife scientists have radio-collared approximately 600 mule deer distributed across several study areas throughout Nevada to monitor and determine causative agents for declines in mule deer populations related to nutrition, environmental conditions, habitat use, migration, dispersal, and predation in adult and juvenile mule deer. The team has collected nutritional information on 500+ mule deer in 3 major study areas across the state. They continue to collect fine-scale movement data on 300+ adult mule deer. Energetics modeling have been developed and await final acquisition of GPS collar information. Finally the team continues to monitor and quantify predation and other related causes of mule deer population declines of 135 mortality events during 2013 and 2014.

Bovine Viral Diarrhea Virus in Free-Ranging Population of Ungulates
To determine the effect of BVDV infections in mule deer in regard to reproductive failures, fawn mortalities and herd recruitment, NAES scientists are still processing sample for analysis of glucocorticoid levels (a response to the immune system). Scientists have quantified bacteria killing ability and hemolytic complement activity, and are currently testing for two antibody levels (IgM & IgG) in deer serum. Finally, the team has begun analyzing samples for presence of BVDV in elk serum. Those samples are currently being processed for antibodies for BVD.

Effects of Provision Water on Juvenile Mule Deer's Survival and Recruitment
During 2014, NAES wildlife scientists captured 31 adult mule deer and 22 neonates and monitored those individuals for survival. The team also continued monitored adults collared the prior year (45) to understand selection of resources in three study areas within the Mojave National Preserve. Neonates were monitored intensively for the first three months and then weekly for the rest of the first six months when expandable collars dropped. Adults were monitored year around and any mortalities were collected and radio collard retrieved. Radio collars were programmed to drop off each individual adult in November 2014.

Impact Of Acute Non-Lethal Neurotoxic Compounds Exposure On Migratory Bird Species
In 2013, our scientists initiated studies to access the impact of methyl mercury on avian reproduction using the homing pigeon model (a surrogates for migratory birds). Findings were reported in 2014 for exposure

at 1.0 mg/kg body wt/day. This year the team conducted a similar study at lower dosages in order to assess a dose-dependent response. They conducted reproductive studies at 0.5 mg MeHG/kg body wt/day, or half the dosage tested the previous year. New for this year was the inclusion of reproductive success and chick survival rates.

Forage Evaluation Of Ephedrine Content And Nutritional Quality
The primary goal of this study is to assist Nevada ranchers (especially sheep operations) in dealing with a rangeland management problem associated with domestic livestock foraging on Ephedra species. Planning efforts were completed with the first sample period beginning in December 2014.

2. Brief description of the target audience

Target audiences include US Fish & Wildlife Services, Nevada Department of Wildlife, sport hunters, livestock owners, local residents, numerous wildlife oriented NGOs, land-use planning agencies, and the scientific community in general.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	130	0	0	0

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

Patent Applications Submitted

Year: 2014
Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	0	9	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Demonstrations, Field Days, and Workshops Conducted

Year	Actual
2014	3

Output #2

Output Measure

- Newsletters Produced

Year	Actual
2014	1

Output #3

Output Measure

- Leveraged Research Projects

Year	Actual
2014	690212

Output #4

Output Measure

- Web Sites Created or Updated

Year	Actual
2014	2

Output #5

Output Measure

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

Output #6

Output Measure

- Number of Graduate Students or Post-Doctorates Trained

Year	Actual
2014	6

Output #7

Output Measure

- Number of Undergraduate Students Involved in Research

Year	Actual
2014	53

Output #8

Output Measure

- Peer reviewed journal articles, chapters, or books.

Year	Actual
2014	14

Output #9

Output Measure

- Non-peer reviewed publications

Year	Actual
2014	1

Output #10

Output Measure

- Presentations

Year	Actual
2014	41

Output #11

Output Measure

- Databases, Models, Protocols, and Research Materials

Year	Actual
2014	2808

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	New fundamental or Applied knowledge
2	Improved skills of students, post-doctorate, and stakeholders
3	New or improved methods
4	Adopt and use new methods or improved technology
5	Greater productivity in food provisions
6	Use new or improved animal varieties
7	Actively apply practical policy and decision-making knowledge
8	Testing a Vaccine for Epizootic Bovine Abortion (a.k.a. Foothill Abortion)
9	Rodents Role in Maintaining the Tick-Borne Disease "Relapsing Fever" in Nature
10	Impact of Low Level Mercury Exposure on Reproductive and Development in Birds
11	Quantifying Nutritional Values of Alternative Forages Found in Nevada

Outcome #1

1. **Outcome Measures**

   New fundamental or Applied knowledge

   Not Reporting on this Outcome Measure

Outcome #2

1. **Outcome Measures**

   Improved skills of students, post-doctorate, and stakeholders

   Not Reporting on this Outcome Measure

Outcome #3

1. **Outcome Measures**

   New or improved methods

   Not Reporting on this Outcome Measure

Outcome #4

1. **Outcome Measures**

   Adopt and use new methods or improved technology

   Not Reporting on this Outcome Measure

Outcome #5

1. **Outcome Measures**

   Greater productivity in food provisions

   Not Reporting on this Outcome Measure

Outcome #6

1. **Outcome Measures**

Use new or improved animal varieties

Not Reporting on this Outcome Measure

Outcome #7

1. **Outcome Measures**

Actively apply practical policy and decision-making knowledge

Not Reporting on this Outcome Measure

Outcome #8

1. **Outcome Measures**

Testing a Vaccine for Epizootic Bovine Abortion (a.k.a. Foothill Abortion)

2. **Associated Institution Types**

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
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
NAES scientists, in collaboration with UC Davis, developed and validated an indirect fluorescent antibody test (iFAT) capable of detecting antibodies specific for the agent of EBA. Sensitivity and specificity were determined by comparing antibody titers from 114 fetuses infected with EBA with 68 fetuses diagnosed with alternate infectious set of causes. Total fetal immunoglobulin (Ig)G was also evaluated as an aid for diagnosing EBA.

Results
The iFAT-based serology assay is rapid, reproducible, and unaffected by fluid color or opacity. Data established specificity at 100% and sensitivity at 94.7% when cutoff criteria for a positive test were assigned at a concentration of greater than 1,000. The presence of immunoglobulin (Ig)G is a sensitive indicator of EBA and increases the specificity of FAT-based serologic diagnosis. Taken together, serology and (Ig)G analyses suggest that the incidence of EBA may be underestimated. Based upon these and other supporting data, the USDA has opened testing to include an addition 2,000 head of cattle from both Nevada and California.

The economic impact from one ranch participating in the vaccine trials (Quinn River Ranch, CA) has reported that naive heifer reproductive success was almost 100% (66 additional animals), up from a 60% loss prior to vaccination.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
311	Animal Diseases

Outcome #9

1. Outcome Measures

Rodents Role in Maintaining the Tick-Borne Disease "Relapsing Fever" in Nature

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual

2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Relapsing fever is a zoonotic disease described across the world in which human cases typically present as an undulating fever with many non-specific symptoms including headache, myalgia, and arthralgia. In the USA, tick-borne relapsing fever occurs throughout the mountainous west and southwestern deserts because of infection by spirochete bacteria found in soft tick, the transmission vector. Human infection risk is associated with rodent infestation of a home or cabin, especially after seasonal periods of vacancy. This study surveyed wild rodents infected with spirochetes (B. hermsii) around Big Bear Lake, southern California, identifying and genotyping the species of bacteria found in the hosts from this region.

What has been done
In 2014, 284 chipmunks from the Eastern Sierra Nevada Mountains had microsatellites sequenced at 11 diploid loci. The resulting data split into two simulations, one where only site locations was used, and one where the locations were separated on the habitat type nested with each site. Simulations were put through analysis of subpopulation structure through the program STRUCTURE, and Structure harvester. Model selection was then preformed within and between simulations and a single model was chosen to represent the results.

Results
Since the tick vectors for relapse fever stay at their nest or birthplace for a long time after birth, these locations may act as the focal point from which infection spreads to the surrounding areas. This could be the most important finding of this analysis due to its implications with public heath, and mitigation strategies to curb, or prevent spillover events from the wild population.

In Big Bear and Twin Lakes, California homeowner association meetings now invite NAES scientists to give annual updates on the prevalence of the disease in their area and ask questions on prevention. Through these meeting, a program was developed for homeowners that spells out what needs to be done when opening up homes and cabins after a winter closure. Since these efforts, outbreaks of the disease in these area have dropped to zero over the past year.

4. Associated Knowledge Areas

KA Code	Knowledge Area
311	Animal Diseases
722	Zoonotic Diseases and Parasites Affecting Humans

Outcome #10

1. Outcome Measures

Impact of Low Level Mercury Exposure on Reproductive and Development in Birds

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The NAES team has developed a model which we believe is useful in testing whether low-dose exposure to environmental and agrochemical contaminants has an adverse effect on migratory birds. We use the homing pigeon as our avian model to determine the impact of various environmental and agrochemical exposures to migratory birds. Although a wide-ranging number of studies have detailed bioaccumulation and adverse effects on avian physiology and reproduction, the effect of non-lethal, low-dose exposures has not conversely been studied at length.

NAES's prior work has shown that at low methylmercury concentrations, flight times of homing pigeons from a particular distance are greatly affected. For the purposes of this study, the project assess effects on reproduction and development at levels lower than those that may cause behavioral abnormalities in adults.

What has been done
In 2013, assessment of the impact of methyl mercury on avian reproduction using the homing pigeon as our model. Findings were reported for exposure at 1.0 mg/kg body wt/day. For 2014 the team conducted a similar studies at lower dosages in order to assess a dose-dependent response (0.5 mg MeHG/kg body wt/day), or ½ the dosage tested the previous year.

Results
The results of this research indicate that even at significantly lower exposure levels to methyl mercury offspring were taking longer to fledge and were overweight. These findings have now been appended to the national models. The Avian Model developed here at the University of Nevada, as well as the information collected on environmental contaminants' effects on birds has now been incorporated into the US Department of Interior's Natural Resource Damage Assessment and Restoration Programs as it relates to migratory birds. The US Fish and Wildlife Service has also included our avian model into their assessments of avian toxicology related to the Deepwater Horizon oil spill.

4. Associated Knowledge Areas

KA Code	Knowledge Area
135	Aquatic and Terrestrial Wildlife

136	Conservation of Biological Diversity
301	Reproductive Performance of Animals
311	Animal Diseases

Outcome #11

1. Outcome Measures

Quantifying Nutritional Values of Alternative Forages Found in Nevada

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Nutritional management affects beef cattle growth, reproductive performance, and health. In order to feed animals to meet their nutritional needs it is critical to know the nutritional value of plants. Information on the nutritional value of some specific plant species found in the state of Nevada such as kochia, cheatgrass, coyote willow, crested wheatgrass, meadow brome, and Great Basin wild rye are mostly inexistent in the scientific literature. The goal of this project was to characterize the nutritional value of plants commonly found in the state of Nevada that may have potential as feed for beef cattle.

What has been done
Two concurrent projects were conducted to clarify National Animal Nutrition Programs? Nutritional Requirements (2000) nutrient values of Forage Kochia in the Great Basin. Using both plastic cow stomachs (dual-flow continuous culture systems) in the lab and cannulated cattle in the field, NAES scientists evaluated the nutritional value of a common perennial shrub Forage Kochia. Samples were analyzed to determine dry matter, organic matter, neutral detergent fiber, acid detergent fiber, ether extract, ash, fatty acids, and bacterial purines.

Results
The alternative forage for range cattle (Forage Kochia) has been shown to function equally in eight key nutrient values as alfalfa and orchard grass. Also, crude protein levels are equal to or greater (winter season) than most available grasses found on the range. Forage kochia has proven to be an adapted, highly palatable forage species for livestock and wildlife. It is

competitive with cheatgrass and much more fire resistant. With all things considered, forage kochia deserves greater use when seeding Nevada rangelands, especially localized areas in which conventional forages may not grow well.

4. Associated Knowledge Areas

KA Code	Knowledge Area
121	Management of Range Resources
302	Nutrient Utilization in Animals

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Competing Public priorities

Brief Explanation

As mentioned earlier, the Experiment Station is still recovering from the 31 hard money positions lost after the 2010 circulation review. Until a number of critical areas are re-staffed the animal science program will be severely hampered. Nevada annual average precipitation continues to decline, with the past three winters scoring some of the driest on record. Without adequate water supplies the competition between livestock and wildlife for resources could prove to be deadly.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Assessment of a fluorescent antibody test for the detection of antibodies against epizootic bovine abortion has revealed that T Helper cells (regulate immune responses) are very important in clearing dames infected with EBA.

Results from relapse fever positive small mammal population structures analysis reveals important finding due to its implications with public heath, and mitigation strategies to curb, or prevent spillover events from the wild population.

Results from the forage kochia analysis has provide sufficient evidence that with addition of certain nutrient supplements, can be used as a primary forage source.

Work on sage grouse survival, with and without large herbivores (cattle and/or horses), has started to reveal a number of trends. The data has found that survival in general is lowest in the fall season and that highest survival rates are beginning to show correlations with areas that only have single species of mammals.

Our finding on migratory bird species exposure to non-lethal amounts of neurotoxic

compounds indicate there are significant effects on homing, reproductive abilities, and the learning abilities of offspring in subsequent generations. These finds are based upon exposure levels far below the normal tests for acute toxicity in migratory birds.

Key Items of Evaluation

- A journal article was published on the detection of epizootic bovine abortion (EBA) using antibodies.
- Development of a serological assay for determining exposure to EBM
- An article on relapse fever was published in the Journal of Medical Entomology
- A microsatellite library was built for Sierra Nevada chipmunks for use in studying relapsing fever.
- Created protocol for pelletization of cheatgrass for use in forage analysis
- A database was constructed to hold sage grouse biometrics, nest success parameters, and habitat choices.
- Built a microsatellite dataset for the three species of Big Horn Sheep found in the Great Basin that provides full genomic coverage, disease status of genotyped individuals, and climate and environmental variables.